

Third Compendium of Low Carbon Pulse

Covering Friday April 1, 2022 to Sunday August 14, 2022

The author of each edition of Low Carbon Pulse included in this Compendium is MJ Harrison.



Introduction

About the form and substance of this Compendium:

This Third Low Carbon Pulse Compendium is to include each edition of Low Carbon Pulse published from October 29 2021 to Sunday August 14, 2022.

The form of each edition of Low Carbon Pulse included in this Third Low Carbon Pulse Compendium takes the form published, subject to a further proof reading and ensuring consistency so that this Third Compendium can be read, as a whole, as a coherent publication.

EDITIONS OF LOW CARBON PULSE	
E 39 : (short-form): Friday April 1, 2022 to Saturday April 30, 2022	E 39 : (long-form): Friday April 1, 2022 to Saturday April 30, 2022
E 40 : (short-form): Sunday May 1, 2022 to Tuesday May 31, 2022	E 40 : (long-form): Sunday May 1, 2022 to Tuesday May 31, 2022
E 41 : (short-form): Wednesday June 1, 2022 to Thursday June 30, 2022	E 41 : (long-form): Wednesday June 1, 2022 to Thursday June 30, 2022
E 42 : Friday July 1, 2022 to Sunday July 10, 2022	E 43 : Monday July 11, 2022 to Sunday July 17, 2022
E 44 : Monday July 18, 2022 to Sunday July 24, 2022	E 45 : Monday July 25, 2022 to Sunday July 31, 2022
E 42 to 45 : consolidated July version	E 46 : Monday August 1 25, 2022 to Sunday August 14, 2022

In addition to each edition of Low Carbon Pulse, this Third Compendium includes three **Report on Reports**. Each **Report on Reports** covers in detail the key findings and issues arising from key papers, reports and studies (**publication**) published in the applicable two month period. Each publication covered in a **Report on Reports** is mentioned in an edition of Low Carbon Pulse (and a link to it is included in that edition). The benefit of **Reports on Reports** was identified in June 2021 – Reports on Reports allow coverage of publications in more detail than the format and length of Low Carbon Pulse allows.

REPORTS ON REPORTS	

About the author of this Third Compendium:

Low Carbon Pulse is authored by Michael Harrison. Michael writes on Saturdays and Sundays. In addition to writing Low Carbon Pulse, Michael authors sibling publications (both alone and with colleagues) across a range of industry sectors (click [here](#) and [here](#) for the **Shift to Hydrogen (S2H2): Elemental Change** series and [here](#) for the **Hydrogen for Industry (H24I)** series, click [here](#) and [here](#) for the Ports, Logistics and World Trade and Waste Compendiums respectively). Michael is a prolific speaker, having presented on the subject matter of climate change, energy transition and net zero on over 80 occasions in calendar year 2021, and on 12 occasions to March 31, 2022.

Monday to Friday, Michael works on projects and transactions across a number of industries and sectors: energy and power (including renewables), e-fuels and future fuels (including ammonia, hydrogen (of all colours), and methanol), infrastructure development (including for CCS / CCUS, giga-factories, pipelines and shared infrastructure), mining and natural resources (including metals and minerals key to energy transition), oil and natural gas (including on CCS / CCUS), LNG, ports (and their hinterlands), shipping and land transport (predominantly rail and road), iron and steel, telecommunications, waste and water. Michael works on projects and transactions from West Africa, East Africa, North Africa, the Middle East, Asia and to the US West Coast.

Notes of thanks:

While Michael is the author of Low Carbon Pulse, Michael works with two to three colleagues on each edition, who add links and who proof. In this context, shout-outs to Florence Chan (devoted to the task since March 2021, and without whose support the author would have "lost the plot" a long time ago), and to Ali Helmes and Sophie Crichton (both of whom have found time to proof while doing their busy day jobs).

Michael Harrison, Senior Partner, Energy, Resources, and Infrastructure

Low Carbon Pulse - Edition 39 (short-form)

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to the **Short Form Version of Edition 39** of Low Carbon Pulse – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Friday April 1, 2022 to Saturday April 30, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1 to 28**, covering October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29 to 38**, covering October 7, 2021 to March 31, 2022).

Legal, Policy Setting and Regulatory highlights:

• **IEA publications during April:**

- On **April 1, 2022**, the **International Energy Agency (IEA)** published [Direct Air Capture – A key technology for net-zero \(DAC Study\)](#). The publication provides a helpful guide to one means of carbon dioxide removal (**CDR**) from the atmosphere.
- On **April 17, 2022**, the **IEA** published its [Sustainable Recovery Tracker – Monitoring Progress towards sustainable recoveries from the Covid-19 crisis](#), with the latest update of its [Sustainable Recovery Tracker](#).
- On **April 15, 2022**, the **IEA** published its [Gas Market Report, Q2-Analysis, including Global Gas Review 2021](#). The key finding from the report is that during the balance of 2022 global demand for natural gas is expected to decline slightly (50 billion m³, equivalent to ½ of the US exports of LNG during 2021), as a result of the disruption caused by the conflict in Ukraine.
- On **April 20, 2022**, the **IEA** published its [Belgium 2022 – Energy Policy Review Report](#) (the **Belgium Report**). The headlines are that Belgium needs to develop the means to increase the rate of reduction of **GHG** emissions and to reduce its reliance on energy imports.

• **IRENA:**

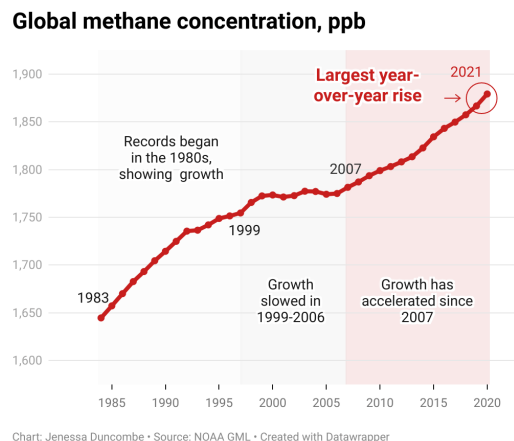
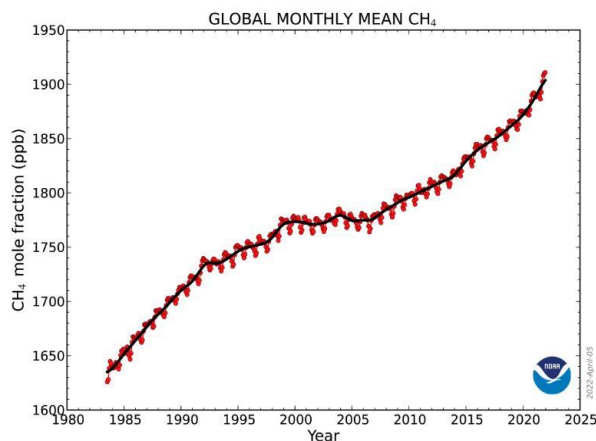
After a busy **March 2022** for the **International Renewable Energy Agency (IRENA)**, **April 2022** was a little quieter in terms of the number of publications, but that which was published was helpful and weighty:

- On **March 14, 2022**, the **IRENA Coalition For Action** published [Decarbonising End-Use Sectors: Green Hydrogen Certification \(Certification Paper\)](#), which provides 10 recommendations, none of which is surprising.
- On **April 11, 2022**, **IRENA** published [Renewable Capacity Statistics 2022](#), with a helpful three page summary [Renewable capacity highlights](#).
- On **April 11, 2022**, **IRENA** published data detailing installed renewable electrical energy [Renewable Capacity Statistics 2022](#). While the content of the data is not surprising, the data is a helpful reference.
- On **April 19, 2022**, **IRENA** published [Grid Codes for Renewable Powered Systems](#). The publication is an update on the **IRENA** publication from 2016, [Scaling Up Variable Renewable Power: The Role of Grid Codes](#).
- **European Commission's plans to publish technical regulations:** On **April 21, 2022**, it was reported widely that on **May 18, 2022**, the **EC** intends to publish technical regulations that will provide the parameters by which hydrogen will be classified as renewable under the [EU RED II](#). **Edition 40** of Low Carbon Pulse will consider the parameters.

- **Denmark proposes corporate carbon tax:** On **April 22, 2022**, **Reuters** reported that the **Danish Government** proposes to introduce a uniform carbon tax - a levy of 1,125 Danish crowns (USD 164.21) per tonne of **CO₂** equivalent. It is understood that the carbon tax will be applicable to the energy sector and heavy industries for the most part.
- **McKinsey & Co:** On **April 26, 2022**, **McKinsey & Co** published its [Global Energy Perspective 2022](#). The key headline is that if all countries implement their [nationally determined contributions \(NDC's\)](#) there will be a **1.7°C** increase in average global temperatures: "*To keep the 1.5°C pathway in sight, even more ambitious acceleration [in GHG emission reduction] is needed*".

Climate change reported and explained:

- **Methane emissions at highest levels:**
 - On **April 7, 2022**, the US **National Oceanic & Atmospheric Administration (NOAA)** issued [Increase in atmospheric methane set another record during 2021 – Carbon dioxide levels also record a big jump](#). The following graphs illustrates key dynamics reported by the **NOAA**, critically the (steepening) upward trend.



- On **April 7, 2022**, [The Washington Post](#) published an excellent article [Methane emissions jumped by record amount in 2021, NOAA](#). The most sobering point in the article is that: "*The effect of carbon dioxide emissions is cumulative. About 40 per cent of the Ford Model T emissions from 1911 are still in the atmosphere today*", illustrating, succinctly, the criticality of the accelerated progress towards **NZE**. Editions [15](#), [24](#), [27](#), [28](#), [29](#), [34](#) and [35](#) of Low Carbon Pulse have background.
- **Methane Reduction and Carbon Dioxide Removal (CDR):** There is an ever increasing focus on **CDR**. The **IPCC WGIII Report** has brought into even sharper focus the need for **CH₄** reduction and **CDR**. The **McKinsey & Co** led **Frontier** initiative is illustrative of both the awareness of the need, and the means to addressing the need, for acceleration of **CDR**. As announced, the Frontier initiative comprises an advance market commitment (**AMC**) of **USD 925 million** (over eight years) to accelerate **CDR** solutions and technologies.

Middle East including GCC Countries:

- **ENOWA HIDC:** On **April 1, 2022**, **ENOWA** [announced](#) that it had established the **Hydrogen Innovation and Development Center (HIDC)**. The **HIDC** is intended to contribute to the objective of the Kingdom of Saudi Arabia (**KSA**) to achieve energy carrier diversification, and as such allow the **KSA** to become a global clean energy leader.
- **Oman considers Green Steel:** On **April 4, 2022**, the [Oman Daily Observer](#) reported that **Hydrogen Rise AG** had "embarked on a strategy to support the production of 'green steel' for the first time in the Sultanate of Oman".
- **Oman progresses with the Oman Green Energy Hub (OGEH):** On **April 5, 2022**, it was announced that **Worley** had been appointed to undertake a concept feasibility study for the **OGEH**. Edition [18](#) of Low Carbon Pulse has background.
- **Helios Green Light:** On **April 5, 2022**, [energy-utilities.com](#) reported (under [Acwa Power consortium signs \\$900m EPC contract for Neom hydrogen project](#)) that Neom Green Hydrogen had signed an EPC Contract with Air Products, under which Air Products Middle East Industrial Gases is to undertake work in the **KSA** and Air Products is to undertake work beyond the borders of the **KSA**. On **April 8, 2022**, [al-Arabiya news](#) reported that **Snam** had contracted for the supply of equipment and plant in the context of the development of the Helios Project.
- **Progress on Helios Industries' KIZAD project:** On **April 8, 2022**, [energy-utilities.com](#) reported (under [Studies completed for \\$1 bn Abu Dhabi green hydrogen and ammonia project](#)) that financial and technical feasibility studies had been completed for **Helios Industries** in respect of the Green Hydrogen and Green Ammonia project to be located in **Khalifa Industrial Zone Abu Dhabi (KIZAD)**. Editions [18](#) & [25](#) of Low Carbon Pulse have background.
- **OPWP proceeds with W-to-E:** On **April 8, 2022**, [energy-utilities.com](#) reported that **Oman Power & Water Procurement Company (OPWP)** was seeking to appoint a technical adviser to advise on the development of the **USD 1 billion waste-to-energy facility** to be located in **Barka, Oman**. **OPWP** has recently signed a memorandum of understanding (**MOU**) with the **Oman Environmental Service Holding Company (be'ah)**.
- **Masdar (Abu Dhabi Future Energy Company) Kyrgyz Government MOU:** On **April 15, 2022**, **Masdar** announced that it had signed a memorandum of understanding (**MOU**) with the **Kyrgyzstan Government** to work together to develop up to **1 GW** of hydroelectric and photovoltaic solar projects.

- **Photovoltaic solar on the near horizon:** On **April 19, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Acwa Power** (KSA utility corporation) is developing plans for two photovoltaic solar projects, **Rabigh (300 MW)** and **Al Shuaiba (2 GW)**, having projected combined installed capacity of **2.3 GW**.
- **Green Ammonia Certification:** On **April 20, 2022**, [hydrogen-central.com](https://www.hydrogen-central.com) reported that **TÜV Rheinland** (a global leading technical service provider) had **announced** the issue of the **First Green Hydrogen and Green Certificate Globally to Green Hydrogen & Chemicals SPC** for the production of Green Hydrogen and Green Ammonia from the project being developed by **ACME Group** and **Scatec ASA** (see **Edition 37** of Low Carbon Pulse).
- **Landfills to be mined:** On **April 20, 2022**, [rechargenews.com](https://www.rechargenews.com) reported that New York based **H₂-Industries** had signed a memorandum of understanding with the **Oman Public Establishment for Industrial Estates (Madayn)** which contemplates the development of a **USD 1.4 billion waste-to-hydrogen** production facility in **Oman**. As reported, the feedstock for the production of hydrogen will be "mined from existing landfills" (the **urban-ore-body**).

Africa:

- **Sovereign Wealth Funds align:** On **April 4, 2022**, [energy-utilities.com](https://www.energy-utilities.com), reported that The Egyptian **Sovereign Fund of Egypt** and the Norwegian **Government Pension Fund Global** had signed a framework agreement, to which **Scatec** (leading Norwegian renewable electrical energy corporation) is also a party, under which the parties will target the development of green projects in **nine African countries - Burundi, the Democratic Republic of Congo, Djibouti, Ghana, Rwanda, Sierra Leone, South Sudan, Tanzania, and Uganda**.
- **Namibia and Germany Joint Communique of intent:** On **April 18, 2022**, it was announced that the Director General of the Namibia's **National Planning Commission, Obeth M. Kandjoze**, and the **German Federal Minister for Education and Research, Anja Karlicek**, agreed to establish a **partnership between Namibia and Germany**, and signed a Joint Communique of Intent (**JoI**).

The **JoI** notes:

"Germany will provide up to €40 million in funding from the economic stimulus package for solar power [harbouring great potential in Namibia] thanks to over 3,500 hours of sunshine per year .. We therefore think that one kg of H₂ from Namibia will cost between €1.50 and €2.00."

Editions 26, 30, and 34 of Low Carbon Pulse provide details about the plans to develop Green Hydrogen capacity.

- **Egyptian Future Fuel Hub-on-Hub:**
 - **AMEA Power to produce Green Ammonia in Egypt for export:** On **April 22, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **AMEA Power** had signed a memorandum of understanding (**MOU**) to produce Green Ammonia for export from **Ain Sokhna Industrial Zone**, Egypt. The **MOU** was signed with the **General Authority for Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**. As reported, the **Green Hydrogen and Green Ammonia** production facility will produce **390,000 metric tonnes of Green Ammonia a year**.
 - **EDF Renewables and Zero Waste team-up in Egypt:** On **April 22, 2022**, [arabnews.com](https://www.arabnews.com) reported that **EDF Renewables and Zero Waste** had signed a memorandum of understanding to develop a carbon-free fuel production project working with the **Ministry of Electricity**, the **General Authority for Suez Canal Economic Zone** and The **Sovereign Fund of Egypt**. The project is to be located within **Suez Canal Economic Zone**.
 - **Hassan Allam Utilities and Masdar agree to develop Green Hydrogen production facility:** On **April 25, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Hassan Allam Utilities** and **Masdar** had signed two memorandums of understanding (**MOUs**) to produce Green Ammonia for export from the **Ain Sokhna Industrial Zone**, Egypt. The **MOUs** were signed with the **Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**.

India and Indonesia:

- **Indonesia to supply Britishvolt giga-factory:** On **March 29, 2022**, it was **announced** by **Britishvolt** (see **Edition 33** of Low Carbon Pulse) that it had signed a memorandum of understanding with **VKTR** to partner to develop a lower to low carbon supply chain for nickel sulphate from Indonesia to supply Britishvolt's Blyth giga-factory (in the north east of England) to manufacture electric vehicle batteries.
- **JSW Energy to develop hydro-electric pumped storage plant:** On **April 4, 2022**, [energy-storage](https://www.energy-storage.com) reported that **JSW Energy** had signed a memorandum of understanding (**MOU**) with the **Government of Chhattisgarh** to develop a **1 GW hydro-electric pumped storage plant** – the **Hasdev Bango Pumped Storage Project (PSP)**. The integration of the **PSP**, with photovoltaic solar and wind renewable energy capacity, will allow **JSW Energy** to "provide firm dispatchable renewable power" 24/7.
- **Indonesia defers the introduction of carbon tax:** On **April 4, 2022**, it was reported widely that the **Government of Indonesia** was to defer the introduction of its carbon tax from April 2022 until July 2022. Head of Fiscal Policy Agency, Ministry of Finance, **Mr Febrio Kacaribu** said:

"The [pressure on prices arising from the conflict in Ukraine] puts pressure on inflation in many countries in the world, including Indonesia. With these developments, the government is ensuring the availability and stabilization of energy and food prices in the country, including providing various forms of social protection to protect the poor and vulnerable from the impact of price increases".
- **NTPC active in Green Hydrogen production and procurement:**
 - **NTPC and Gujarat Gas Ltd to blend** On **April 5, 2022**, it was reported widely that **NTPC and Gujarat Gas Limited** had agreed to blend Green Hydrogen with natural gas.
 - **NTPC Renewable Energy Ltd (NREL) to electrolyse:** On **April 26, 2022**, it was reported widely that **NREL** is seeking to work with electrolyser technology corporations and developers to procure up to **1 GW** of electrolyser capacity on a turnkey basis. **NREL** has indicated that it intends for tender for **400 MW** of PEM electrolysers and **600 MW** of electrolysers using other electrolyser technologies.

- **Mitsui & Co. invests big, and early:** On **April 7, 2022**, it was reported widely that **Mitsui & Co.** had invested in **ReNew**. **ReNew** has a power purchase agreement with **Solar Energy Corporation of India (SECI)**, a state-owned corporation) to supply **400 MW** of renewable electrical energy from photovoltaic solar and wind installations across **Karnataka, Maharashtra, and Rajasthan**, and from an accompanying **BESS** (the **RTC Project**). The **RTC Project** is reported to have a capital cost of **USD 1.2 billion**, and will provide renewable electrical energy capacity 24/7.
- **PT Pertamina and Indonesian investments plans:** On **March 25, 2022**, [energyvoice.com](https://www.energyvoice.com) reported that **PT Pertamina** plans to invest up to **USD 11 billion** on renewable energy projects over the period 2022 to 2026 so as to continue making progress in energy transition, in particular to allow it to install **10 GW** of clean energy generation capacity by 2026 (**6 GW** from gas-to-power, **3 GW** from renewable energy sources, and **1 GW** from other initiatives). On **April 4, 2022**, [energy voice.com](https://www.energyvoice.com) reported that, more broadly, Indonesia would require **USD 25.2 billion** to develop Green Hydrogen from 2031 to 2060. This is in addition to the **USD 11 billion** identified as being required to be invested by **PT Pertamina** from 2022 to 2026.
- **PT Pertamina and Mitsui & Co:** On **April 8, 2022**, it was reported widely that **PT Pertamina** and **Mitsui & Co** were to undertake jointly a study in respect of **CCUS**, critically, the pathways to the commercialisation of **CCUS** projects in Indonesia.
- **Solar Energy Corporation of India (SECI) continuing to procure:** On **April 14, 2022**, [energy-storage](https://www.energy-storage.com) reported that **SECI** had issued a **Request for Selection** document to procure **500MW / 1,000 MWh** of **BESS**. It is reported that this is expected to be the first stage of a procurement program that will procure up to **4,000 MWh** of **BESS**.
- **CATL to invest USD 6 billion in battery chain:** On **April 15, 2022**, [electrek](https://www.electrek.com) reported that **CATL**, through a subsidiary, is to take a majority stake in five of six battery projects to be developed with **PT Aneka Tambang** and **PT Industri Baterai Indonesia**.
- **8% of Singapore load:** On **April 19, 2022**, it was reported widely that **Quantum Power** and **Ib Vogt**, through a joint venture, **Anantara**, have plans to develop renewable energy facilities within the **Riau Islands Province, Indonesia**, to supply renewable electrical energy to the Republic of Singapore, using a subsea cable, requiring **USD 5 billion** to develop and to deploy **3.5 GW** of photovoltaic capacity and **12 GWh** of **BESS**.
- **PLN Sub and IHI co-venture on co-firing:** On **April 25, 2022**, it was reported widely that **Pembangkitan Jawa-Bali (PJB)**, a subsidiary of **PLN** and **IHI Corporation** are to work together to develop ammonia-co-firing technology to allow co-firing of natural gas and ammonia at the **PJB gas-fired power plants** at **Gresik**, east Java, Indonesia.
- **POME feedstock for clean gas:** On **April 27, 2022**, it was reported widely that **PT Pertamina**, **Inpex Corporation**, **JGC Holdings Corporation** and **Osaka Gas Co., Ltd** had signed a study agreement under which they agreed to work together to assess the commercial and technical feasibility of producing clean natural gas from palm oil mill effluent (**POME**). **Biogas** and **biomethane** and **bio-LNG** can be derived or produced from **POME**.

Japan and Republic of Korea (ROK):

- **Hyundai Mobis invests USD 1.1 billion in FCE plants:** On **April 1, 2022**, it was reported widely that **Hyundai Mobis** is to develop two new fuel cell manufacturing plants, one close to **Seoul**, and the other in **Ulsan**. The two new plants will commence manufacture in Q2 of 2023 and will have capacity to manufacture up to 100,000 fuel cells a year. The fuel cells manufactured are intended for use in vehicles used in the construction and logistics mobility sectors.
- **SK to invest USD 2.5 billion in PRC plants:** During the first week of **April, 2022** it was reported widely that SK is to develop a new battery factory in the **PRC** to manufacture batteries for EVs.
- **KOGAS MOU with Semptra Infrastructure:** On **April 4, 2022**, it was reported widely that **KOGAS** and **Semptra Infrastructure** had signed a memorandum of understanding (**MOU**) to consider how they may work together to transition to lower-carbon and to zero-carbon fuels.

Europe and UK:

- **No fool's day:** On **April 1, 2022**, seven projects were granted funding support by the **Climate, Infrastructure and Environment Executive Agency (CINEA)**, with aggregate funding support of **€1.1 billion**.

While some projects are detailed elsewhere in this **Edition 39** of Low Carbon Pulse they are listed here for convenience:

- **The BECSS project:** Located in **Stockholm, Sweden**, this project is the first full-scale Bio-Energy Carbon Capture and Storage (**BECCS**) project, capturing **CO₂** and heat from an existing biomass project.
 - **The Ecoplanta project:** Located in **El Morell, Spain**, this first-of-a-kind processing and production plant processes waste (that would otherwise be landfilled), and produces methanol from that waste.
 - **The Hybrit project:** Located in **Gällivare and Oxelösund, Sweden**, this Hydrogen Breakthrough Ironmaking Technology Demonstration (**Hybrit**) project will produce fossil-fuel free iron and steel.
 - **The Kairos@C project:** Located in the **Port of Antwerp**, this project is the first and largest cross-border carbon capture and storage value chain to capture, liquefy, ship, and store permanently **CO₂**.
 - **The K6 project:** Located in **Lumbres, France**, this first-of-a-kind project uses an industrial scale-combination of airtight kiln and cryogenic carbon capture technology, with captured **CO₂** to be stored in the North Sea.
 - **The SHARC project:** Located at the **Porvoo refinery, Finland**, the **Sustainable Hydrogen and Recovery of Carbon (SHARC)** project will reduce **GHG** emissions on transition from use of fossil fuels to renewable hydrogen production.
 - **The Tango project:** Located in **Catania, Italy**, this project involves the development of industrial-scale production capacity to manufacture high-performance photovoltaic solar modules.
 - **EC considering higher renewable energy target:** On **April 20, 2022**, Reuters reported that the **Deputy Director-General of the Energy Department** of the **EC** had stated: "*We are working on it full speed to take, first of the proposal of going from 40% to 45%, but also in the context of higher energy prices*".
- While the **EC** may be considering the proposal at full speed, the **EU Member States** and the **European Parliament** will have to be aligned if the proposal is to become the new policy setting.

- **Portugal increases rate of speed of light:** On **April 4, 2022**, pv-tech.org reported that the **Government of Portugal** is to increase the rate of development and deployment of renewable electrical energy installation so that by 2026, 80% of electrical energy dispatched to match load will be from a renewable energy source.
- **European Hydrogen Backbone response to REPowerEU:**
 - On **April 5, 2022**, the **European Hydrogen Backbone (EHB)** published a [paper](#) (entitled [European Hydrogen Backbone – April 2022](#)) detailing the growth in the network (comprising the backbone necessary to facilitate the use of hydrogen) to meet the **REPowerEU** policy settings.
 - On **April 25, 2022**, it was reported widely that the **Nordic Hydrogen Route** (part of the **EHB**) is to be developed in the **Bothnian Bay** region by **Gasgrid Finland** and **Nordion Energi**. There has been a marked level of news coverage since the announcement of the **Bothnian Bay** region project.
 - Towards the end of April the **EHB website** launched a map function to detail the pipelines comprising, and to comprise, the **EHB**.
- **Editions 11, 13, 14 and 20** of Low Carbon Pulse provide details about the **EHB**.
- **Common themes – the need for common / share infrastructure and a common market:**
 - On **April 5, 2022**, the [hydrogen economist](#) provided an analysis of the benefits of the development of common / shared infrastructure by Germany and the Netherlands, in particular the benefits of the development of a hydrogen backbone, with the central premise being common / shared infrastructure will increase demand, possibly even doubling the projected demand (up to 401 TWh a year by 2050).
 - **EWI Study supports needs identified:** On **April 14, 2022**, **EWI** (Institute of Energy Economics at the University of Cologne) published a study, [Development of Hydrogen Market in Eastern Germany – An Infrastructure analysis based on regional potentials and demand](#). The study was commissioned by **GASCADE Gastransport GmbH**.
 - **TES Fast-tracks:** On **April 14, 2022**, **Forbes** (under [German Clean Energy Hub Pivotal to Reducing Reliance on Russian Gas](#)) published an article reporting on an interview with the CEO of **Tree Energy Solutions (TES)**, Mr Otto Waterlander, about green gas. **TES** (a green hydrogen corporation, reported on in **Editions 36** of Low Carbon Pulse) is reported to be "fast-tracking" the development of a **green hydrogen hub** at **Wilhelmshaven** in Northern Germany (the **TES-Wilhelmshaven project**).
On **April 25, 2022**, **TES** announced that it was running an open-season process to fast-track the import of **LNG** to its **TES-Wilhelmshaven project**. It is understood that under the first phase of open-season process non-binding expressions of interest are sought. The second phase will involve binding commitments, with third phase involving conclusion of the binding commitments. **Edition 37** of Low Carbon Pulse provides background about **TES**.
 - **UK Export Finance (UK EF) provides clean guarantee:** On **April 6, 2022**, gtreview.com reported that the **UK EF** had agreed to guarantee a **GBP 400 million** sustainability-linked facility provided to **Johnson Matthey** by **Bank of America**, **HSBC** and **SMBC**. **Johnson Matthey** is a leading developer of sustainable technologies, including for Green Hydrogen production and metals recovery and recycling.
 - **UK doubles hydrogen target and 50 by 30:** On **April 6, 2022**, among other things, **UK Prime Minister, Mr Boris Johnson** announced that the UK would double its target for hydrogen production capacity from **5 GW** by 2030, to **10 GW** by 2030. Key points in the new **British Energy Security Strategy** also include the development and deployment of eight new nuclear reactors and the promotion of policy settings to accelerate the installation of roof-top photovoltaic solar. The full form of the strategy is attached: [Policy Paper – British energy security strategy](#).
 - **Studied release:** On **April 8, 2022**, the **UK Government Department of Business, Energy and Industrial Strategy (BEIS)** released [Atmospheric Implications of Increased Hydrogen Use](#). The headline from the study is the importance of preventing the leakage of hydrogen into the atmosphere so as to prevent the compounding of hydrogen with other compounds and elements creating **GHGs**.
 - **Hydrogen Investor Roadmap:** On **April 8, 2022**, the **BEIS** published [Hydrogen investor roadmap: leading the way to net zero \(HIR\)](#). The purpose of the **HIR** is to summarise government policies supporting the development of the low-carbon hydrogen economy in the UK.
 - **CCS Investor Roadmap:** On **April 8, 2022**, the **BEIS** published [CCUS Investor Roadmap – Capturing Carbon and a Global Opportunity \(CIR\)](#). In context, the **CIR** needs to be read with the UK Government target of capturing 20 to 30 million metric tonnes of **CO₂** a year.
 - **UK Low Carbon Hydrogen Standard:** On **April 8, 2022**, the **BEIS** published [UK Low Carbon Hydrogen Standard: emissions reporting and sustainability criteria](#). The publication marks considerable and marked progress since August 17, 2021, when the **BEIS** published [Designing a UK low carbon hydrogen standard](#).
 - **UK progressing to CfDs for hydrogen production:** On **April 11, 2022**, rechargenews.com (under [UK finalise world's first national subsidy for clean hydrogen production by the year](#)) reported that the **BEIS** had announced the use of contracts for difference (**CfD**) for hydrogen.
 - **Germany and UK interconnect:** On **April 12, 2022**, **CNBC** reported (under [Giant undersea cables set to give the UK and Germany their first direct energy link](#)) on the **NeuConnect project** which is to allow each way electrical energy supply of **1.4 GW** between Germany and the UK. The interconnector, **725 kilometres** in length, has been dubbed the "invisible energy highway".

Americas:

- **Land release:** On **April, 21, 2022**, rechargenews.com reported that the **US Bureau of Land Management (BLM)** plans to green-light the development of **39 utility-scale photovoltaic solar projects**, together to have more than **29 GW** of installed capacity, on Federal lands in six western states.
- **Earth Day Executive Order:** On **April 22, 2022**, **US President, Mr Joe Biden**, signed an [Executive Order](#) to:

(a) safeguard mature and old-growth forests on Federal lands; (b) strengthen reforestation initiatives across the US; (c) combat global deforestation, consistent with commitments made at **COP-26**; and (d) enlist nature to address efforts to address climate change.

- **Pennsylvania powers ahead:** On **April 22, 2022**, the **US State of Pennsylvania** (responsible for 4% of US **GHG** emissions) published regulations to require power station owners to pay for each ton of carbon that they emit.

As reported, both opponents and supporters of the regulations expect delay in the application of the regulations. The regulations are reported to be part of the Regional Greenhouse Gas Initiative, including 11 north eastern US States.

France and Germany:

- **France committed to 40 by 50:** On **March 31, 2022**, and in early April, it was reported widely that the French Government had committed to the development of **40 GW** off-shore wind field capacity by 2050 (**40 by 50**). As contemplated, the commitment envisages that the capacity will be installed across **50** off-shore wind fields. To reach **40 by 50**, France will have to auction a minimum of **2 GW** of off-shore wind field capacity a year from 2025. In today's Euros, the development of **40 by 50** will cost in the region **€40 billion**.
- On **March 31, 2022**, it was reported that the **Hy3 Project** study had been published jointly by **Forschungszentrum Julich, Dena**, and **TNO**. As might be expected, the key finding of the **Hy3 Project** study is that cooperation between Germany and the Netherlands, in developing a common hydrogen market and common infrastructure, will boost opportunities to realise a decarbonised regional economy.
- **Germany committed to up to 215 by 30:**
 - On **April 6, 2022**, it was reported widely that Germany intended to introduce and **EEG Easter Package** to accelerate the development and deployment of photovoltaic solar capacity and wind, critically to accelerate development and deployment across open-spaces and roof-tops, so as to deploy **22 GW** by **2023**, and to deploy **215 GW** of photovoltaic solar capacity by **2030 (215 by 30)**.
 - On **April 7, 2022**, it was reported widely that Germany intended to change (as part of the **EEG Easter Package**) the targets for the installation of off-shore wind field capacity, stretching those targets to **30 GW** by **2030**, **40 GW** by **2040**, and at least **70 GW** by **2045**.

Australia:

- **Federal Australian Government to fund Marinus Link:** On **April 3, 2022**, the **Department of Industry, Science and Resources** [announced](#) the funding support will be provided for the development of a 250 kilometre sub-sea interconnector between the States of Tasmania and Victoria, described as "unlocking" access to renewable electrical energy generation capacity in Tasmania, predominantly existing hydro-electric and on-shore wind.
- **Federal Government of Australia announces further funding support:** On **April 19, 2022**, the Federal Government announced support for the critical minerals industry (**CMI**), the clean hydrogen industry (**CHI**) and **CCS**:
 - **CMI: Critical Minerals Accelerator Initiative** was announced by the **Federal Minister for Resources and Water, Mr Keith Pitt**. This announcement builds on the loan to Iluka Resources to develop Rare Earths and Elements refinery (see **Iluka to develop REE refinery in Western Australia** below);
 - **CHI:** The **Federal Minister for Industry, Energy and Emissions Reduction, Mr Angus Taylor**, announced the provision of further funding support to the clean hydrogen industry, including:
 - the **H2Kwinana Clean Hydrogen Industrial Hub** – with up to **AUD 70 million**; [arrows]
 - the **Pilbara Hydrogen Hub** – with up to **AUD 70 million**;
 - **CCS:** The Federal Government announced funding support in respect of **CCS** projects:
 - the **Woodside Energy multi-user CCS** hub on the **Burrup Peninsula, Western Australia** - with up to **AUD 40 million**;
 - the **Mitsui E&P Mid-West CCS** hub – with up to **AUD 20 million**; and
 - the **Buru Energy** for potential on-shore **CCS** – with up to **AUD 7 million**.

The Federal Government is to be commended for striking a balance between providing a helping hand, and a hand-out, to projects that are being developed by the private-sector.

Bioenergy and heat-recovery:

- **Veolia and Waga Energy deploy France's largest biomethane production facility:** On **April 1, 2022**, the author came across reports in French outlining the deployment of a 120 GW h per year biomethane production facility deriving **biogas** from landfill (**biogas** comprising **CH₄** and **CO₂**, and trace compounds), and processing that **biogas** to produce biomethane. This will be largest **biomethane** production facility in France, at least for the time being.
- **Veolia to develop world's largest biorefinery in Finland:** On **April 6, 2022**, [biofuels-news.com](#) reported (under [Veolia launches biorefinery project using alternative feedstock](#)) that **Veolia** is to develop a bio-refinery producing **CO₂-neutral methanol**. The **bio-methanol** will be produced from organic paper and wood waste sourced from the **Metsä Fibre's Äänekoski** pulp mill in Finland. It is understood that the **bio-methanol** plant will produce up to **12,000 metric tonnes** of **bio-methanol** a year. It is understood that production will commence in 2024.
- **NREL on top of biogas potential:** On **April 8, 2022**, **NREL** (the **National Renewable Energy Laboratory** of the US Department of Energy) published [Biogas Potential in the United States \(Fact Sheet\), Energy Analysis](#). The headline is the **CH₄** that could be derived and produced from waste that would otherwise be landfilled, animal manure, wastewater, and organic waste streams from commercial, industrial and commercial sources is estimated to be sufficient to provide 9% of the natural gas demand of the US. The by-product of the production of **biogas** is digestate (using anaerobic technology), which is can be used, in processed form, as a fertiliser.

BESS and HESS (and energy storage):

- **AboitizPower proceeds with BESS:** On **April 6, 2022**, [energy-storage](#) reported that **SNAP (SN Aboitiz Power Group)** had made a final investment decision to proceed with the procurement of a **20 MW / 20 MWh BESS**, and

for this purpose had contracted with **Hitachi Energy** to supply and to install the **BESS**. The **BESS** is to be installed at the **360 MW Magat hydro-electric power station in Ramon, Isabela**, in the north Philippines.

- **Uniper back-to-the-future:** On **April 11, 2022**, **Uniper** [announced](#) that it was to test the former Krummhörn natural gas storage facility for suitability for use at a **HES**. A demonstration **HES** is to be developed, with storage capacity of up to **250,000 m³**.
- **Market control of BESS:** On **April 12, 2022**, it was reported widely that **EnergyAustralia** signed a deal with **Edify** to take market control of **Edify's Darlington Point (25 MW / 50 MWh)** and **Riverina 2 (65 MW / 130 MWh) BESSs** in New South Wales, Australia.
EnergyAustralia operates **Edify's Gannawarra (25 MW / 50 MWh) BESS** in Victoria, Australia, and **Ausnet's Ballarat (30 MW / 30 MWh) BESS**, also in Victoria. **EnergyAustralia** is developing its own **BESS**, the **Wooreen (350 MW / 1400 MWh) BESS**, in the Latrobe Valley, Victoria.
- **Virtual BESS:** On **April 14, 2022**, **AGL** and **Neoen** [announced](#) that they had signed a virtual **BESS capacity contract (BESS CC)**. Under the **BESS CC**, **Neoen** provides **AGL** with **70 MW / 140 MWh** of virtual **BESS** capacity in New South Wales, Australia. The **BESS CC** allows **AGL** to charge and to dispatch the **BESS**, providing **AGL** with flexibility in respect its customer load.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

- **Stockholm Exergi's BECS project receives €180 million of EU support funding:** On **April 1, 2022**, it was announced by **Stockholm Exergi** that the **CINEA** had committed to provide funding support, in the form of a grant, to allow the installation of **BECCs** technology for **Stockholm Exergi's** project will capture **800,000** metric tonnes of biogenic carbon dioxide a year, capturing nearly 90% of the biogenic carbon dioxide arising.
- **Hanson CCS project and HeidelbergCement leadership:**
 - On **April 6, 2022**, [constructionnews.co.uk](#) reported that **Hanson** (part of the **HeidelbergCement Group**) is to spend **GBP 400** to install carbon capture technology at its cement manufacturing plant at **Padewood**, near **Mold, North Wales (Padeswood Project)**.
 - On **April 11, 2022**, **HeidelbergCement Group** announced that the **Concrete Sustainability Council** had certified **16** of its cement manufacturing plants using the new **CO₂** module.
 - On **April 11, 2022**, the **HeidelbergCement Group** cement manufacturing plant at which **CO₂** is to be captured and then transported for storage in the **Northern Lights Project** was featured in an article in [chemindigest.com](#) (under **Capturing Carbon Dioxide through Cement**).
- **ExxonMobil pre-FEED:** During the week beginning **April 11, 2022**, it was reported widely that **ExxonMobil** had commenced pre-FEED work to assess the potential for the use of the **Gippsland Basin** (located in the south east of Australia) for the storage of carbon. The pre-FEED work is understood to be focussing on the use of existing infrastructure to store **CO₂** in the depleted Bream field off the coast of Gippsland, Victoria.
- **Technip Energies selected for Kasawari CCS project:** On **April 19, 2022**, **Technip Energies** [announced](#) that it and **NPCC (National Petroleum Construction Corporation)**, had been selected by **Petronas Carigali Sdn. Bhd** (a subsidiary of **PETRONAS**) to undertake **FEED** for one of the world's largest off-shore **CCS** projects.

Carbon Credits and Hydrogen Markets and Trading:

Physical hydrogen trading: On **April 12, 2022**, [hydrogen-central.com](#) reported that during a visit to the North Sea Port in Terneuzen the Dutch **Minister of Climate and Energy** Mr Rob Jetten, had received the first certificated for Green Hydrogen from **HyXChange**.

The hydrogen exchange initiative has been developed by **Gasunie, Port of Rotterdam Authority, Port of Amsterdam, Gronigen Seaports**, and **North Sea Port**). The **HyXChange** is a trading platform that will allow the physical trading of hydrogen, with each certificate required to trade a Guarantee of Origin.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

- **Neste nest egg and perfect plastic:**
 - On **April 4, 2022**, **Neste** [announced](#) that it had signed a funding support agreement with the **CINEA** under which **CINEA** commits to provide **€88 million** in grant funding to allow **Neste** to continue the development and deployment of its **SHARC** project at its **Porvoo refinery in Finland**.
 - On **April 1, 2022**, it was reported widely that **Neste** intends to conduct a feasibility study to consider whether it was possible to process liquified feedstock derived from plastic waste at the **Porvoo refinery**.
- **Air Liquide safe bet in Las Vegas:** On **April 4, 2022**, **Air Liquide** announced that it is to develop a landfill gas>to biogas>to clean-gas project near **Las Vegas, Nevada** (the **Nevada Hydrogen Factory**). The **Nevada Hydrogen Factory** will produce 30 metric tonnes of liquid hydrogen (**LH2**) a day. In the first instance, it is understood that the **LH2** will be transported to California for sale into the mobility market.
- **Bakken Energy and Mitsubishi Heavy Industries continue to progress:**
 - On **April 5, 2022**, [asia.nikkei.com](#) reported (under [Mitsubishi Heavy taps US partner for \\$2 bn hydrogen project](#)) that **Mitsubishi Heavy Industries** was continuing to work with **Bakken Energy** develop the largest clean hydrogen project in North America to date, the **300,000 metric tonnes** a year **North Dakota Clean Hydrogen Hub Project**. The feedstock for the production of clean hydrogen is natural gas.
 - On **April 10, 2022**, [asia.nikkei.com](#) updated early reporting (under [Mitsubishi Heavy's U.S. hydrogen hub to receive \\$90 million in aid: governor](#)) that the US State of **North Dakota** was to provide USD 90 million of funding support, including subsidies and low-interest financing for the development of the **North Dakota Clean Hydrogen Hub Project**. See **Editions 19** and **25** of Low Carbon Pulse for background.
- **Mitsubishi and Shell aligned:** On **April 7, 2022**, [h2-view.com](#) reported that **Mitsubishi Corporation** and **Shell plc** had agreed to work together to develop and to deploy **Green Hydrogen** production capacity using renewable

electrical energy sourced from **4 GW** of off-shore wind fields off the Netherlands. As currently contemplated, together **Mitsubishi** and **Shell** plan to produce **400,000** metric tonnes a year of Green Hydrogen by 2030.

- **Lhyfe aligned wpd and Mitsui:**

- On **April 11, 2022**, [h2.view.com](https://www.h2view.com) reported that **Lhyfe** and **wpd** have agreed to work together to develop and to deploy a large-scale Green Hydrogen production facility, of up to **600 MW**, using renewable electrical energy sourced from a planned **1 GW** off-shore wind field.
- On **April 13, 2022**, **Mitsui & Co., Ltd** [announced](#) that it had invested in **Lhyfe**, on the basis that it is aligned the sustainability goals of **Mitsui**, critically, to allow **Mitsui** to import Green Hydrogen into European markets.
- **ACE Terminal progressing:** On **April 11, 2022**, **Vopak** provided an update in respect of the **ACE Terminal**. The **ACE Terminal**, being developed by **Gasunie**, **HES International B.V.** and **Vopak**. The Green Ammonia import terminal is being developed in the Port of Rotterdam. The **ACE Terminal** is planned to be operational from 2026.
- **Gladstone to get another hydrogen production facility:** On **April 12, 2022**, it was reported widely that **The Hydrogen Utility (H2U) Group** and **Orica** are to assess the first stage of the development of a **3 GW Green Hydrogen Hub**, capable for producing up to 5,000 metric tonnes of Green Hydrogen a day.
- **Desert Bloom progresses:** On **April 11, 2022**, it was reported widely that **Osaka Gas** had agreed to develop **Desert Bloom** jointly with Aqua Aerem (air-to-water technology developer). The involvement of **Osaka Gas** is telling, providing support for both the project and the technology. See **Edition 32** of Low Carbon Pulse for background.
- **Shell and Uniper progress:** On **April 12, 2022**, **Shell** [announced](#) (under [Shell and Uniper to work together on Blue Hydrogen production facility in the UK](#)) the signature of a cooperation agreement with **Uniper** to progress plans for low-carbon hydrogen production at Uniper's **Killingholme Site** in North Lincolnshire, England. As contemplated, the low-carbon hydrogen produced will be used by heavy industry, land transport mobility, and heating and power across the Humber region (and beyond). As noted in **Edition 37** of Low Carbon Pulse, the project satisfied the eligibility criteria for the Phase-2 carbon capture, usage and storage Cluster Sequencing Programme.
- **Seoul Sludge to Hydrogen:** On **April 12, 2022**, it was reported that **Seoul Water Recycling Corporation** is working with **Plagen** (a pyrolysis and renewable fuel production corporation) to develop jointly technology to source **biogas** from the sludge arising from waste water treatment to produce hydrogen from the **biogas**.
- **Total Eren chilled:** On **April 14, 2022**, it was reported that **Total Eren** is progressing with the development of its **8 GW** Green Hydrogen production facility in the **Magallanes** region, Southern Chile with the reported appointment of Wood (leading global consulting and engineering corporation) to undertake conceptual design and engineering work. See **Edition 32** of Low Carbon Pulse for background.
- **Project Global Hydrogen Supply by 2030:** On **April 13, 2022**, **EDF Group** [announced](#) (under [The EDF Group launches a new industrial plan to produce 100% low-carbon hydrogen](#)) that it aims to develop "3 GW of electrolytic hydrogen projects worldwide by 2030. These projects will involve between €2 and €3 billion of investment, will be developed and co-financed through industrial partnerships and by drawing on national and European support mechanisms". The hydrogen produced will be both Green and Pink.
- **Sun Cable continues to progress:** On **April 20, 2022**, the Australian Broadcasting Corporation (**ABC**) on-line news feed, [abc.net.au](https://www.abc.net.au) reported that the [environmental impact assessment \(EIS\)](#) for **Sun Cable** had been lodged. As regular readers of Low Carbon Pulse will know, the **Sun Cable** (and the **Australia-Asia PowerLink**) projects have been covered in Low Carbon Pulse from the earliest editions (see **Editions 2, 3, 13, 26, 28, 32**).
- **CIP and Madoqua Renewables progress in Portugal:** On **April 20, 2022**, [renews.biz](https://www.renews.biz) reported that **Copenhagen Infrastructure Partners' Energy Transition Fund** is working with **Madoqua Renewables** and **Power2X** to develop a **€1 billion 500 MW** Green Hydrogen and Green Ammonia production facility to be located in **Sines, Portugal** (the **MadoquaPower2X** project). The **MadoquaPower2X** project will produce **50,000** metric tonnes of Green Hydrogen and **500,000** metric tonnes of Green Ammonia a year.
- **Advanced Methanol Rotterdam (AMR):** On **April 24, 2022**, as reported the **AMR** facility will produce up to **90,000** metric tonnes of renewable methanol a year from feedstock comprising **180,000** metric tonnes of non-recyclable waste, currently being treated thermally. The **AMR** facility will capture all **CO₂** arising, and it will be used in local greenhouses, and the bottom ash will be used for cement production, with other residual streams (including ammonia and salts) to be sold.
- **Aker Horizons and Nordkraft shape the north:** On **April 25, 2022**, it was reported widely that **Aker Horizons** and **Nordkraft** plan to develop, in joint venture, a large-scale hydrogen production facility in **Narvik, Norway**. It is understood that common use infrastructure will be developed to provide sites for energy intensive industries.
- **Permacand and RES to develop Green Hydrogen production facility:** On **April 25, 2022**, it was reported widely that **Permacand** and **RES** had signed a letter of intent (**LOI**) to develop a Green Hydrogen production facility in **Alby, Ånge Municipality, Sweden**.
- **US DOE lends to the Advanced Clean Energy Storage Hub Project:** On **April 26, 2022**, it was reported that the **US DOE Loan Program Office** had committed, conditionally, to provide up to **USD 504.4** million of debt funding in respect of the **Advanced Clean Energy Storage Hub Project**. The **Advanced Clean Energy Storage Hub Project** is to be developed by **Magnum Development LLC** and **Mitsubishi Power Americas Inc**, and it expected to the commence operations in 2025. On **April 27, 2022**, it was reported that **Black & Veatch** had been selected as an EPC provider for the Project.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

- **Enel receives funding support for expansion of giga-factory:** On **April 1, 2022**, the **Enel Green Power** (subsidiary of Enel, leading international renewables and utility corporation) [announced](#) that it had signed a grant agreement with the **CINEA** under which it will receive **€118 million** to be contributed to the cost of the expansion of its 200 MW bifacial photovoltaic module factory in Catania, southern Italy, into a **3 GW** Giga-factory. The total cost of expansion is understood to be **€600 million**.

- **John Cockerill and Greenko Group roost:** On **April 11, 2022**, rechargenews.com reported the **John Cockerill Group** is to develop a **2 GW** electrolyser giga-factory in India in conjunction with a subsidiary of **Greenko Group**. The **John Cockerill Group** manufactures alkaline electrolysers.

ELECTROLYSER GIGA-FACTORIES				
Cummins 1 GW x 2 *	FFI – 2 GW	ITM Power – 5 GW	McPhy – 1 GW	NEL – 2GW +
Ohmium – 0.5 to 2 GW \$	Plug Power 1 GW x 2 #	Siemens Energy – 1 GW	Sunfire – 1 GW	Thyssenkrupp – 5 GW

* Cummins has announced two Giga-Factories, one with Iberdrola, and one with Sinopec,

Plug Power has announced two Giga-Factories, one in the US, one in ROK.

\$ Ohmium International announced on April 18, 2022 that it is to increase electrolyser manufacturing capacity to 2 GW by the end of 2022 at its giga-factory in Bangalore, India.

+ NEL ASA announced on April 20, 2022, that its fully automated electrolyser manufacturing facility in Herøya, Norway, was on-line.

- **Republic of Ireland's first Hydrogen Valley:** On **April 14, 2022**, renews.biz reported that the **Port of Galway** and **SSE Renewables** had unveiled plans for Ireland's first Hydrogen Valley (the **Galway Hydrogen Hub**).
- **100 cities to participate in EU Missions:** On **April 28, 2022**, the **EC** announced the [100 EU cities](https://ec.europa.eu/mission/) that will participate in the [EU Mission](https://ec.europa.eu/mission/), the so called **Cities Mission**.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

- **Highlight for HYBRIT:** On **April 1, 2022**, **LKAB**, **SSAB** and **Vattenfall** [announced](https://www.vattenfall.com/en/press-releases/2022/04/01/vattenfall-lkab-ssab-sign-funding-agreement) the signature of the funding support agreement with the **CINEA**. The funding support is to allow the scaling up and commercialisation of the value chain for the use of hydrogen to produce green iron and steel. **Editions 13, 16, 20, 25, 26** and **27** of Low Carbon Pulse provide background.
- **POSCO and Hancock testing feasibility of HBI plant:** On **April 1, 2022**, the author picked up on reporting in the **ROK** press that **POSCO** had announced the execution of a memorandum of understanding (**MOU**) between **POSCO** and **Hancock** to Produce Low Carbon Steel Raw Materials, with the **MOU** focusing on testing the feasibility of a **hot briquette iron (HBI)** production facility, and, depending on the outcome of the testing of feasibility, the development of an iron ore mine to provide dedicated iron ore to produce **HBI**. To some with long memories, and longer in the tooth, **HBI** has long been a good idea the time for which may be nigh.
- **Iluka to develop REE refinery in Western Australia:** On **April 3, 2022**, **Iluka Resources** [announced](https://www.ilukaresources.com/news/2022/04/03/iluka-resources-announces-ree-refinery) that the Australian Federal Government had approved an **AUD 1.25** billion loan to allow **Iluka Resources** to develop a rare earths and elements refinery.

Wind round-up, on-shore and off-shore:

- **Lithuania moves to off-shore:** On **April 1, 2022**, it was reported widely that on **March 31, 2021**, the **Lithuanian Parliament (Seimas)** had approved laws to allow the development of the off-shore wind field capacity in the **Lithuanian sector of the Baltic Sea**. As reported, the first off-shore wind field progress to development during Q3 of 2023, and is to have **700 MW** of installed capacity, with first electrical energy in **2028**.
- **Australia's first off-shore wind project starts heavy lifting:** On **April 1, 2022**, it was reported widely that the developers of the **2.2 GW Star of the South Project**, off the coast of **Victoria, Australia**, were progressing to undertake detailed ground investigations along the route of the on-shore transmission route. **Editions 13, 14, 16** and **31** provide earlier reports on the **Star of the South**.
- **GWEC – Global Wind Report:** On **April 4, 2022**, the **Global Wind Energy Council (GWC)** released the [Global Wind Report 2022](https://www.gwec.org/global-wind-report-2022/), which is worth a read to firm up thinking on current trends and projected installations.
- **Eni and CIP JV proceeds to floating off-shore:** On **April 6, 2022**, it was reported widely that **Plentitude** (a joint venture between **Eni SpA**, **CDP Equity** and a fund managed by **Copenhagen Infrastructure Partners**) was to proceed to develop **two floating off-shore wind fields** off the coast **Marsala, Italy**, in combination the two off-shore wind fields will comprise **750 MW** of installed capacity.
- **Floating off-shore hydrogen production facility:** On **April 7, 2022**, [pv.magazine.com](https://www.pv-magazine.com) reported (under [Renewable offshore floating hydrogen production](https://www.pv-magazine.com/2022/04/07/renewable-offshore-floating-hydrogen-production/)) that **Scottish Development International** and **J-DeEP** plan to develop a **floating off-shore Green Hydrogen production facility** off the coast of Scotland.
- **Equinor unveils USD 23 billion plans:** On **April 22, 2022**, [maritime-executive.com](https://www.maritime-executive.com) reported that **Equinor** intends to invest **USD 23 billion** in off-shore wind projects in the near term (over the next five years), with the intention of having **16 GW** of installed off-shore wind field capacity by 2030.
- **Iberdrola approval for next phase of USD 4 billion project:** On **April 25, 2022**, rechargenews.com reported that **Iberdrola** had received approval from the **Federal German Government** authorities to develop the second of three off-shore wind field projects in the **German sector of the Baltic Sea**: the development of the **476 MW Bald Eagle project**.
- **Dutch continuing to double-up:** On **April 13, 2022**, it was reported widely that the ruling political parties in the Netherlands (WD and D66) want the Netherlands to more than double its goal for the production of **Green Hydrogen**. In the [2019 National Climate Agreement of the Netherlands](https://www.climaterecord.com/2019-national-climate-agreement-of-the-netherlands/), the commitment was to establish **4 GW** of **Green Hydrogen** production capacity by 2030, the **increase to 8 GW** would go hand in hand with the planned increase scaling up of off-shore wind field capacity.
- **Enefit Green progress in Estonia:** On **April 29, 2022**, [offshorewind.biz](https://www.offshorewind.biz) reported on the progress being made towards the development of the **1.1 GW Hiiu** (or **Loode-Eesti**) off-shore wind field development to be located 12 kms north of the second largest island in the Estonia sector of the Baltic Sea (**Hiumaa**).

Solar and Sustainability (including NZE Waste):

- **Second life and recycling:** On **April 7, 2022**, **CIC energiGUNE** published a map-graphic (entitled [Second Life and Recycling – Companies in Europe](#)) providing a snap shot of the battery recycling plants across Europe and the UK. As ever, thanks to the good folk at **CIC energiGUNE**.
- **ENEOS and TotalEnergies aligned:** On **April 13, 2022**, it was reported widely that **ENEOS** and **TotalEnergies** had established a **50:50 joint venture** to develop up to **2 GW** of decentralised photovoltaic solar capacity over the next five years.
- **Chile tenders nearly 2,800 hectares:** On **April 14, 2022**, [pv-magazine.com](#) reported that Chile's **Ministry of National Property** announced a tender for nearly **2,800 hectares** of land located in the **Commune of Santa Elena**, 27.5 km northwest of **Quillagua**, in the **Antofagasta** region of **Chile**. Those interested in tendering for the land must do so by **May 25, 2022**. The land must be used to develop large-scale renewable energy generation capacity.
- **Gemini Project closes:** On **April 26, 2022**, [rechargenews.com](#) reported on financial close of the US's largest-ever photovoltaic solar-plus **BESS** project (the **Gemini Project**): the **Gemini Project** comprises **690 MW** of photovoltaic solar and **380 MW / 1,417 MWh** of **BESS**. **Primergy Solar** and **Quinbrook Infrastructure Partners** are reported to have closed the **USD 1.9 billion** construction debt (circa **USD 1.3 billion** in debt) and tax equity financing for the **Gemini Project** to be located in the **Mojave Desert, Nevada**.
- **JERA to deploy 1 GW of photovoltaic solar:** On **April 27, 2022**, [rechargenews.com](#) reported that it intends to develop and to deploy up to **1 GW** of photovoltaic solar by 2025 to provide electrical energy to **JERA's** domestic market.

Land Mobility / Transport:

- **Buses and coaches:**
 - **Solaris Bus & Coach continues its roll:** During **April 2022**, **Solaris Bus** and **Coach** continued to agree sales of its **Solaris Urbino** electric bus with the following sales: **12** electric buses to **JGSP Novi Sud** (Serbian bus operator), and accompanying supply of electric charging infrastructure; **17** electric buses to **MZK Grudziądz** (Polish bus operator in the City of Grudziądz); **10** hydrogen buses (Urbino) are to be mobilised for use by two operators (five to each), **Busreisen Ettenhuber GmbH** and **Martin Geldhauser GmbH & Co. KG**.
 - **NY School Buses electric by 2035:** On **April 8, 2022**, it was reported widely that **Governor Ms Kathy Hochul** is to propose legislation to require 100% of all school buses to be electric by 2035 in the State of New York.
 - **Spain's hydrogen fuel celled buses:** On **April 8, 2022**, it was reported widely that **Transports Metropolitans de Barcelona (TMB)** begun operating a **CaetaniBus** powered and propelled by fuel cell technology. In addition, it is understood that another seven **CaetaniBuses** will enter into service by the end of 2022.
 - **German operator receives grant funding:** On **April 11, 2022**, [fuelcellbuses.eu](#) reported (under [RVK received grant of 108 hydrogen-powered fuel cell hybrid buses](#)) that a German public transport operator, **Regionalverkehr Köln GmbH (RVK)**, is to receive funding support from the German Federal Government Ministry of Digital Affairs and Transport. The funding support will allow the mobilisation of 108 hydrogen-powered and propelled buses, which will be added to the **RVK** fleet by 2024.
 - **BEV Bus Depot:** On **April 13, 2022**, the **Government of Queensland, Australia**, [announced](#) (under [A one-way ticket to low-emissions public transport](#)) that **Australia's first 100%** electric bus depot was now open, and would be providing battery charging for **30 electric buses**.
- **Cars (including taxis and air-taxis):**
 - **Airborne taxis and airports:**
 - **Hyundai plans hydrogen powered and propelled air taxis:** On **April 1, 2021**, it was reported widely that **Hyundai** is progressing with plans to develop and to deploy air-taxi by 2030 – using advanced air mobility technology, and having established an **Advanced Air Mobility Unit** to develop the **eSTOL** aircraft.
 - **AFC Energy fuels cells showcased:** On **April 29, 2021**, [hydrogen-central.com](#) reported (under [AFC Energy Hydrogen Fuel Cell to be Showcased at Flying Taxi Airport](#)) that "one of the hydrogen batteries" of **AFC Energy PLC (AFC Energy)** "will be used to charge Air One's fleet of electric vehicles" based at "the flying taxi airport that opened in Coventry" during April 2022.
 - **Paris electrolysis:**
 - **Edition 4** of **Low Carbon Pulse** reported on plans to develop **10** hydrogen storage facilities at locations around Paris. On **April 4, 2022**, **Cummins Inc.** announced that its affiliate, **Hydrogenics Europe N.V.**, had signed a contract to supply a **2.5 MW** electrolyser to **Hysetco** (a mobility corporation owned by **Air Liquide, Korous, TotalEnergies** and **Toyota**) to allow production of hydrogen in **Paris, France**. The **hydrogen** will be **delivered** to **12** sites with hydrogen refuelling infrastructure.
 - On **April 25, 2022**, [euractiv.com](#) published an article (under [Fleets of hydrogen taxis are picking up across Europe](#)) focussing on the activity in France, both policy setting and private sector progress. It is noted in the article that hydrogen is an ideal source for "random intensive uses like taxis".
 - **Hike in taxi plans:** On **April 21, 2022**, [zefer](#) reported that two pan-European projects have worked together to bring zero-emission hydrogen taxis and hydrogen refuelling infrastructure to the **Copenhagen**. The two pan-European projects are: **ZEFER** (Zero Emission taxi Fleets for European Rollout) and **H2ME2** (Hydrogen Mobility Europe), funded by the **EU** Clean Hydrogen Partnership, and they have mobilised **100** zero emission taxis.
- **Industrial Vehicles and Trucks:**
 - **Wholesale switches:**
 - On **April 2, 2022**, it was reported widely that **Lidl** (retail giant) is transitioning its entire battery electric fleet (used in its logistics centres) to fuel cell technology, using Green Hydrogen.

- On **April 20, 2022**, **Plug Power** announced that it had agreed with **Walmart** to supply Green Hydrogen (in liquid form) to power and to propel material handling lift trucks across the **Walmart distribution and fulfilment centers** in the US.
- **Scania and Cummins aligned:** On **April 8, 2022**, it was announced that **Scania** is working with **Cummins, Inc** to develop 20 fuel cell electrical trucks to be fuelled by Green Hydrogen (for the **HyTruck Project**). **Scania** will manufacture the trucks, and **Cummins** will supply and install the fuel cells. The trucks will be delivered to **Air Liquide** and the **Port of Rotterdam Authority** as part of the **HyTrucks Project**. **Edition 18** of Low Carbon Pulse has background on the **HyTruck Project**.
- **Edmonton International Airport to convert to hydrogen:** On **April 27, 2022**, [flyeia.com](https://www.flyeia.com) reported **Edmonton International Airport** was to participate in the **VEXSL Hydrogen Project** using **Hydra Energy's** retrofit solution and technology to convert trucks powered and propelled by diesel power plants to co-combust with hydrogen.
- **Recharging and refuelling infrastructure:**
 - **Eni and Linde aligned:** On **April 15, 2022**, it was reported widely that **Eni** (leading international energy corporation) has opened the first hydrogen refuelling station in **Venice, Italy**, with equipment and infrastructure supplied and installed by **Linde**.
 - **Ever active Everfuel:**
 - **Everfuel to develop heavy-duty hydrogen station in Germany:** On **April 8, 2022**, it was reported widely that **Everfuel GmbH** had contracted with **WSW mobil GmbH** to develop and to deploy hydrogen refuelling infrastructure (including stations) to serve a fleet of fuel cell buses.
 - **Everfuel to develop largest HRS in Denmark:** On **April 21, 2022**, Everfuel [announced](#) that, with Taulov Dry Port, it was to expand the green logistics hub at Fredericia to establish the largest hydrogen refuelling station in Denmark.

Ports Progress and Shipping Forecast:

- **Ferries and other craft:**
 - **Electric on blue:** On **April 1, 2022**, [Norwegian Ship Design](https://www.norwegian-ship-design.com) reported **Cemre Shipyard** and **Torghatten Nord** As had entered into a contract to build a new ferry for the Bognes – Lødingen route, in northern Norway.
 - **Sea Change edging closer to the water:** On **April 21, 2022**, it was reported widely that the launch of the **Sea Change** was ever closer, with a launch date of mid-May 2022 reported. **Editions 19, 26** and **30** of Low Carbon Pulse have background about the **Sea Change**.
- **Green Ports:**

HyTransPortRTM get first customer: On **April 14, 2022**, it was reported widely that **Shell** is the first customer for the **hydrogen transportation pipeline** in the **Port of Rotterdam** – the **HyTransPortRTM**. **Shell** is developing a **Green Hydrogen production facility** at the **Conversion Park, Maavlake** (see **Edition 27** of Low Carbon Pulse for the most recent coverage), with the Green Hydrogen will be transported through the **HyTransPortRTM** to allow the delivery of Green Hydrogen into networks to deliver Green Hydrogen to customers.
- **Green Corridors:**
 - **Australia to East Asia Green Corridor LoI:** On **April 6, 2022**, it was reported widely that a letter of intent had been signed by **BHP, Rio Tinto, Oldendorff Carriers** and **Star Bulk Carriers Corp** to assess the development of a Green Corridor between Australia and East Asia, with the assessment being led by the **Global Maritime Forum**. See **Editions 19** and **30** of Low Carbon Pulse for detail about the **Global Maritime Forum, Green Corridors** and the **Clydebank Declaration**.
 - **Chilean Green Corridors Network:** On **April 14, 2022**, **Maersk McKinney Møller Center for Zero Carbon Shipping** [announced](#) that it had signed a formal agreement with the Ministry of Energy In Chile to establish a network of Green Corridors allowing for green maritime transportation of goods in and out of **Chile**.
 - **Maersk McKinney Møller Center for Zero Carbon Shipping** is to undertake and to complete by the end of 2022 the assessment and mapping of the most promising Green Corridors, and will route the way for the development of **Green Corridors** identified.
- **Green Shipping:**
 - **The World Bank values carbon:** On **April 1, 2022**, **The World Bank** published [Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition-Technical Paper](#). The **Technical Paper** is well-worth a read.
 - **Bulk: Cement and Grain:** On **April 5, 2022**, it was announced by [HeidelbergCement](https://www.heidelbergcement.com) and [Felleskjøpet AGRI](https://www.felleskjøpet-agri.no) that **ENOVA** (Norwegian government enterprise owned by the Ministry of Climate and Environment) had provided funding support for the zero-emission cargo ship, the **With Orca**. **Editions 20** & **37** of Low Carbon Pulse have further background.
 - **DSME LCO2 carrier headed for the water:** On **April 8, 2022**, [lngprime.com](https://www.lngprime.com) reported that **Daewoo Shipbuilding & Marine Engineering (DSME)** that **DSME** had received classification society basic design approval for its 250 / 44 metre dimensioned vessel to carry **liquid carbon dioxide (LCO2)**. The basic approval in principle is understood to make the **DSME** vessel the largest dimensioned **LCO2** carrier to receive approval in principle to date, with containment tank capacity stated to be **70,000 m³**.
 - **Ammonia and LCO2 carrier updates:** On **April 14, 2022**, the **Ammonia Energy Association** posted an [update](#), including the following **Approvals in Principle (AIP)**: the concept design for a **50,000 m³** ammonia and **LCO2** carrier from **Mitsui O.S.K Lines, Ltd.** and **Mitsubishi Heavy Industries**, the **AIP** from **DNV** for an ammonia powered and propelled **7,000 car** carrier designed by **China State Shipbuilding Corporation**, and the **AIP** for the **7,500 m³** ammonia carrier, the **MS Green Ammonia**, designed by **Grieg Edge** and using a Wärtsilä W25dF ammonia engine.

- **NZE emission carriers:** In addition to the cargoes that are to be carried, the carriers carrying those cargoes are progressing to become **NZE** emissions carriers. **Mitsui O.S.K Lines, Ltd** is reported to be aiming to deploy 110 **NZE** carriers by 2035.
- **Yara bookends the month of April:**
 - **Yara International pacesetting:** On **April 1, 2022**, [h2-view.com](https://www.h2-view.com) reported that **Yara International** was continuing to develop the world's first carbon-free ammonia fuel bunker network in Scandinavia.
 - **Yara Birkeland wetted:** On **April 29, 2022**, the **Wilhelmsen Group** [announced](#) the official christening of the **Yara Birkeland**, the world's first autonomous and zero-emission container vessel: the **Yara Birkeland** was developed in collaboration with Kongsberg Group and was built by VARD, and will transport mineral fertiliser between Porsgrunn and Brevik.

Airports and Aviation:

- **Airbus Industries and Kawasaki Heavy Industries aligned:** On **April 12, 2022**, it was reported widely that **Airbus** and **Kawasaki** have agreed to work together to develop supply hydrogen supply chains to deliver hydrogen and hydrogen-based fuels to airports, and to develop the accompanying hydrogen eco-systems.
- **ENEOS and TotalEnergies align:** On **April 14, 2022**, [biofuel-news.com](https://www.biofuel-news.com) reported that **ENEOS Corporation** and **TotalEnergies** had agreed to work together to assess the feasibility of a **SAF** production facility at **ENEOS' Negishi** refinery in Japan. (**ENEOS** and **TotalEnergies** had previously commenced studies on supply).
- **Air Products, Honeywell and World Energy SAF and sound:** On **April 25, 2022**, it was reported widely that **Air Products**, **Honeywell** and **World Energy** (a producer and supplier of **SAF**) are to work together to develop North America's first commercial scale **SAF** production facility in **Paramount, California**.
The **USD 2 billion SAF** production facility (with current nameplate production capacity of **340 million gallons** a year) is to be located at the production hub of **World Energy**, using hydrogen supplied by **Air Products**, with **Honeywell** continuing to work with **World Energy** to continue to develop more efficient and new processes.

Low Carbon Pulse - Edition 39 (long-form)

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to the **Long Form Version of Edition 39** of Low Carbon Pulse – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Friday April 1, 2022 to Saturday April 30, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1 to 28**, covering October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29 to 38**, covering October 7, 2021 to March 31, 2022).

Headlines:

Earth Day 2022:

Friday April 22, 2022, was **Earth Day 2022**. There was considerable coverage before, on and after Earth Day 2022 about all aspects of the environment, including the need to cease activities giving rise to degradation, and to undertake activities that will remedy degradation that has occurred. **Edition 40** of Low Carbon Pulse will cover in detail.

The Month Ahead:

As flagged in **Edition 32** of Low Carbon Pulse, during the coming month:

- **May 2 to 6:** The **XV World Forestry Congress** will be held in Seoul, Republic of Korea (**ROK**) under the theme of **Building a Green Healthy and Resilient Future with Forests**. The **XV World Forestry Congress** will consider six sub-themes.

For the author of Low Carbon Pulse, the progress made at the **Congress** will be key, both for forestry and land use. During the first four months of 2022, there has been a clear uptick in interest in the role that land-management and optimal land-use can have on increased absorption of **CO₂**, i.e., its negative **GHG** emission impact.

- **May 9 to 20:** The **15th United Nations Conference to Combat Desertification** will be held in the Côte d'Ivoire. Consistent with **LDC5**, the **UN Biodiversity Conference** and the **XV World Forestry Congress**, the overarching theme that may be expected to emerge will be how to address deforestation, reforestation, afforestation, and land restoration, and land-management and land-use generally.

The Month in the rear view mirror:

- The impact of the conflict in Ukraine continues to resonate globally. The rate at which countries have committed to the development and deployment of liquefied natural gas (**LNG**) receiving terminals (floating and land based) remains a marked trend, as does the rate at which Green Hydrogen infrastructure (production and transportation facilities) is being developed. As might be expected, this activity has been particularly pronounced in Europe (see the **Europe and UK** section); and
- **Edition 38** of Low Carbon Pulse (published on **April 14, 2022**) outlined the key findings arising from [IPCC WGIII Climate Change 2022: Mitigation of Climate Change](#) report and the [IRENA World Energy Transitions Outlook 2022](#). From the number of engagements, and feedback, it seems to have struck a balance.

Vale those lost:

Finally, condolences for those lost in the conflict in Ukraine, and safe-haven to those displaced.

Content of this Edition 39:

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Timeline for April and May 2022:

- **IPCC WGIII conference and publication:**

- **Climate Change 2022: Mitigation:**

- On **April 4, 2022** the [IPCC WGIII Climate Change 2022: Mitigation of Climate Change](#) report (**IPCC WGIII Report**) was published. **Edition 38** of Low Carbon Pulse covered its key findings, and those of **WETO 2022**: in summary, the findings of the **IPCC WGIII Report** and **WETO 2022** are not new, but the findings are as compelling as any report so far because of their clarity and detail, around the need for immediate and urgent action to reduce **GHG** emissions, and otherwise act to mitigate the impacts of climate change.
 - **Facts and stats:** As with the lead up to the publication of the **IPCC WGII - Climate Change 2022: Impacts, Adaptation and Vulnerability** report (on February 28, 2022), during the lead-up to the publication of the **IPCC WGIII Report**, the **IPCC** provided a narrative about the number of scientists involved, comments received, and documents reviewed: 271 scientists from 65 countries were involved, 59,000 comments were received (including 21,500 comments on the first draft, and 32,500 comments on the second draft), and 18,000 publications were assessed. A mammoth undertaking, and an excellent report.
 - **Jaw, Jaw Reports:** In the lead up to the publication of the **IPCC WGIII Report** there was reporting about the lack of alignment on the findings, with the session schedule extended into **April 3, 2022** ahead of publication on **April, 4, 2022**. The same issue that extended proceedings at **COP-26** (held in Glasgow, Scotland (scheduled to end November 12, 2021, running into November 13 and 14, 2021)), extended the **IPCC WGIII** session to finalise the **IPCC WGIII Report** – that issue was fossil fuels.
 - **Contention late in the day:** Given the importance of the **IPCC WGIII Report** it is understood that finalisation was contentious "because it covers the policies, technologies and finances needed to cut greenhouse gas emissions" (as reported in The Guardian).
As reported, the most contentious engagement was around the timeline to phase out fossil fuels, and, in this context, the use of technologies to extend the timeline. While the reporting around lack of alignment is no doubt accurate, the noise / static should not distract us from what needs to be done, which is known, and the means to do what needs to be done, which already exist
 - **There is no time to lose:** As noted in **Edition 37** of Low Carbon Pulse, to the author, the **IPCC WGIII Report** is the most important of the reports produced by the three **IPCC Working Groups** because it provides "how to do" "what needs to be done" outlined in the **IPCC WGI Report** (August 2021) and **IPCC WGII Report** (February 2022), which cover the extent of climate change and its impacts.

- **IPCC reports – next steps:**

- The **IPCC WGIII Report** is the third of the three Assessment reports from each **IPCC** Working Group forming part of **AR6: Working Groups I, II and III**.
 - In **September 2022**, the **IPCC** will publish the **Synthesis Report** for the purposes of **AR6**. The **Synthesis Report** will synthesise and integrate findings and materials contained in the reports from each **IPCC Working Group**, and findings and materials contained in three Special Reports ([Global Warming of 1.5°C](#), [Climate Change and Land](#) and [The Ocean and Cryosphere in a Changing Climate](#)).
Following the tried and tested format, the **Synthesis Report** will be in two parts, the **Summary of Policymakers (SPM)** and the **Longer Report**.
 - Just as the **IPCC Working Group I Climate Change 2021: The Physical Science Basis** report (in particular the Summary of Policy Makers contained in it) informed discussions at and outcomes from **COP-26**, the **SPM** and the **Longer Report** (contained in the **Syntheses Report** for the purposes of **AR6**) will inform discussion of **COP-27** to be held in Sharm el-Sheikh, South Sinai, Egypt from **November 7 to November 18, 2022**.



Legal, Policy Setting and Regulatory highlights:

This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse in respect of laws and regulation, and broader policy settings, in each case describing substance, progress and impact.

• **IEA publications during April:**

- On **April 1, 2022**, the **International Energy Agency (IEA)** published [Direct Air Capture – A key technology for net-zero \(DAC Study\)](#). The publication provides a helpful guide to one means of carbon dioxide removal (**CDR**) from the atmosphere.

The publication of the **DAC Study** dovetailed neatly with the publication of the **IPCC WGIII Report**, particularly to inform some of the headlines arising from the **IPCC WGIII Report** about the need for **CDR** in the context of limiting global warming to a **1.5°C** or **2°C** increase in average global temperatures.

As has been noted in various editions of Low Carbon Pulse, Article 4 of the Paris Agreement contemplates **CDR**. Also as has been noted in various editions of Low Carbon Pulse, **CDR** needs to be used now (see **Edition 27** of Low Carbon Pulse and explained in full in **Edition 38** of Low Carbon Pulse).

Direct Air Capture is one of the means that will be used to effect **CDR**. There is nothing new in this, but what is new is the realisation broadly that **CDR** needs to occur immediately and at scale, rather than leaving it until mid-century. **Edition 38** of Low Carbon Pulse explains this in detail.

- On **April 17, 2022**, the **IEA** published its [Sustainable Recovery Tracker – Monitoring Progress towards sustainable recoveries from the Covid-19 crisis](#), with the key findings being:
 - As at the end of March 2022, Governments worldwide had earmarked **USD 710 billion** for sustainable recovery measures;
 - Governments of more advanced economies had ear-earmarked **USD 370 billion** for clean energy measures to be spent by the end of 2023 (consistent with the near-term spending estimated by the **IEA** as necessary to progress to achieve **NZE** by 2050);
 - There is a widening gap between the more advanced and the emerging and developing economies (with the near-term spending of emerging and developing economies estimated by the **IEA** to be at less than a quarter of the near-term spending necessary to progress to achieve **NZE** by 2050).

The latest update of the **IEA Sustainable Recovery Tracker** is available in full form on line, and details over 1,000 policy settings in the context of sustainable recovery from the Covid-19 crises.

- On **April 15, 2022**, the **IEA** published its [Gas Market Report, Q2-Analysis, including Global Gas Review 2021](#). The key finding from the report is that during the balance of 2022 global demand for natural gas is expected to decline slightly (50 billion m³, equivalent to ½ of the US exports of LNG during 2021), as a result of the disruption caused by the conflict in Ukraine.

The report references the **IEA 10-Point-Plan** (published on March 3, 2022, and covered in **Edition 36** of Low Carbon Pulse), that outlined measures that may be taken across Europe to reduce gas imports from Russia, with demand in Europe expected to reduce by 6%. The **IEA** report notes the impact on natural-gas and LNG spot prices since the start of 2022.

- On **April 20, 2022**, the **IEA** published its [Belgium 2022 – Energy Policy Review Report](#) (the **Belgium Report**). The **Belgium Report** is well-worth a read. The headlines are that Belgium needs to develop the means to increase the rate of reduction of **GHG** emissions and to reduce its reliance on energy imports.

• **IRENA:**

After a busy **March 2022** for the **International Renewable Energy Agency (IRENA)**, **April 2022** was a little quieter in terms of the number of publications, but that which was published was helpful and weighty:

- On **March 14, 2022**, the **IRENA Coalition For Action** published [Decarbonising End-Use Sectors: Green Hydrogen Certification \(Certification Paper\)](#), which provides the following recommendations: **1.** Develop a standard definition of Green Hydrogen, **2.** Certify the origin of renewable energy used to produce hydrogen; **3.** Ensure certificates contain sufficient information to address policy settings and the market; **4.** Simplify the Green Hydrogen tracking system to avoid overly burdensome administration; **5.** Implement a cost effective and efficient tracking system; **6.** Put in place control systems to avoid the consequences of any abuse or lack of transparency; **7.** Ensure interfaces between tracking and control systems work effectively, both existing, and new; **8.** Avoid double counting; **9.** Use policy setting taxonomy and green finance criteria to encourage compliance; and **10.** Promote international cooperation to establish globally accepted requirements.
- On **April 11, 2022**, **IRENA** published [Renewable Capacity Statistics 2022](#), with a helpful three page summary [Renewable capacity highlights](#);
- On **April 19, 2022**, **IRENA** published [Grid Codes for Renewable Powered Systems](#). The publication is an update on the **IRENA** publication from 2016, [Scaling Up Variable Renewable Power: The Role of Grid Codes](#). The publication is excellent, and well-worth a read;
- On **April 11, 2022**, **IRENA** published data detailing installed renewable electrical energy [Renewable Capacity Statistics 2022](#). While the content of the data is not surprising, the data is a helpful reference.

By way of reminder: During **March 2022**, in addition to **WETO 2022**, **IRENA** published the following: [Decarbonising end-use sectors Green Hydrogen Certification](#); [Green Hydrogen For Industry – A Guide to Policy Making](#) (considered in detail in **Edition 37** of Low Carbon Pulse under **A Guide to Policy Making**); [Collaborative Framework on Critical Materials For The Energy Transition](#), with the associated publication of [Collaborative Framework on Critical Materials For The Energy Transition](#), with the [Collaborative Framework on Critical Materials For The Energy Transition](#) following like-frameworks from **IRENA** (including on Hydropower, Ocean Energy / Offshore Renewable Energy, Green Hydrogen, Geopolitics of Energy Transformation, Just and

Inclusive Energy Transition and Enhancing Dialogues of High Shares of Renewables in Energy Systems), and the [Renewable Energy Market Analysis: Africa and its Regions](#) report.

The [Collaborative Framework on Critical Materials For The Energy Transition](#) and the [Renewable Energy Market Analysis: Africa and its Regions](#) report will be considered in the **March and April Report on Reports** to be included in the Third Compendium of Low Carbon Pulse to be issued shortly.

- **European Commission's plans to publish technical regulations:** On **April 21, 2022**, it was reported widely that on **May 18, 2022**, the **EC** intends to publish technical regulations that will provide the parameters by which hydrogen will be classified as renewable under the [EU RED II](#). **Edition 40** of Low Carbon Pulse will consider the parameters.
- **Denmark proposes corporate carbon tax:** On **April 22, 2022**, **Reuters** reported that the **Danish Government** proposes to introduce a uniform carbon tax, under which corporations will have to pay a levy of 1,125 Danish crowns (USD 164.21) per tonne of **CO₂** equivalent. It is understood that the carbon tax will be applicable to the energy sector and heavy industries for the most part. The **Danish Government** states that the carbon tax could reduce Denmark's carbon emissions by 3.7 million tonnes per year by 2030. Additionally, the **Danish Government** has proposed investing 7 billion Danish crowns to assist corporations to develop and implement their energy transition strategies.
- **McKinsey & Co:** On **April 26, 2022**, **McKinsey & Co** published its [Global Energy Perspective 2022](#). As ever, the publication is excellent and is well-worth a read. The key headline is that if all countries implement their [nationally determined contributions \(NDC's\)](#), **McKinsey & Co** models a **1.7°C** increase in average global temperatures: "*To keep the 1.5°C pathway in sight, even more ambitious acceleration [in GHG emission reduction] is needed*".

As regular readers of Low Carbon Pulse will know, this is broadly aligned with other models. For the purposes of this modelling, **McKinsey & Co** models that demand for hydrogen is expected to increase by four to six fold by 2050.

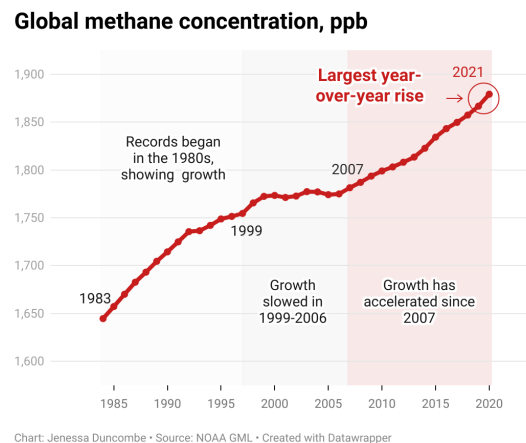
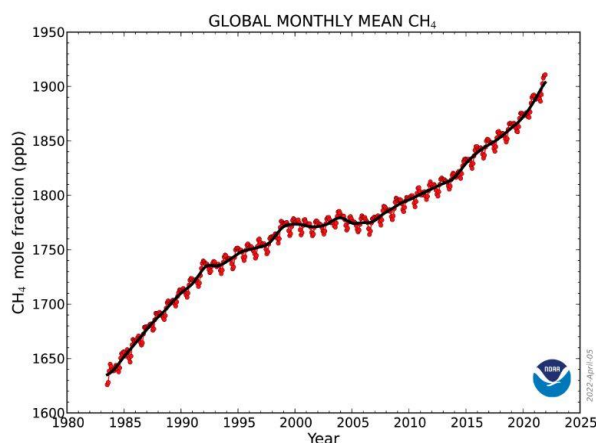
(For ease of reference, [links](#) are attached to previous **McKinsey & Co** reports.)

Climate change reported and explained:

*This section considers news items within the news cycle of this **Edition 39** of Low Carbon Pulse relating to climate change and its impact. The intention is to monitor significant and material data points and information, and to explain them.*

• Methane emissions at highest levels:

- On **April 7, 2022**, the US **National Oceanic & Atmospheric Administration (NOAA)** issued [Increase in atmospheric methane set another record during 2021 – Carbon dioxide levels also record a big jump](#). The following graph illustrates key dynamics reported by the **NOAA**, critically the (steepening) upward trend.



- **A more granular graph:** Also on **April 7, 2022**, [eos.org](#) published an excellent article (under [A Climate Mystery Warns US to Heed the Unknown](#)). The article contains the above graphic (to the right above), which continues to illustrate the point, in a more granular way.

- On **April 7, 2022**, [The Washington Post](#) published an excellent article [Methane emissions jumped by record amount in 2021, NOAA](#). In the context of the **IPCC WGI Report**, it is worth reminding oneself that the reduction of **CH₄** is one means of buying time: by reducing the rate at which the global carbon budget of **3,000 GtCO₂** is used the better (noting that at the end of 2019 **2,400 GtCO₂** of the global carbon budget had been used). Key points that arise from the excellent article in **The Washington Post** are (each point shared by an **NOAA** scientist and reported in the article):

1. Given that **CH₄** released to the atmosphere has up to 84 times the global warming potential of **CO₂**, but a relatively short life as a **GHG** (ceasing to have global warming potential after about 9 years according to the article), a reduction in the rate of emission of **CH₄** will allow a more effective response in the near term, relative to other **GHG** reduction initiatives;

2. Heavy rains arising from the **La Nina** weather patterns over the last two years may have flushed large quantities of **CH₄** from wetlands.

In addition to fugitive emissions from fossil fuel production and transportation, **CH₄** from landfills and livestock are "dominant drivers" behind the increased **CH₄** emissions monitored since 2006 / 07;

3. The "need for speed" should be motivating every climate scientist, every climate policymaker, every climate activist. Reducing and ceasing **CH₄** emissions represents the single biggest, fastest and cheapest way to reduce global warming in the near term.

Also reductions in **CH₄** emissions lower the cost "of climate mitigation and the cost adaptation, and lower reliance on learning how to remove carbon dioxide from the atmosphere" (see [Article 4](#) of the Paris Agreement, including as reported on in [Edition 38](#) of the Low Carbon Pulse and the [Anniversary Edition](#) of Low Carbon Pulse); and

4. "The effect of carbon dioxide emissions is cumulative. About 40 per cent of the Ford Model T emissions from 1911 are still in the atmosphere today".

Point 4 is sobering, and illustrates, succinctly, the criticality of the accelerated progress towards **NZE**.

- **By way of reminder:**

- **Edition 15** of Low Carbon Pulse reported that:

"Both President Xi Jinping and President Vladimir Putin made key statements at the Leaders' Summit. Each President re-affirmed key existing commitments: in the case of the **PRC**, achieving peak **GHG** emissions by 2030 and netzero **GHG** emissions by 2060, and to exercise strict control over coal-fired electrical energy generation, and in the case of Russia to reduce "significantly" its **GHG** emissions over the next three decades, noting that since 1990 Russia had reduced its **GHG** emissions by nearly 50%. Importantly, President Putin noted the need to reduce methane (**CH₄**): as noted in [Edition 14](#) of Low Carbon Pulse, there is increasing concern about **CH₄** levels in the atmosphere as a result of its global warming potential. It is hoped that there is increased concentration on this issue ahead of **COP-26**, in Glasgow, Scotland, in October / November, 2021. Also President Putin touched on the role of negative **GHG** emissions initiatives, and the potential for Russia to be a key player given its natural advantage of land mass".

- **Edition 24** of Low Carbon Pulse noted that the reduction in **CH₄** emissions is important because the global warming potential of **CH₄**, as a **GHG**, in terms of potency per tonne, is greater than carbon dioxide (**CO₂**): a molecule of **CH₄** has a half-life of 9 years, compared to **CO₂** with a half-life of 100 years. Over 20 years, **CH₄** traps up to 84 times as much heat energy as **CO₂**.

- **Edition 27** of Low Carbon Pulse reported that: "Increasing concern about increasing the concentration of **CH₄** resulted in the announcement on September 17, 2021, by the **EC** and US of the [Global Methane Pledge](#), given jointly, to reduce **CH₄** emissions by nearly a third within the next decade. At that time Low Carbon Pulse expressed: "The hope, [that] the objective of the **EC** and US now has to be to ensure, that as many countries as possible join with them in this critical initiative".

- **Editions 29** and **30** of Low Carbon Pulse reported on progress, as over 100 countries took the [Global Methane Pledge](#). In addition, **Edition 29** of Low Carbon Pulse reported on International Energy Agency (**IEA**) [Curtailling Methane Emissions from Fossil Fuel Operations](#) (**CCH4R**). The headline from the **CCH4R** was that the reduction in methane (**CH₄**) emissions is "among the most impactful ways to combat near-term climate change". The **CCH4R** noted that:

"Methane has contributed around 30% of the global rise in temperature to date ... Emissions from fossil fuel operations present a major opportunity [to limit global warming in the near term] since the pathways to reduction are both clear and cost-effective".

- **Edition 34** of Low Carbon Pulse noted that as at February 4, 2022, 103 countries had signed the Global Methane Pledge. **Edition 34** also noted that: "While many countries have signed the Pledge, work needs to be done to implement the Pledge, considerable work". As of **April 30, 2022**, 131 countries have signed the Pledge.

- **Edition 35** of Low Carbon Pulse reported that: "On **February 8, 2022**, [nature.com](#) reported on increasing levels of methane (**CH₄**) in the climate system (under [Scientists raise alarm over "dangerously fast" growth in atmospheric methane](#)). **CH₄** concentration exceeded 1,900 parts per billion during 2021 (see [NOAA 2022 Sea Level Rise Technical Report](#)).

- **Methane Reduction and Carbon Dioxide Removal (CDR)**: The author of Low Carbon Pulse notes that there is an ever increasing focus on the reduction in methane emissions to ensure that less methane enters the atmosphere (and is emitted from the bio-sphere) and the removal of carbon dioxide already in the atmosphere, and not to ascribe carbon credits to the carbon dioxide that has been removed from the atmosphere.

This increasing focus was present before the publication of the **IPCC WGIII Report**. The **IPCC WGIII Report** has brought into even sharper focus the need for **CH₄** reduction and **CDR**. This sharper focus is becoming ever more focussed.

While not the only initiative, the **McKinsey & Co** led [Frontier](#) initiative (announced on April 13, 2022) is illustrative of both the awareness of the need, and the means to addressing the need, for acceleration of **CDR**.

As announced, the Frontier initiative comprises an advance market commitment (**AMC**) of **USD 925 million** (over eight years) to accelerate **CDR** solutions and technologies. The purpose of **Alphabet**, **Shopify**, **Meta** and **Stripe**, working with each other and McKinsey & Co, is to support the expansion of the supply of **CDR** solutions and technologies, rather than increase competition for the supply that exists today.

For those wishing to read more on **CDR** across a range of initiatives, in February 2022, the excellent [euractiv.com](#) published a series of helpful articles framing thinking broadly across **CDR**. [Carbon removals](#); [Carbon removals: the secret to reaching net zero emissions](#); [Europe aims to scale up infrastructure for permanent carbon removals](#); [Finnish MEP: 2020s need to be 'decade of change' for Europe's depleting carbon sinks](#); [EU wants to reward farmers and foresters for nature-based carbon removals](#); [Researcher: Carbon removal technologies 'need to be upscaled quickly'](#).

Middle East including GCC Countries:

This section of Low Carbon Pulse considers news items within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the Gulf Cooperation Council (**GCC**) Countries, being countries that are leading the way in the development of Blue Hydrogen and Green Hydrogen capacity for own use and for export.

- **ENOWA HIDC:** On **April 1, 2022**, **ENOWA** [announced](#) that it had established the **Hydrogen Innovation and Development Center (HIDC)**. The **HIDC** is intended to contribute to the objective of the Kingdom of Saudi Arabia (**KSA**) to achieve energy carrier diversification, and as such allow the **KSA** to become a global clean energy leader.
By way of reminder: On **March 21, 2022**, **NEOM** launched **ENOWA** to lead the development and deployment of **NEOM's** world class sustainable energy and water systems, including [The Line](#), **OXAGON** (see **Editions 31** and **35** of Low Carbon Pulse) and [Trojena](#), and of course as a shareholder in the joint venture with Acwa Power and Air Products (**Neom Green Hydrogen**) to develop the Helios Green Hydrogen production project.
- **Oman considers Green Steel:** On **April 4, 2022**, the [Oman Daily Observer](#) reported that **Hydrogen Rise AG** (a renewable energy corporation, headquartered in Munich, Germany) had "embarked on a strategy to support the production of 'green steel' for the first time in the Sultanate of Oman". As reported, this involves plans "to trial the production of green steel at the Sohar Port complex of Jindal Shadeed Iron and Steel".
As might be expected, the trial will involve the use of Green Hydrogen as a high-heat temperature source so as to displace the use of fossil fuel in the production of iron and steel.
- **Oman progresses with the Oman Green Energy Hub (OGEH):** On **April 5, 2022**, it was announced that **Worley** had been appointed to undertake a concept feasibility study for the **OGEH**.
By way of reminder: **Edition 18** of Low Carbon Pulse reported that:
"On May 22, 2021, plans to develop a USD 30 billion, 25 GW, **Oman Green Energy Hub (OGEH)** were announced. The **OGEH** is to be located close to the Arabian Sea. The development of the **OGEH** is to be spear-headed by **InterContinental Energy**, in partnership with **OQ** (state owned Omani oil and gas company) and **EnerTech** (Kuwaiti based investor). The renewable electrical energy produced from on-shore photovoltaic solar and wind farms, will allow the production of 1.8 million metric tonnes per annum of Green Hydrogen and, as reported, 10 million metric tonnes a year of Green Ammonia.
Construction of **OGEH** is to be undertaken in phases, and is scheduled to commence in 2028, with completion of the final phase scheduled for 2038. On full development, the **OGEH** is to be powered by 25 GW of photovoltaic solar and wind.
InterContinental Energy is a name that will be familiar to those following the **Asian Renewable Energy Hub** being developed in the Pilbara Region of Western Australia (see **Edition 2** of Low Carbon Pulse) [and, latterly, the **Western Green Energy Hub** in Western Australia (see **Edition 22** of Low Carbon Pulse)]."
- **KSA National Hydrogen Strategy:** On **April 7, 2022**, it was reported that the **National Hydrogen Strategy** for **KSA** was being finalised, and that in the context of its finalisation it is likely that the **National Hydrogen Strategy** will target up to capital expenditure **USD 36 billion** by 2030 to develop hydrogen production capacity.
It is understood the **National Hydrogen Strategy** will focus on the key elements of the hydrogen value chain, including production and export of hydrogen, and on domestic use of clean hydrogen by the infrastructure and the transport sectors.
- **NEOM progress continues:**
 - **Helios Green Light:**
 - **Edition 37** of Low Carbon Pulse reported that: "On **March 17, 2022**, it was reported widely that the USD 5 billion Helios Green Hydrogen production project (part of the development of the Neom project) is to commence construction. The Helios project is to be powered by 4 GW of renewable electrical energy. It is expected that the Helios project will be producing Green Hydrogen by 2026. The Helios project is to deploy 120 electrolyzers supplied by thyssenkrupp AG. The commencement of construction is a landmark".
 - On **April 5, 2022**, [energy-utilities.com](#) reported (under [Acwa Power consortium signs \\$900m EPC contract for Neom hydrogen project](#)) that Neom Green Hydrogen had signed an EPC Contract with Air Products, under which Air Products Middle East Industrial Gases is to undertake work in the **KSA** and Air Products to undertake work beyond the borders of the **KSA**.
As well as being the EPC Contractor, Air Products is an equity 33.3% participant in **Neom Green Hydrogen**, with the other equity participants being Acwa Power and Neom Company (an **ENOWA** subsidiary) with 33.3% and 33.4% equity participation respectively.
 - On **April 8, 2022**, [al-Arabiya news](#) reported that **Snam** (Italian energy infrastructure operator) had contracted for the supply of equipment and plant in the context of the development of the Helios Project.
 - **Progress on Helios Industries' KIZAD project:** On **April 8, 2022**, [energy-utilities.com](#) reported (under [Studies completed for \\$1 bn Abu Dhabi green hydrogen and ammonia project](#)) that financial and technical feasibility studies had been completed for **Helios Industries** in respect of the Green Hydrogen and Green Ammonia project to be located in **Khalifa Industrial Zone Abu Dhabi (KIZAD)**.
By way of reminder: Previous editions of Low Carbon Pulse have reported on the progress of this world scale project as follows:
 - **Edition 18** reported that on May 25, 2021, the Khalifa Industrial Zone Abu Dhabi (**KIZAD**) announced the development of a Green Hydrogen facility by Helios Industries. The Green Hydrogen facility is to be developed in phases, and on full development will produce up to 40,000 tonnes of Green Hydrogen and 200,000 tonnes of Green Ammonia per year. It is understood that the Green Hydrogen facility is to be powered by a 800 MW photovoltaic solar farm within **KIZAD**. Head of Industrial Cities & Free Zone Cluster, Mr Abdullah Al Hameli, said that: "**Abu Dhabi Ports is proud to be the host of an innovative company like Helios Industries, and one of the region's first green ammonia plants with zero-carbon emissions**".

- **Edition 25** recounted the announcement of the development of a Green Hydrogen and Green Ammonia facility by Helios Industries within the Khalifa Industrial Zone Abu Dhabi (**KIZAD**), adding that on August 16, 2021, it was reported that Helios Industries had contracted with thyssenkrupp to undertake a technical study in respect of an initial production of 20,000 tonnes per annum (**tpa**) of Green Hydrogen, with production to develop overtime to 200,000 **tpa**."

As was apparent from another piece in **Edition 25** of Low Carbon Pulse (**German flagship projects – progress check**) thyssenkrupp was the ideal organisation to undertake this work: thyssenkrupp is coordinating one of the three flagship projects critical to the development of the hydrogen economy in Germany - **H2Giga**: involving the development of large-scale use of electrolyzers using renewable electrical energy to produce Green Hydrogen.

- **OPWP proceeds with W-to-E**: On **April 8, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Oman Power & Water Procurement Company (OPWP)** was seeking to appoint a technical adviser to advise on the development of the **USD 1 billion waste-to-energy facility** to be located in **Barka, Oman**. The waste-to-energy facility will have between 130 and 150 MW of electrical energy generating capacity. **OPWP** has recently signed a memorandum of understanding (**MOU**) with the **Oman Environmental Service Holding Company (be'ah)**. Plans for the waste-to-energy facility were put on hold in 2020 in response to the impact of the C-19 pandemic.
- **Maldives W-to-E**: On **April 7, 2022**, there was news about the **waste-to-energy** project in the Maldives. While the Maldives is not within the Middle East, it is developing a waste-to-energy facility, with **Urbaser** (Spanish head-quartered waste management corporation) using a Design Build Operate contract delivery model. The Maldives **Ministry of Environment**, with funding support provided by the **Asian Development Bank (ADB)** and the **Japan Fund** for the **Joint Development Mechanism**, is working with **Urbaser**. The waste-to energy facility will be located on reclaimed-land on the island of **Thilafushi, Maldives**.
- **Masdar (Abu Dhabi Future Energy Company) Kyrgyz Government MOU**: On **April 15, 2022**, **Masdar** (one of the world's leading renewable energy corporations) announced that it had signed a memorandum of understanding (**MOU**) with the **Kyrgyzstan Government** to work together to develop up to **1 GW** of renewable electrical energy projects, as planned, hydroelectric and photovoltaic solar.
The **MOU** was signed in Bishkek by His Excellency Bekmurzaev Doskul Djumagulovich, Minister of Energy of the Kyrgyz Republic and Mr Abdulla Zayed, Head of Development and Investment, Central Asia and Russia, for Masdar.
- **Technology transfer**: On **April 18, 2022**, [English.aawsat.com](https://www.english.aawsat.com) reported that **Mitsubishi** intends to launch a "number of understandings" with the **KSA** to help transfer knowledge and technologies in a number of sectors, including agriculture and energy.
- **Photovoltaic solar on the near horizon**: On **April 19, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Acwa Power (KSA utility corporation)** is developing plans for two photovoltaic solar projects, **Rabigh (300 MW)** and **Al Shuaiba (2 GW)**, having a projected combined installed capacity of **2.3 GW**. The projects are being developed under the second round of the renewable energy program of **Public Investment Fund**, with those plans to be submitted during May 2022. **Edition 40** of Low Carbon Pulse will cover progress.

By way of reminder: Edition 14 of Low Carbon Pulse reported on the Round 2 of the National Renewable Energy Program (**NREP**) as follows: "At the inauguration for the Sakaka IPP on April 8, 2021, Crown Prince Mohammad bin Salman bin Abdulaziz announced the results of the tenders for seven large-scale solar capacity projects under the **NREP**. The seven new projects are to be located in Jeddah, Madinah, Quarayyat, Rafha, **Rebigh, Al Shuaiba** and Sudair.

The 600 MW Al Shuaiba photovoltaic solar project was awarded on the basis of a world record low bid price for electrical energy of USD 0.0104 kWh (a little over 1 cent per kWh, or USD 10.40 per MWh). The Sudair photovoltaic solar project was awarded with the second lowest bid price of USD 0.01239 (1.239 cents per kWh or USD 12.39 MWh). On development, the Sudair photovoltaic solar project will be **KSA's** largest solar project, comprising around 1.5 GW of installed capacity. Approximately 3.6 GW of energy was contracted under Rounds 1 and 2 of the **NREP**.

On October 18, 2021, it was reported widely that **KAS's Renewable Energy Project Development Office (Repdo)** had shortlisted bidders for Round 3 of the **NREP**, with 1.2 GW to be contracted under Round 3. There are two categories of project in Round 3, Category A and Category B.

Category A projects are the 120 MW Wadi al-Dawasir PV IPP (**WADIPP**) and the 80 MW Layla PV IPP (**LIPP**). It is understood that TotalEnergies and Tamasuk Holding Company and the Acwa Power Consortium (comprising Acwa Power, SPIC (Huanghe Hydropower Development Company) and WEHC (Water and Electric Holding Company)) ranked first and second on **WADIPP** and Acwa Power Consortium and Alfanar ranked first and second on the **LIPP**.

Category B projects are the 700 MW Al-Rass PV IPP (**ARIPP**) and the 300 MW Saad PV IPP (**SIPP**). It is understood that the Acwa Power Consortium and Jinko Power ranked first and second on the **ARIPP** and that Jinko and Masdar ranked first and second on the **SIPP**.

As noted above, the Round 2 of the **NREP** resulted in a world record low bid price. Round 3 of the **NREP** has not resulted in new low bid prices, but the pricing is nevertheless at a level that continues the narrative about low photovoltaic solar costs. It is reported that the levelized cost of electricity (**LCOE**) bids have tariffs at the following: **WADIPP** US cents 1.9 kWh, **LIPP** US cents 3 kWh, **ARIPP** US cents 1.5 kWh and **SIPP** US cents 1.5 kWh".

- **Green Ammonia Certification**: On **April 20, 2022**, [hydrogen-central.com](https://www.hydrogen-central.com) reported that **TÜV Rheinland** (a global leading technical service provider) had **announced** the issue of the **First Green Hydrogen and Green Certificate Globally to Green Hydrogen & Chemicals SPC** for the production of Green Hydrogen and Green Ammonia from the project being developed by **ACME Group** and **Scatec ASA**. To all intents and purposes, **TÜV Rheinland** provides a green light to the effect that the proposed greenfield project will produce a Product Carbon Footprint of less than or equal to zero along with the planned production capacity of 1.2 million tonnes of ammonia in Oman.

The issue of the **Green Hydrogen and Green Ammonia Certificate (TÜV Rheinland Standard H2.21 Carbon-Neutral Hydrogen)** **TÜV Rheinland** provides evidence confirming that the ammonia and hydrogen produced at the photovoltaic solar powered Hydrogen-Ammonia plant will be from renewable sources, and will have lower levels of **GHG** emission than grey hydrogen.

By way of a reminder: Edition [37](#) of Low Carbon Pulse noted that on March 7, 2022, it was reported widely that Acme Group (Indian renewable energy company) and Scatec (Norway based renewable power producer) are to develop an ammonia production facility in Oman. The ammonia production facility is world scale, with nameplate ammonia production capacity of 1.2 million metric tonnes a year on completion of planned development and deployment.

- **Landfills to be mined:** On **April 20, 2022**, rechargenews.com reported that New York based **H₂-Industries** had signed a memorandum of understanding with the **Oman Public Establishment for Industrial Estates (Madayn)** which contemplates the development of a **USD 1.4 billion waste-to-hydrogen** production facility in **Oman**.

As reported, the feedstock for the production of hydrogen will be "mined from existing landfills" (the **urban-ore-body**). The waste-to-hydrogen production facility would be powered by **300 MW** of photovoltaic solar and **70 MW** of **BESS**.

At this stage, it is reported that rights to mine for feedstock have yet to be obtained by **H₂-Industries**. The counterparty to any right to mine contract is understood to be **Oman Environmental Service Holding Company (be'ah)**.

The production of hydrogen from waste has been reported on in a number of editions of Low Carbon Pulse, a [Hydrogen for Industry](#) publication, is considered below (at [Air Liquide safe bet in Las Vegas](#) and [Seoul Sludge to Hydrogen](#)) and is considered in detail in an article entitled **Future Fuels** to be published in mid-May 2022 (the primary author of which is the author of Low Carbon Pulse).

Africa:

*This section considers news items within the news cycle of this **Edition 39** of Low Carbon Pulse relating to Africa. Africa remains the continent with the most developing countries, the most **Least Developed Countries** and the most countries vulnerable to climate change, and the continent with some of the lowest levels of electrification.*

- **Sovereign Wealth Funds align:** On **April 4, 2022**, energy-utilities.com, reported that The Egyptian **Sovereign Fund of Egypt** and the Norwegian **Government Pension Fund Global** had signed a framework agreement, to which **Scatec** (leading Norwegian renewable electrical energy corporation) is also a party, under which the parties will target the development of green projects in **nine African countries - Burundi, the Democratic Republic of Congo, Djibouti, Ghana, Rwanda, Sierra Leone, South Sudan, Tanzania, and Uganda** (seven of the 46 least developed countries in the World: see [Editions 32](#) and [33](#) of Low Carbon Pulse). The framework agreement continues the marked increase in activity that the author is observing across Africa.

- **Eni and Government of Rwanda:** On **April 8, 2022**, **Eni** [announced](#) that it had signed a memorandum of understanding (**MOU**) with the **Government of Rwanda** under which **Eni** and the **Government of Rwanda** are to work together to identify opportunities to develop and to implement initiatives to promote the circular economy and to decarbonise value chains. Under the **MOU**, **Eni** and the **Government of Rwanda** will focus on the collection of used cooking oils and waste oils, waste management recycling and valorisation, with the particular fields of interest being AFOLU and bio-feedstock derivation, including for use to produce bio-fuels. This is in addition to reduction of **CO₂** in the wood-fuel value chain and the derivation of carbon credits as a result of the planned initiatives.

By way of reminder: Edition [37](#) of Low Carbon Pulse (under **Eni water PPPs**) reported that: "On **March 23, 2022**, eni.com announced that its subsidiary corporations, **Nigerian Agip Exploration** and **Agip Energy and Natural Resources**, and the **Food and Agriculture Organisation** of the UN (**FAO**), had commissioned 11 water schemes in the Borno and Yobe States, North East Nigeria. Each water scheme is integrated: comprising sourcing raw water from boreholes, use of electrical energy sourced from photovoltaic solar panels to pump water and to power water treatment facilities, providing water for domestic use and drinking, and for micro-irrigation purposes".

- **Namibia and Germany Joint Communique of intent:** On **April 18, 2022**, it was announced that the Director General of the Namibia's **National Planning Commission**, **Obeth M. Kandjoze**, and the **German Federal Minister for Education and Research**, **Anja Karlicek**, agreed to establish a **partnership** between **Namibia** and **Germany**, and signed a Joint Communique of Intent (**JoI**). The **JoI** marks continued progress of Namibia as a major producer and exporter of Green Hydrogen.

The **JoI** notes:

"Germany will provide up to €40 million in funding from the economic stimulus package for solar power [harbouring great potential in Namibia] thanks to over 3,500 hours of sunshine per year .. We therefore think that one kg of H₂ from Namibia will cost between €1.50 and €2.00."

By way of reminder:

- **Edition 26** of Low Carbon Pulse reported (under **Green Hydrogen from Namibia**) that: "Germany was to partner with Namibia to allow the production and export of Green Hydrogen from Namibia and transportation and import into Germany at a price of USD 1.8 per kg. Namibia has world class renewable energy resources, with over 3,500 hours of sun each year, and strong wind resources. These world class resources are considered close to ideal for the production of Green Hydrogen at a price of between €1.50-2 per kg. Further it is estimated that up to 1.7 million metric tonnes per annum of Green Hydrogen could be produced by 2030. This mass of Green Hydrogen production delivered into Germany would be close to sufficient to decarbonise the German iron and steel industry given its current rate of production".

- **Edition 30** recounted (under **Namibia perfectly placed**) the consideration of the development of a Green Hydrogen project in Namibia, and reported that: "Hyphen Hydrogen Energy had been selected by the Government of Namibia to develop a large-scale Green Hydrogen project (**NH₂ Project**).

The **NH₂ Project**, to be located in the Tsau / Khaeb national park, was to produce 300,000 metric tonnes of Green Hydrogen a year. It is reported that the renewable electrical energy for the **NH₂ Project** will comprise 2 GW mixed photovoltaic solar and wind, and **BESS**, with a total capital cost of USD 4.4 billion.

The location in the Tsau / Khaeb national park is a function of: "The Tsau / Khaeb national park [being] among the top 5 locations in the world for low-cost hydrogen production, benefiting from a combination of co-located onshore wind and solar resources near the sea and land export routes to market".

The **NH2 Project** will be capable of expansion to 5 GW of renewable electrical energy and 3 GW of electrolyser capacity, with a total capital cost of USD 9.4 billion on expansion.

- **Edition 30** of Low Carbon Pulse (under **Ports connecting the dots**) reported that on November 13, 2021: "the Namibian Ports Authority (**NPA**) had signed a memorandum of understanding (**MOU**) with the Port of Rotterdam Authority (**PORA**). The **MOU** contemplates that Namport, Namibia, will become the key export port of Green Hydrogen and Green Hydrogen-based fuels produced by the **NH2 Project**. Under the **MOU**, **NPA** and **PORA** will work together to connect Namibia with the Port of Rotterdam, and as such, provide a gateway to access European buyers of Green Hydrogen and Green Hydrogen based-fuels. The development of port capacity is key in the context of any Green Hydrogen Hub".
- **Edition 34** of Low Carbon Pulse (under **Botswana-Namibia 5 GW Green Hydrogen project**) recounted the reporting from **Edition 26** of Low Carbon Pulse, reporting further that: "plans for a Green Hydrogen Project in Botswana and Namibia had expanded from 1 GW to 5 GW to be powered by photovoltaic solar electrical energy".
- **Egyptian Future Fuel Hubhub:**
 - **AMEA Power to produce Green Ammonia in Egypt for export:** On **April 22, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **AMEA Power** had signed a memorandum of understanding (**MOU**) to produce Green Ammonia for export from **Ain Sokhna Industrial Zone**, Egypt. The **MOU** was signed with the **General Authority for Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**. As reported, the **Green Hydrogen** and **Green Ammonia** production facility will produce **390,000 metric tonnes of Green Ammonia a year**.
 - **EDF Renewables and Zero Waste team-up in Egypt:** On **April 22, 2022**, [arabnews.com](https://www.arabnews.com) reported that **EDF Renewables** and **Zero Waste** had signed a memorandum of understanding to develop a carbon-free fuel production project working with the **Ministry of Electricity**, the **General Authority for Suez Canal Economic Zone** and The **Sovereign Fund of Egypt**. The project is to be located within **Suez Canal Economic Zone**.
 - **Hassan Allam Utilities and Masdar agree to develop Green Hydrogen production facility:** On **April 25, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Hassan Allam Utilities** and **Masdar** had signed two memorandums of understanding (**MOUs**) to produce Green Ammonia for export from the **Ain Sokhna Industrial Zone**, Egypt. The **MOUs** were signed with the **Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**. As reported, the Green Hydrogen production facilities will be developed to produce up to **100,000 metric tonnes of e-methanol a year by 2026** (being methanol using renewable electrical energy in respect of all power required for the purposes of producing the methanol). It is reported that overtime the electrolyser capacity will increase to **4 GW** to allow increased production of e-methanol.

As will be apparent from the following reminder, the **Ain Sokhna Industrial Zone** is going to be home to considerable **Green Hydrogen, Green Ammonia** and **Green Methanol** production capacity.

- **By way of reminder Edition 36 of Low Carbon Pulse reported that:**

- On **March 10, 2022**, it was reported widely that **Scatec** (leading Norwegian renewable electrical energy corporation) had signed a memorandum of understanding (**MOU**) with the **Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**.

It is understood that the **MOU** provides for the development jointly of a **1 million metric tonnes per annum Green Ammonia** production facility (with potential to expand to 3 million metric tonnes annually).

The Green Hydrogen and Green Ammonia production facility is to be sited in the **Ain Sokhna Industrial Zone** (itself located within the **Suez Canal Economic Zone**). The **New and Renewable Energy Authority** will allocate land proximate to the production facility to allow renewable electrical energy capacity to be installed to generate power for the production facility.

- On **March 28, 2022**, it was reported widely that **A.P. Moller – Maersk** had entered into a memorandum of understanding (**MOU**) signed by Prime Minister of Egypt, [Mr. Mostafa Madbouly](https://www.mostafamadbouly.com), under which **A.P. Moller – Maersk** will work with the **Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority** to develop green energy and green fuel production capacity.

India and Indonesia:

*This section considers news items within the news cycle of **Edition 39** of Low Carbon Pulse relating to India and Indonesia, two countries with increasing populations and urbanisation, attendant increased levels of electrification, and being the countries with the third and seventh most **GHG** emissions.*

- **Indonesia to supply Britishvolt giga-factory:** On **March 29, 2022**, it was [announced](https://www.britishvolt.com) by **Britishvolt** (see **Edition 33** of Low Carbon Pulse) that it had signed a memorandum of understanding with **VKTR** (a new division of Bakrie Autoparts, and as such part of Bakrie Brothers Group) to partner to develop a lower to low carbon supply chain for nickel sulphate from Indonesia to supply Britishvolt's Blyth giga-factory (in Northumberland, the north east of England) to manufacture electric vehicle batteries.
- **JSW Energy to develop hydro-electric pumped storage plant:** On **April 4, 2022**, [energy-storage](https://www.energy-storage.com) reported that **JSW Energy** (part of the Indian conglomerate, **JSW**, noting that **JSW Steel** is mentioned in **Edition 36** of Low Carbon Pulse) had signed a memorandum of understanding (**MOU**) with the **Government of Chhattisgarh** (a land-locked state in central east India) to develop a **1 GW hydro-electric pumped storage plant** – the **Hasdev Bango Pumped Storage Project (PSP)**. The integration of the **PSP**, with photovoltaic solar and wind renewable energy capacity, will allow **JSW Energy** to "provide firm dispatchable renewable power" 24/7.

The **MOU** with the **Government of Chhattisgarh** is clearly part of a well-developed strategy of **JSW Energy: JSW Energy** is developing a **1.5 GW PSP** in **Maharashtra**, and a **1 GW PSP** in **Rajasthan**. **JSW Energy** has expressed the view that India has the potential to develop **90 GW** of **PSP**.

- **Indonesia defers the introduction of carbon tax:** On **April 4, 2022**, it was reported widely that the **Government of Indonesia** was to defer the introduction of its carbon tax from April 2022 until July 2022 (The announcement having been made on the weekend of April 2 and 3, 2022.) Head of Fiscal Policy Agency, Ministry of Finance, **Mr Febrio Kacaribu** said:

"The [pressure on prices arising from the conflict in Ukraine] puts pressure on inflation in many countries in the world, including Indonesia. With these developments, the government is ensuring the availability and stabilization of energy and food prices in the country, including providing various forms of social protection to protect the poor and vulnerable from the impact of price increases".

At the same time as announcing deferment, **Mr Kacaribu** said that the Government of Indonesia is continuing to hone laws and regulations to implement the carbon tax, and to monitor when the economy is ready for the carbon tax, critically, the electrical energy sector. **Mr Kacaribu** noted: *"This readiness is important as the core of objective of implementing a carbon tax is to have the optimal impact"*.

The **Ministry of Finance** continues to hone regulations aimed at levelling the carbon tax, and as such the level of tariff or tariffs under the carbon tax. In addition to continuing to hone the carbon tax, work is being done to place the role and impact of the carbon tax within a carbon tax roadmap. The carbon tax roadmap will be framed by reference to intermediate and ultimate objectives (including achievement of Indonesia's nationally determined contribution and **NZE**) and key milestones. The key milestones will include decarbonisation of priority sectors, with **GHG** emission reduction targets for them, and alignment with new and renewable electrical energy development and deployment.

- **NTPC active in Green Hydrogen production and procurement:**

- **NTPC and Gujarat Gas Ltd to blend** On **April 5, 2022**, it was reported widely that **NTPC** (state owned integrated power utility) and **Gujarat Gas Limited** had agreed to blend Green Hydrogen with natural gas. While the scale of the project may not grab the headlines (Green Hydrogen produced from an electrolyser powered by the 1 MW NTPC Kawas floating photovoltaic solar project), the project is a first for India, and is significant because it will pave the way for blending of natural gas and hydrogen gas in future.

- **NTPC Renewable Energy Ltd (NREL) to electrolyse:** On **April 26, 2022**, it was reported widely that **NREL** is seeking to work with electrolyser technology corporations and developers to procure up to **1 GW** of electrolyser capacity on a turnkey basis. **NREL** has indicated that it intends for tender for **400 MW** of PEM electrolysers and **600 MW** of electrolysers using other electrolyser technologies.

- **Mitsui & Co. invests big, and early:** On **April 7, 2022**, it was reported widely that **Mitsui & Co.** (leading Japanese trading house) had invested in **ReNew** (a leading renewable energy corporation headquartered in India). While Low Carbon Pulse rarely reports on investments and acquisitions, this investment is significant, and is aligned with the plans of **JSW Energy** to develop **PSPs** detailed above.

ReNew has a power purchase agreement with **Solar Energy Corporation of India (SECI**, a state-owned corporation) to supply **400 MW** of renewable electrical energy from photovoltaic solar and wind installations across **Karnataka, Maharashtra, and Rajasthan**, and from an accompanying **BESS** (the **RTC Project**). The **RTC Project** is reported to have a capital cost of **USD 1.2 billion**, and will provide renewable electrical energy capacity 24/7.

- **PT Pertamina and Indonesian investments plans:** On **March 25, 2022**, energyvoice.com reported that **PT Pertamina** plans to invest up to **USD 11 billion** on renewable energy projects over the period 2022 to 2026 so as to continue making progress in energy transition, in particular to allow it to install **10 GW** of clean energy generation capacity by 2026 (**6 GW** from gas-to-power, **3 GW** from renewable energy sources, and **1 GW** from other initiatives). On **April 4, 2022**, [energy voice.com](http://energyvoice.com) reported that, more broadly, Indonesia would require **USD 25.2 billion** to develop Green Hydrogen from 2031 to 2060. This is in addition to the **USD 11 billion** identified as being required to be invested by **PT Pertamina** from 2022 to 2026.

As reported, the Indonesian Government estimates that it will cost **USD 1.043 trillion (USD 1,043 billion)** to develop and deploy renewable electrical energy capacity to achieve its goal of **NZE** by 2060.

- **PLN considering importing electrical energy from BEVs:** As noted in previous editions of Low Carbon Pulse, in Europe electrical energy corporations and municipalities are importing electrical energy stored in **battery electric vehicles (BEVs)** onto their distribution networks overnight to optimise electrical energy storage within urban areas. Effectively, electrical energy stored in **BEVs** is being drawn upon to provide a multiple battery **BESS**.

During the first part of **April 2022**, it was reported widely that **PT PLN** (state-owned electrical energy corporation) is offering a 30% discount to owners of **BEVs** who charge their **BEVs** from 10 pm to 5 am.

The contrasting approaches reflect the different levels of transition from fossil-fuel electrical energy generation (base load) and renewable electrical energy generation (variable load).

- **O2 Power and Powin Energy aligned:** On **April 8, 2022**, energy-storage.news reported that **O2 Power** (renewables corporation, backed by Singapore's **Temasek** and Sweden's **EQT** (a global private equity firm) and **Powin Energy** (an energy storage solutions company) are to work together to advance the development and deployment of **BESS** across India.

- **PT Pertamina and Mitsui & Co:** On **April 8, 2022**, it was reported widely that **PT Pertamina** (national energy corporation) and **Mitsui & Co** (leading trading house) were to undertake jointly a study in respect of **CCUS**, critically, the pathways to the commercialisation of CCUS projects in Indonesia.

By way of reminder: Edition 36 of Low Carbon Pulse reported as follows: **"Indonesia to develop Green Hydrogen & Ammonia and CCUS:** On March 4, 2022, hydrogen-central.com reported that First Deputy Minister of State-Owned Enterprises, Mr Pahala Mughraha Mansury stated: "We have developed the ammonia and biomass co-firing as well as the utilisation of carbon capture technology to reduce the usage of coal at [coal-fired] power plants".

For these purposes, it was reported that on March 2, 2022, PT Pupuk Indonesia (state-owned fertiliser corporation), PT Pertamina (state-owned national energy corporation) and Mitsubishi Corporation had signed a cooperation agreement to progress the development of Green Hydrogen and Ammonia production capacity".

- **Solar Energy Corporation of India (SECI) continuing to procure:** On April 14, 2022, [energy-storage](#) reported that **SECI** had issued a **Request for Selection** document to procure **500MW / 1,000 MWh** of **BESS**. It is reported that this is expected to be the first stage of a procurement program that will procure up to **4,000 MWh** of **BESS**.
- **CATL to invest USD 6 billion in battery chain:** On April 15, 2022, [electrek](#) reported that **CATL** (leading electrical vehicle battery manufacturer, **CATL** being short form for **Contemporary Amperex Technology Co Ltd**), through a subsidiary, is to take a majority stake in five of six battery projects to be developed with **PT Aneka Tambang (ANTAM)**, being a state-owned mining corporation) and **PT Industri Baterai Indonesia (IBI)**, being a state-owned corporation dedicated to invest in battery manufacture other state-owned corporations). It is reported that the projects will include nickel mining and processing, battery materials production and manufacturing, and battery recycling.
- **Plans to supply 8% of Singapore load:** On April 19, 2022, it was reported widely that **Quantum Power** (an independent power producer based in Singapore) and **Ib Vogt** (a German solar power plant developer), through a joint venture, **Anatara**, have plans to develop renewable energy facilities within the **Riau Islands Province, Indonesia**, to supply renewable electrical energy to the Republic of Singapore, using a subsea cable. The planned development is world scale: **USD 5 billion** to develop and to deploy **3.5 GW** of photovoltaic capacity and **12 GWh** of **BESS**.
- **PLN Sub and IHI co-venture on co-firing:** On April 25, 2022, it was reported widely that **Pembangkitan Jawa-Bali (PJB)**, a subsidiary of **PLN**) and **IHI Corporation** (a Japanese engineering corporation) are to work together to develop ammonia-co-firing technology to allow co-firing of natural gas and ammonia at the **PJB gas-fired power plants** at **Gresik**, east Java, Indonesia.
By way of reminder: Edition 18 of Low Carbon Pulse reported that IHI and JERA had announced notice of acceptance of their joint grant application to undertake a demonstration project to co-fire ammonia in the generation of thermal power. It was understood that the co-firing project would commence in June 2021 (in fact it commenced later), continuing to March 2025, the plan was to commence co-firing at JERA's Unit 5, Hekinan Thermal Power Station from August to December 2021. With the rate of co-firing to increase over time, so that by 2024, co-firing will be taking place at a rate of 20% Green Ammonia, 80% coal, at Unit 4, Hekinan Thermal Power Station.
As is a recurring theme reflected in Low Carbon Pulse, this is another world first for Japan - the first large scale ammonia and thermal coal co-firing project. The co-firing project is consistent with the policy settings in Japan.
(The grant was approved under the New Energy and Industrial Technology Development Organization's "Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation / Research, Development and Demonstration of Technologies for Ammonia Co-Firing Thermal Power Generation" program: an approval process likely shorter than the name of the program under which it was granted!)"
- **Figures firming higher:** On April 27, 2022, it was reported widely that the **Ministry of Trade and Industry**, Japan had presented an estimate of the cost to the Japanese material industry of progressing to achieve **NZE** by 2050: ¥24 trillion (USD 187 billion) at the **Industrial Structure Council**, the advisory council of the Ministry. As reported, it is expected that the estimate will firm higher over time.
- **POME feedstock for clean gas:** On April 27, 2022, it was reported widely that **PT Pertamina, Inpex Corporation, JGC Holdings Corporation** and **Osaka Gas Co., Ltd** had signed a study agreement under which they agreed to work together to assess the commercial and technical feasibility of producing clean natural gas from palm oil mill effluent (**POME**). **Biogas** and **biomethane** and **bio-LNG** can be derived or produced from **POME**.

Japan and Republic of Korea (ROK):

*This section considers news items within the news cycle of this **Edition 39** Low Carbon Pulse relating to Japan and ROK, being the countries with the fifth and tenth most **GHG** emissions, and the greatest dependence on imported energy carriers.*

- **Hyundai Mobis invests USD 1.1 billion in FCE plants:** On April 1, 2022, it was reported widely that **Hyundai Mobis** is to develop two new fuel cell manufacturing plants, one close to **Seoul**, and the other in **Ulsan**. The two new plants will commence manufacture in Q2 of 2023 and will have capacity to manufacture up to 100,000 fuel cells a year. The fuel cells manufactured are intended for use in vehicles used in the construction and logistics mobility sectors.
- **SK to invest USD 2.5 billion in PRC plants:** During the first week of **April, 2022** it was reported widely (also having been reported at the end of March) that **SK (ROK conglomerate, and leader in energy transition technology)** is to develop a new battery factory in the **PRC** to manufacture batteries for EVs.
- **KOGAS MOU with Sempra Infrastructure:** On **April 4, 2022**, it was reported widely that **KOGAS** (the owner and operator of **ROK's** gas transmission and distribution system, and the largest single buyer of liquefied natural gas (**LNG**) in the world) and **Sempra Infrastructure** (leading North American energy infrastructure company) had signed a memorandum of understanding (**MOU**) to consider how they may work together to transition to lower-carbon and to zero-carbon fuels.
It is understood that the **MOU** contemplates that **KOGAS** and **Sempra Infrastructure** may develop projects jointly around the world, including, **LNG** projects, CCS projects and hydrogen infrastructure projects, as well as the off-take of lower-carbon and zero-carbon fuels from those projects.
- **Bloom Energy SOE deployed in ROK:** On **April 6, 2022**, it was reported widely that **Bloom Energy** has deployed its high-temperature solid oxide electrolyser in **Gumi, ROK**. (See **Editions 2, 4, 22** and **29** of Low Carbon Pulse for previous coverage of Bloom in **ROK**, and see **Edition 37** for a description of the principal electrolyser technologies.)

PRC and Russia:

*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the **PRC** and **Russia**, being countries that give rise to the most and the fourth most **GHG** emissions.*

- **PRC Hydrogen Plan:**

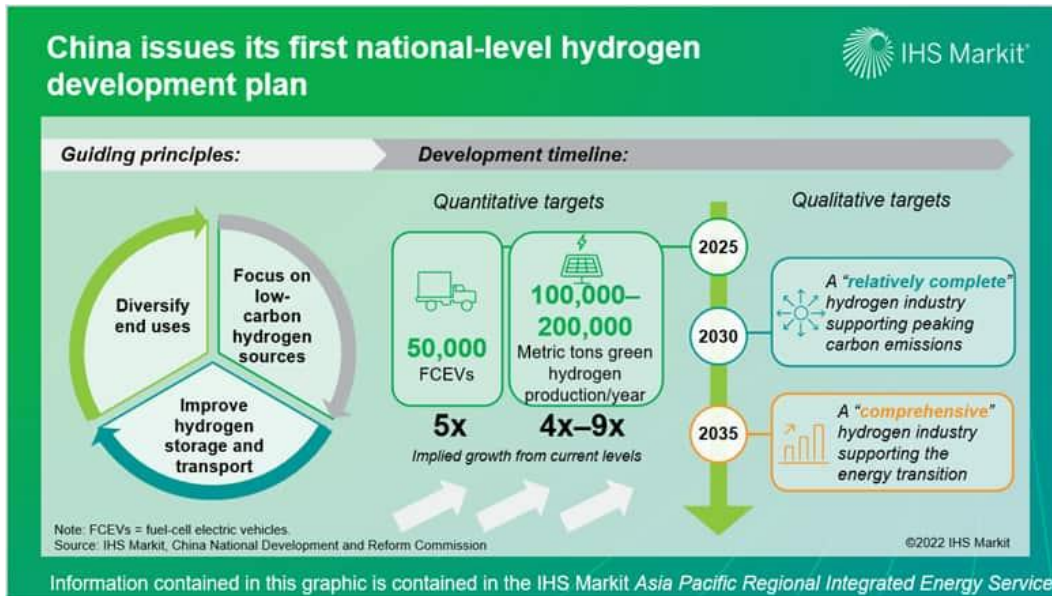
- **In words:** **Edition 37** of Low Carbon Pulse reported on: "the plans of the **PRC** for the development of hydrogen production capacity with the National Development and Reform Commission (**NDRC**) and the National Energy Administration (**NEA**) providing a roadmap to 2025, 2030 and to 2035.

In the near term, the plan is to develop hydrogen production capacity so as to produce 200,000 metric tonnes of clean hydrogen by 2025. This sits well inside the aspirations of Sinopec to have developed 500,000 metric tonnes of Green Hydrogen production capacity by 2025.

In the medium term (by 2030), the plan is to have developed a hydrogen production industry configured to produce clean hydrogen using integrated hydrogen technologies so as to maximise the reduction in **GHG** emissions arising from production, transportation, storage and use of hydrogen. In the near to medium term, the focus appears to be the decarbonisation of the mobility industry.

In the medium to longer term (by 2035), the plan is to have developed hydrogen production capacity so as to support the decarbonisation of the difficult to decarbonise industries".

- **In pictures:** On **April 4, 2022**, the good folk at **IHS Markit** (now part of S&P Global) published the following infographic providing a visual summary of the plans of the **PRC**.



- **A reminder of PRC plans:**

On **March 5, 2022**: [Reuters](#) reported that the **PRC** had firmed-up plans to develop and to deploy 450 GW of new photovoltaic solar and wind capacity in the Gobi Desert, and other desert regions: Director of **NDRC**, Mr He Lifeng said:

"China is going to build the biggest scale of solar and wind power generation capacity on the Gobi desert in history, at 450 GW".

While the development and deployment of photovoltaic solar and wind power in the Gobi Desert has been flagged (for example, see **Edition 21** of Low Carbon Pulse) for some time, the confirmation from **NDRC** at the National People's Congress can be viewed as a firm policy setting. It is understood that the construction of 100 GW of photovoltaic solar capacity is already underway in the Gobi Desert.

As noted in previous editions of Low Carbon Pulse, the renewable electrical energy generated in the Gobi Desert, and other desert regions, will be transmitted to the load for that electrical energy using ultra-high voltage direct current transmission systems.

During the week beginning **February 28, 2022**, it was reported widely that the **PRC** plans to develop and to deploy hydrogen refuelling infrastructure at 2,000 sites across China, and for 1 million FCEV in China, by 2035.

- **Coal-fired power cancellations:** On **April 24, 2022**, [powermag.com](#) reported that the decision of the **PRC** not to finance overseas coal-fired projects had resulted in the cancellation of 15 coal-fired power plants.

The report is based on research from the **Centre for Research on Energy and Clean Air (CREA)** [released](#) on **April 22, 2022**.

Europe and UK:

This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to countries within the European Union (EU) and the EU itself (as an economic bloc) and the UK given geographical proximity, and similar policy settings and progress towards NZE. In combination, countries comprising the EU give rise to the most GHG emissions after the Peoples Republic of China (PRC) and the US. The UK is a top-twenty GHG emitter, but has been a front-runner in progress towards NZE.

- **No fool's day:** On **April 1, 2022**, seven projects were granted funding support by the **Climate, Infrastructure and Environment Executive Agency (CINEA)**, with aggregate funding support of **€1.1 billion**. Please see the following announcement for full details (<https://www.eeas.europa.eu/>). The funding support was awarded from the **EU Innovation Fund**, funded by revenues from the **EU ETS**.

While some projects are detailed elsewhere in this **Edition 39** of Low Carbon Pulse they are listed here for convenience:

- **The BECCS project:** Located in **Stockholm, Sweden**, this project is the first full-scale Bio-Energy Carbon Capture and Storage (**BECCS**) project, capturing **CO₂** and heat from an existing biomass project.
 - **The Ecoplanta project:** Located in **El Morell, Spain**, this first-of-a-kind processing and production plant processes waste (that would otherwise be landfilled), and produces methanol from that waste.
 - **The Hybrit project:** Located in **Gällivare and Oxelösund, Sweden**, this Hydrogen Breakthrough Ironmaking Technology Demonstration (**Hybrit**) project will produce fossil-fuel free iron and steel.
 - **The Kairos@C project:** Located in the **Port of Antwerp**, this project is the first and largest cross-border carbon capture and storage value chain to capture, liquefy, ship, and store permanently **CO₂**.
 - **The K6 project:** Located in **Lumbres, France**, this first-of-a-kind project uses an industrial scale-combination of airtight kiln and cryogenic carbon capture technology, with captured **CO₂** to be stored in the North Sea.
 - **The SHARC project:** Located at the **Porvoo refinery, Finland**, the **Sustainable Hydrogen and Recovery of Carbon (SHARC)** project will reduce **GHG** emissions on transition from use of fossil fuels to renewable hydrogen production.
 - **The Tango project:** Located in **Catania, Italy**, this project involves the development of industrial-scale production capacity to manufacture high-performance photovoltaic solar modules.
- **EC considering higher renewable energy target:** During **April 2022** there were a number of news items, and from the author's perspective, a number of conversations with folk in Europe, suggesting that the **EC** was assessing whether the **EU** may be able to achieve a higher renewable electrical energy target (45% by 2030), than that currently contemplated (40% by 2030).

On **April 20, 2022**, Reuters reported that the **Deputy Director-General of the Energy Department** of the **EC** had stated: "We are working on it full speed to take, first of the proposal of going from 40% to 45%, but also in the context of higher energy prices".

While the **EC** may be considering the proposal at full speed, the **EU Member States** and the **European Parliament** will have to be aligned if the proposal is to become the new policy setting.

- **Portugal increases rate of speed of light:** On **April 4, 2022**, pv-tech.org reported that the **Government of Portugal** is to increase the rate of development and deployment of renewable electrical energy installation so that by 2026, 80% of electrical energy dispatched to match load will be from a renewable energy source.

Between 2010 and 2022 renewable electrical energy dispatched from renewable electrical energy sources increased from 41% to 58%.

- **European Hydrogen Backbone response to REPowerEU:**

- On **April 5, 2022**, the **European Hydrogen Backbone (EHB)** published a [paper](#) (entitled **European Hydrogen Backbone – April 2022**) detailing the growth in the network (comprising the backbone necessary to facilitate the use of hydrogen) to meet the **REPowerEU** policy settings.
- On **April 25, 2022**, it was reported widely that the **Nordic Hydrogen Route** (part of the **EHB**) is to be developed in the **Bothnian Bay** region by **Gasgrid Finland** and **Nordion Energi**. The **Bothnian Bay** region project will comprise 1,000 km of dedicated new hydrogen pipelines. There has been a marked level of news coverage since the announcement of the **Bothnian Bay** region project.
- Towards the end of April the **EHB website** launched a map function to detail the pipelines comprising, and to comprise, the **EHB**.

By way of reminder:

- **Edition 37** of Low Carbon Pulse reported that: "On **March 8, 2022**, the **European Commission (EC)** outlined its plans to accelerate the development of renewable electrical energy capacity across the **EU**, and to increase fourfold the Green Hydrogen production capacity by 2030 (**REPowerEU**, including a **Hydrogen Accelerator**).

In short, there are two legs to **REPowerEU**, first, near to medium term energy security (through diverse sources of natural gas supply, delivered into the **EU** as liquified natural gas (**LNG**) and increased production of bio-gas and bio-methane within the **EU**) and, second, the dash to accelerate renewable electrical energy deployment."

In the context of the **EHB**, what the **REPowerEU** means as a practical matter is that an additional **15 million metric tonnes** of hydrogen is now contemplated, which when combined with the **5.6 million metric tonnes** projected in **Fit-for-55** means that **20.6 million metric tonnes** of hydrogen is now contemplated by 2030, and infrastructure needs to be augmented and expanded and developed to accommodate the fourfold increase.

- **European Hydrogen Backbone:** The **EHB** has been covered in previous editions of Low Carbon Pulse as follows:
 - **Northern Europe Clean Hydrogen Coastline:** **Edition 13** reported:
"**Edition 12** of Low Carbon Pulse (under "**Hydrogen Republic of Germany**") lauded "as a case study in planning and integration" plans of the City of Hamburg (including the port, connected to the North Sea by the Elbe River) for the **Hamburg Hydrogen Industry Network (HH-WIN)**, and the integration of those plans

with those of Bremen, Lower Saxony, Mecklenburg-Western Pomerania and Schleswig-Holstein, and the development of 500 MW of electrolyser capacity by 2025.

On March 24, 2021, a number of major industrial companies (including EWE, ArcelorMittal and FAUN Group) in Northern Germany announced plans to develop a network, spanning the Dutch, German, and Danish coastline, to develop an integrated hydrogen network (**Clean Hydrogen Coastline**) comprising 400 MW of electrolysers and storage by 2026.

In two line simple sentence CEO of steel manufacturer ArcelorMittal, Mr Reiner Blackscheck sums up what is required for industrials (including in Difficult to Decarbonise Industries) to transition of Green Hydrogen: " ... *the transformation process [requiring] the technology change in order to use Green Hydrogen in production. To do this, we need a functioning supply of hydrogen at economic costs so that we can keep the Bremen steel location competitive over the long term*".

To provide demand for "a functioning supply of hydrogen", ArcelorMittal plans to invest up to USD 1.4 billion to develop both a direct reduction iron ore (**DRI**) facility (using natural gas (predominantly **CH₄**) as the reducing gas in the first instance until the provision of Green Hydrogen from across the **Clean Hydrogen Coastline network**), and an electric arc furnace (**EAF**).

The integrated hydrogen network may be regarded as consistent with the plans outlined in a publication titled "**European Hydrogen Backbone**" outlined "How Dedicated Hydrogen Infrastructure Can Be Created". The Publication was sponsored by Enagas, Energinet, Flyxys Belgium, Gasunie, GRTgas, NET4GAS, OGE, ONTRAS, Snam, Swedegas, and Terega.

- **EHB updates its vision for the European Hydrogen back bone: Edition 14** reported:

"On April 13, 2021, the European Hydrogen Backbone (**EHB**) group released a press release detailing the "version of its vision for a dedicated hydrogen transport infrastructure network across Europe". The initial version of the **EHB** vision was released in July 2020. The **EHB** comprises 12 European gas transmission system operators from 11 countries. The **EHB** initiative proposes a hydrogen network of 39,700 km by 2040, with a grid connecting 21 countries."

- **Backbone of hydrogen demand: Edition 20** reported:

"**Headline:** On June 15, 2021, at the launch of the European Hydrogen Backbone (**EHB**) initiative, a [report](#) was released (**EBR**) providing a perspective on the likely size and shape of hydrogen demand by 2050. The headline is that demand for hydrogen could reach 45% of the levels of natural gas use in 2019, with final total energy Low Carbon Pulse - Edition 20 consumption (**TEC**) of hydrogen equating to 2,300 TWh a year, book-ended by a low-side estimate of 2,150 TWh **TEC**, and a high-side estimate of 2,750 TWh **TEC**.

Consensus arising: The **EBR** is consistent with "established thinking" that hydrogen has a crucial role to play as an energy carrier for use in the production of cement, chemicals and iron and steel. Across these Difficult to Decarbonise industries it is estimated that 1,200 TWh of energy will be used for high-heat temperature processes, and 200 TWh for medium to high-heat temperature use: hydrogen can be used as a high-heat temperature energy carrier, able to displace fossil, and other carbon intensive, feedstocks and fuels.

In addition to use in these Difficult to Decarbonise industries, hydrogen will be used to power and to propel vehicles (particularly heavy goods vehicles / trucks) using **FCT**. Further, it is stated that hydrogen will be used as a fuel to produce dispatchable electrical energy or, as noted in the next paragraph, Hydrogen Energy Carrier Storage (**HECS**) (up to 600 TWh) and, in some countries, to heat buildings (up to 600 TWh), including through district heating.

Efficiency in hydrogen use and storage: The **EBR** notes that while it would be possible for the **EU** and the UK to produce sufficient Green Hydrogen to satisfy this level of projected demand, this will require considerable investment in renewable electrical energy development. While production and supply of Green Hydrogen within the **EU** and the UK will fulfil some of the early policy setting thinking around energy security, it is likely to prove more expensive than sourcing Green Hydrogen from countries and regions with renewable energy sources better suited to the production of Green Hydrogen and, as a result, lower cost production.

As noted in previous editions of Low Carbon Pulse, while hydrogen can be used to produce dispatchable energy, it will be interesting to see how this prospective use develops given thinking of policy settings and the thinking of development / policy banks: current trends reflect the view that hydrogen should not be used as a fuel for base load dispatchable energy, rather hydrogen (suited as it is to storage) is best used to provide **HECS**. The **EBR** recognises the use of hydrogen for **HECS** in the context of use of hydrogen to produce dispatchable energy only, not to provide a fuel for base-load dispatchable energy."

- **Common themes – the need for common / share infrastructure and a common market:**

- On **April 5, 2022**, the [hydrogen economist](#) provided an analysis of the benefits of the development of common / shared infrastructure by Germany and the Netherlands, in particular the benefits of the development of a hydrogen backbone, with the central premise being common / shared infrastructure will increase demand, possibly even doubling the projected demand (up to 401 TWh a year by 2050).

The benefits will become self-fulfilling with higher projected demand resulting in the development of increased off-shore wind field capacity, increasing Green Hydrogen production, and therefore supply.

The project demand estimates suggest that the supply of Green Hydrogen, using renewable electrical energy sourced from off-shore wind fields in the North Sea, is achievable, but will be greatly enhanced by infrastructure providing a clear path to the point of use of the Green Hydrogen.

Helpfully the article identifies what needs to happen at a legal and regulatory level to allow the benefits to be realised, including:

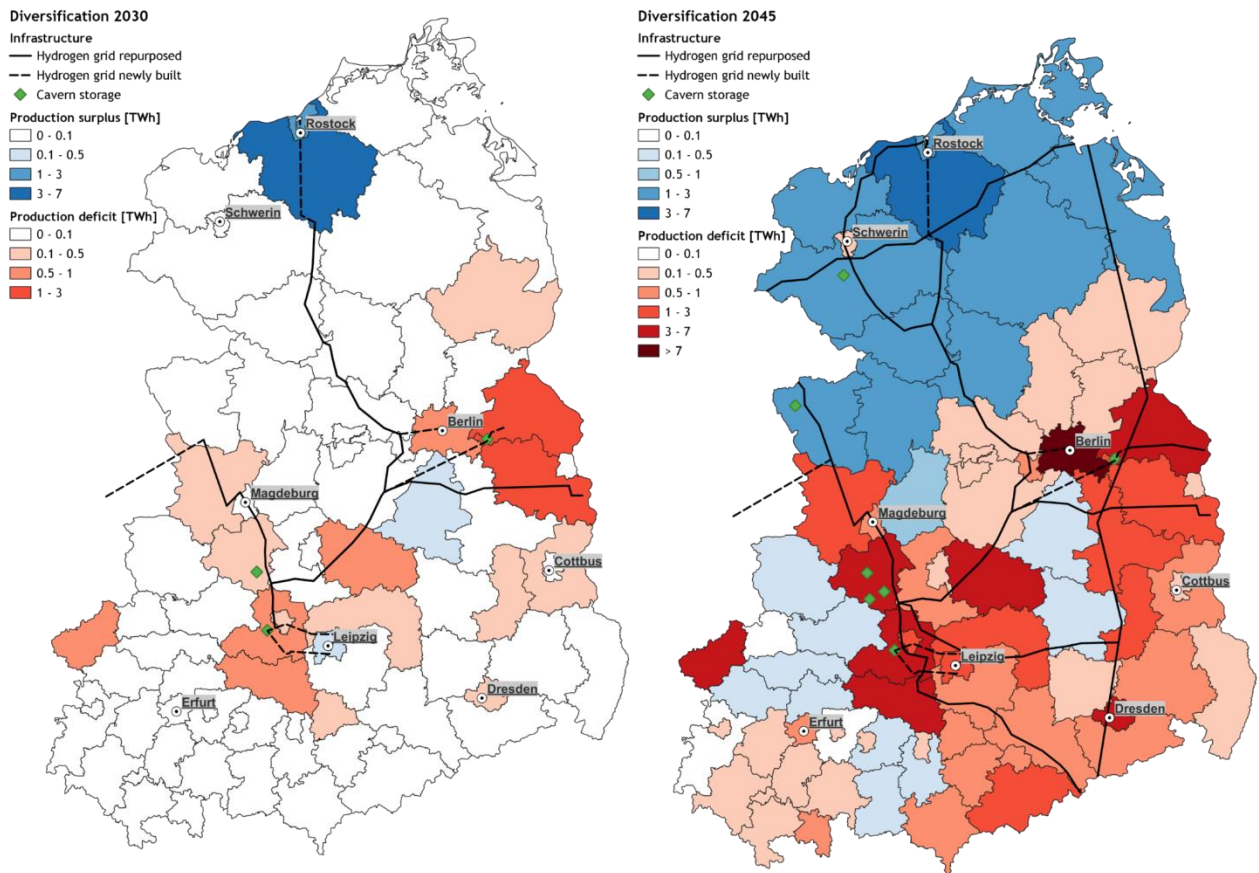
1. the classification of Green Hydrogen as a chemical in the Netherlands;
2. the development of a regulatory framework for the development and operation of hydrogen pipeline infrastructure; and

3. the co-ordinated cross-border planning in line with the EU's Trans-European Network for Energy (TEN-E) and the Ten-Year Network Development (TYND) Plan.

In addition, the article notes that it is critical that Germany and the Netherlands develop a legal definition of Green Hydrogen, and develop a Guarantee of Origin, and accompanying certification, regime.



- EWI Study supports needs identified above and below:** On **April 14, 2022**, **EWI** (Institute of Energy Economics at the University of Cologne) published a study, [***Development of Hydrogen Market in Eastern Germany – An Infrastructure analysis based on regional potentials and demand.***](#) The study was commissioned by **GASCADE Gastransport GmbH** (German gas transportation infrastructure company). The following map-graphic provides a number of helpful insights.



Source: [EWI](#)

• **By way of reminder:**

- **Edition 37** of Low Carbon Pulse reported that: "On **March 24, 2022**, that RWE (the German renewables electrical energy giant) and OGE (a German TSO) outlined plans to roll-out hydrogen infrastructure to produce and transport hydrogen, including a 1 GW electrolyser and a 1,500 kilometre, hydrogen pipeline system (the **H₂ercules Project**). It is reported the **H₂ercules Project** will cost around €3.5 billion.



Source: [Hydrogen fast track: OGE and RWE present national infrastructure concept "H2ercules"](#)

- **EHB and H₂ercules Project aligned:** The **H₂ercules Project** will allow the import Green Hydrogen from Belgium, the Netherlands and Norway. With the developments during March 2022, it is estimated that by 2030, Germany may have 30 GW of Green Hydrogen capacity, around three times as that contemplated in July 2020 by the German Federal Government.
- **Northern Europe and Nordic countries leading the way in innovation:**
 - As noted above, of the seven projects awarded funding on **April 1, 2022 (April Fuel Day)**, three were from Nordic countries:
 - **The BECSS project:** Located in **Stockholm, Sweden**, this project is the first full-scale Bio-Energy Carbon Capture and Storage (**BECCS**) project, capturing **CO₂** and heat from the existing biomass project.
 - **The Hybrit project:** Located in **Gällivare and Oxelösund, Sweden**, this Hydrogen Breakthrough Ironmaking Technology Demonstration (**Hybrit**) project will produce fossil-fuel free iron and steel.
 - **The SHARC project:** Located at the **Porvoo refinery, Finland**, the Sustainable Hydrogen and Recovery of Carbon (**SHARC**) project will reduce **GHG** emissions on transition from use of fossil fuels to renewable hydrogen production.
 - **TES Fast-tracks:** On **April 14, 2022, Forbes** (under [German Clean Energy Hub Pivotal to Reducing Reliance on Russian Gas](#)) published an article reporting on an interview with the CEO of **Tree Energy Solutions (TES)**, Mr Otto Waterlander, about green gas. **TES** (a green hydrogen corporation, reported on in **Editions 36** of Low Carbon Pulse) is reported to be "fast-tracking" the development of a **green hydrogen hub** at **Wilhelmshaven** in Northern Germany (the **TES-Wilhelmshaven project**).

"Clean hydrogen will be used as a bridging fuel in the early years. By 2030, there will likely be a 50:50 split between clean and green hydrogen. In the initial phase, 25 [TWh a year] of green methane, from which more than half a million [metric tonnes] of [clean] hydrogen can be produced, will be imported into Wilhelmshaven. That will increase to 250 TWh [a year] and more than 5 million metric tonnes of hydrogen in a final stage. The green hydrogen will be produced using exclusively renewable sources, mainly solar in several cased wind or hydroelectricity [or both]."

Edition 37 of Low Carbon Pulse included a map-graphic outlining the plans of **TES** in visual form, for ease of reference a [link](#) to the map-graphic is included. As will be apparent from the map-graphic, clean hydrogen will be sourced from the Middle East, **CO₂** will be captured and shipped to the Middle East, the **CO₂** will be combined with hydrogen to produce green methane, which is then liquified, with the green **LNG** shipped to Germany. As reported, the **TES-Wilhelmshaven project**, on full development, will comprise six berths, and eight on-site storage tanks, with combined storage capacity of **1,600,000 m³**.

On **April 25, 2022, TES** announced that it was running an open-season process to fast-track the import of **LNG** to its **TES-Wilhelmshaven project**. It is understood that under the first phase of open-season process non-binding expressions of interest are sought. The second phase will involve binding commitments, with third phase involving conclusion of the binding commitments.

- **All is well in the Kingdom of Denmark and beyond:**
 - **Topsoe (previously Haldor Topsoe) clusters:** On **April 1, 2022, Topsoe** (leading electrolyser technology corporation) [announced](#) that it had joined a consortium that is focused on the development and deployment of technology to produce green fuels for aircraft and ships. In addition to **Topsoe**, the consortium comprises, **Aalborg Airport, Aarhus Airport, Aarhus Havn** (Port of Aarhus), **AAU Energy, Alfa Laval, A.P. Moller – Maersk, COWI, Crossbridge Energy, DLR, Energy Cluster Denmark, GreenFuelHub, SkyNRG** and **Steeper Energy**.
 - **Energinet hot-to-trot:**
 - As noted above, on **April 5, 2022**, the **EHB** published a [paper](#) (entitled [European Hydrogen Backbone – April 2022](#)). One of the key conclusions from the paper is that the case for the Danish-German connection has been accelerated to a 2030 timeline. In this context, **Energinet** (Danish TSO) is preparing to develop a Green Hydrogen export pipeline from Denmark to Germany to access the European market.
 - By way of a reminder:** Denmark intends to develop two power islands, the Baltic Sea Energy Island (with renewable electrical energy from 2 GW of off-shore wind field capacity), and the North Sea Energy Island (with renewable electrical energy from 3 GW of off-shore wind field capacity). (See **Editions 5, 8, 9, 27, 29, 32** Low Carbon Pulse.)

CURRENT PLANNED DEVELOPMENT OF OFF-SHORE WIND			
North Sea Energy Island – 3 GW	Baltic Sea Energy Island – 2 GW	Hesselo (Baltic Sea) – up to 1.2 GW	North Sea Thor – 1 GW

- On **April 5, 2022, Energinet** progressed with work in respect of the off-shore wind field development so as to facilitate the development of both Energy Islands, likely on an accelerated basis.
- On **April 19, 2022**, the **Danish Government** outlined plans to increase photovoltaic solar and on-shore wind farm development, as well as the energy islands and off-shore wind fields.

The **Danish Prime Minister, Mr Mette Frederiksen** said: "We now raise our ambitions even more with onshore wind additions, more solar panels and off-shore wind as well as more energy islands. We want to extend our renewable energy by as much as possible and in the most clever way". As outlined, the **Danish Government** plans will increase on-shore wind capacity four-fold.

- **UK Export Finance (UK EF) provides clean guarantee:** On **April 6, 2022, qtreview.com** reported that the **UK EF** had agreed to guarantee a **GBP 400 million** sustainability-linked facility provided to **Johnson Matthey** by **Bank of America, HSBC** and **SMBC**. **Johnson Matthey** is a leading developer of sustainable technologies, including for Green Hydrogen production and metals recovery and recycling. As reported, as part of the sustainability-linked facility

structure, **Johnson Matthey** has committed to reduce its **GHG** emissions and to decarbonise its energy procurement, with progress to be monitored and reported upon by an independent third party.

- **UK doubles hydrogen target and 50 by 30:** On **April 6, 2022**, UK Prime Minister, **Mr Boris Johnson** announced that the UK would double its target for hydrogen production capacity from **5 GW** by 2030, to **10 GW** by 2030. This is one facet of a multi-faceted plan that provides that the UK will match 95% of its load for electrical energy from renewable energy sources by 2030, including deploying up to **50 GW** of off-shore field capacity by 2030.

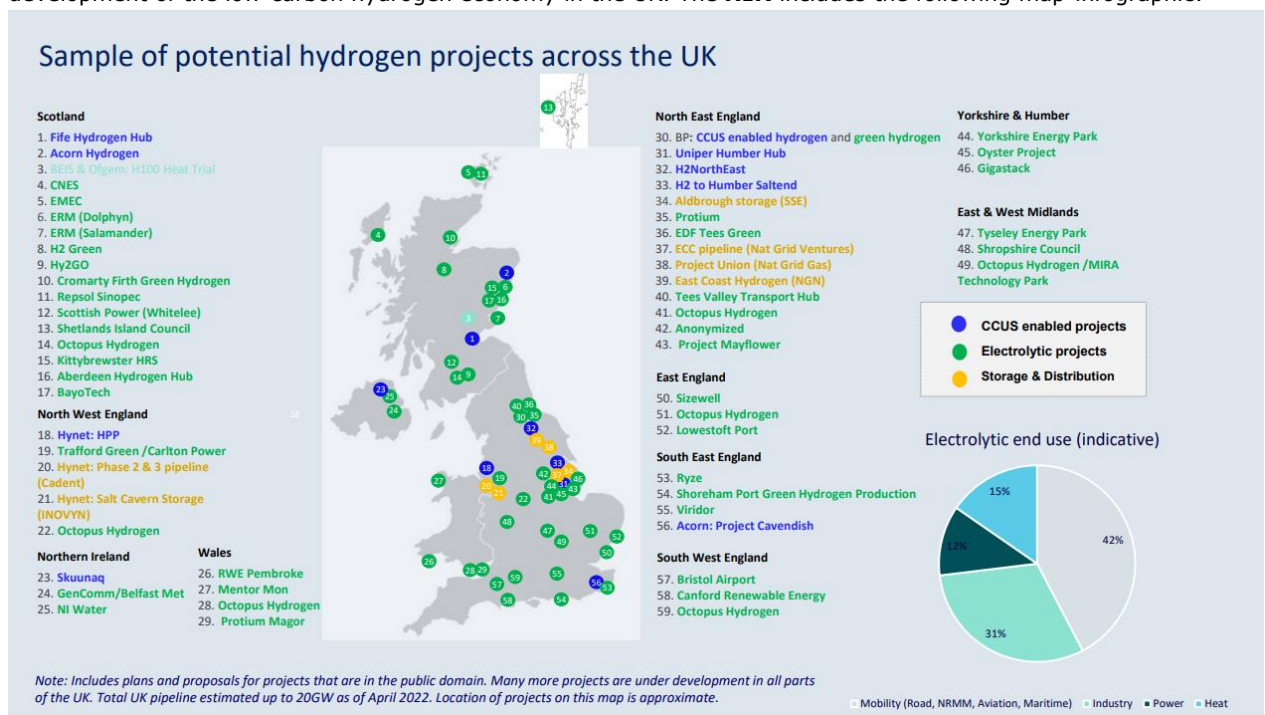
The key points of the new **British Energy Security Strategy** also include the development and deployment of eight new nuclear reactors (located at Bradwell, Hartlepool, Heysham, Hinkley, Moorside, Oldbury, Sizewell and Wylfa) and the promotion of policy settings to accelerate the installation of roof-top photovoltaic solar.

For the full form of the [Policy Paper – British energy security strategy](#), please click on the attached. As ever, with publications from the UK Government, it is both clear and compelling. For an assessment of the implications of the **Policy Paper – British energy security strategy** on the power sector see the **ICIS paper, UK Energy Security Strategy: Implications for the power sector**.

- **Studied release:** On **April 8, 2022**, the UK Government **Department of Business, Energy and Industrial Strategy (BEIS)** released [Atmospheric Implications of Increased Hydrogen Use](#).

The headline from the study is the importance of preventing the leakage of hydrogen into the atmosphere so as to prevent the compounding of hydrogen with other compounds and elements creating **GHGs**. The study is important and timely as governments around the world develop and progress policy settings, laws, regulations and standards to allow the development of the hydrogen economy.

- **Hydrogen Investor Roadmap:** On **April 8, 2022**, the **BEIS** published [Hydrogen investor roadmap: leading the way to net zero \(HIR\)](#). The purpose of the **HIR** is to summarise government policies supporting the development of the low-carbon hydrogen economy in the UK. The **HIR** includes the following map-infographic:



- **CCS Investor Roadmap:** On **April 8, 2022**, the **BEIS** published [CCUS Investor Roadmap – Capturing Carbon and a Global Opportunity \(CIR\)](#). In context, the **CIR** needs to be read with the UK Government target of capturing 20 to 30 million metric tonnes of **CO₂** a year. Many commentators and participants note that the current target is modest, as are the timelines.
- **UK Low Carbon Hydrogen Standard:** On **April 8, 2022**, the **BEIS** published [UK Low Carbon Hydrogen Standard: emissions reporting and sustainability criteria](#). The publication marks considerable and marked progress since August 17, 2021, when the **BEIS** published [Designing a UK low carbon hydrogen standard](#).
- **UK progressing to CfDs for hydrogen production:** On **April 11, 2022**, [rechargenews.com](#) (under [UK finalise world's first national subsidy for clean hydrogen production by the year](#)) reported that the **BEIS** had announced the use of contracts for difference (**CfD**) for hydrogen: described as a "variable premium price support model" subsidising any "difference between a 'strike price' reflecting the cost of producing hydrogen and a 'reference price' reflecting the market value of the hydrogen." As reported, the UK will finalise the terms of the **CfDs** during 2022, and start to contract under them during 2023.
- **Germany and UK interconnect:** On **April 12, 2022**, [CNBC](#) reported (under [Giant undersea cables set to give the UK and Germany their first direct energy link](#)) on the **NeuConnect project** which is to allow each way electrical energy supply of **1.4 GW** between Germany and the UK. The interconnector, **725 kilometres** in length, has been dubbed the "invisible energy highway".
- **Gasunie hot to trot:** On **April 21, 2022**, [europeangashub.com](#) reported on the **Gasunie Hydrogen Backbone**. The following map-infographic provides a helpful overview.



- **ScotWind Clearing Round becomes clearer:** On **April 26, 2022**, it was announced by the **Crown Estate Scotland** that "a further process of Clearing has today, 26 April 2022, begun". The Clearing allows applicants that met the required standards for the **ScotWind Leasing Process** (see **Editions 22, 33, and 37** of Low Carbon Pulse), but were unsuccessful in their bid or bids for any preferred lease area to revise their application to an alternative lease area.

It is important to note that the Clearing process does not allow new applicants to participate: the process is open only to those who applied, were assessed, but were not successful in the ScotWind leasing process. The deadline for eligible applicants is May 10, 2022. **Edition 40** of Low Carbon Pulse will provide an update.

Americas:

*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the US, Brazil, Canada, and Mexico, being countries that give rise to the second, sixth, ninth and eleventh most **GHG** emissions.*

• Hubbub among the States:

• By way of reminder:

- Under the **Infrastructure Investment and Jobs Act (IIAJA)** also known as the Bipartisan Infrastructure Law (**BIL**) there is USD 8 billion to provide support for **at least four hydrogen hubs** that are able to demonstrate that their development and deployment will contribute to production of clean hydrogen and to multiple uses of that clean hydrogen.

Clean Hydrogen for these purposes is hydrogen that gives rise to less than 2 kg of **CO₂** for each 1 kg of hydrogen produced.

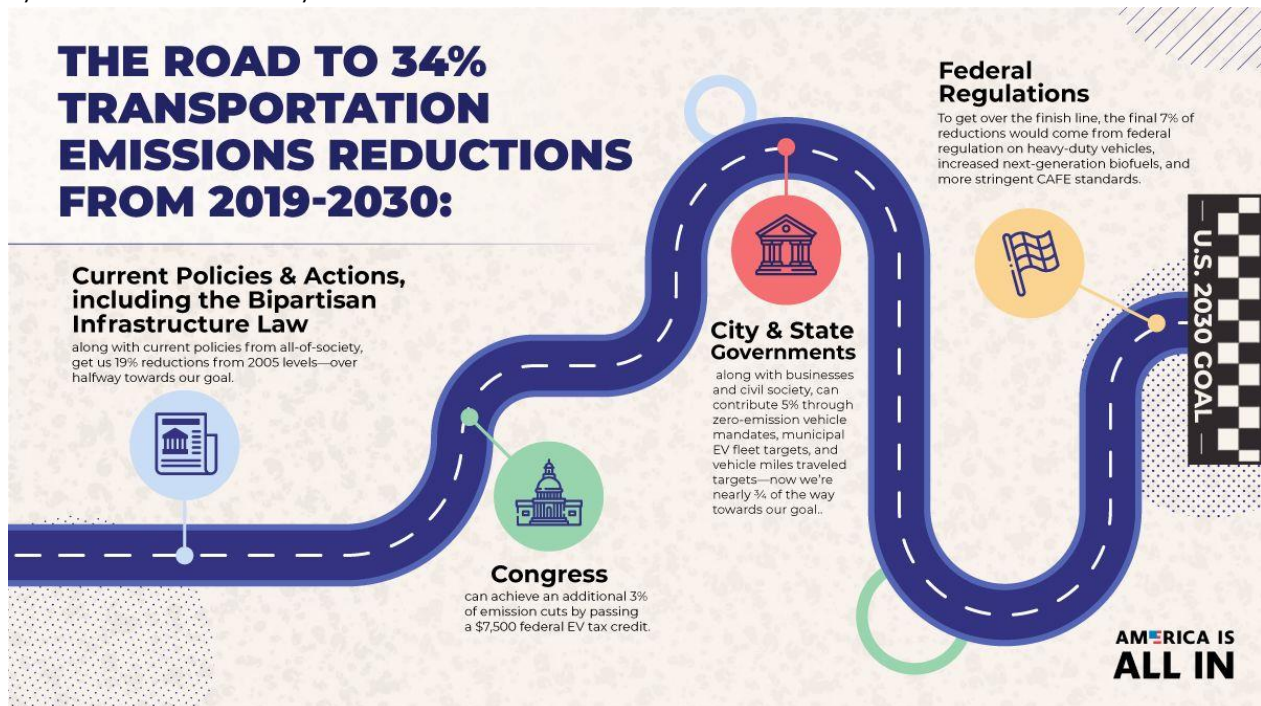
The **IIAJA** prescribes that at least one hydrogen hub will use fossil fuel feedstock to produce hydrogen, one will use renewables and one will use nuclear.

- **Editions 36 and 37** reported that:
 - **Colorado, New Mexico, Utah and Wyoming** had signed a memorandum of understanding to develop a regional clean Hydrogen Hub, and in so doing, position more effectively to seek funding from the **IIAJA**;
 - **Mississippi States Hub: Arkansas, Louisiana and Oklahoma** were progressing with a like initiative to create a bipartisan three-state bloc to develop a **regional clean Hydrogen Hub**;
 - **West Virginia**, through the **West Virginia Hydrogen Hub Coalition**, had submitted a proposal to the US **DOE** seeking funding to develop a hydrogen hub in the State;
 - the Governor of New York State, Ms Kathy Hochul had indicated that **New York**, together with **Connecticut, Massachusetts and New Jersey**, and 40 hydrogen ecosystem partners, were combining for the purposes of seeking to become one of at least four regional clean hydrogen energy hubs.
- On **April 8, 2022**, [fuelcellworks.com](https://www.fuelcellworks.com) reported (under **Biden's Hydrogen Hub Plan Sparks \$8 Billion Race Among US States**) that **Colorado, New Mexico, Utah and Wyoming; Arkansas, Louisiana and Oklahoma; Connecticut, Massachusetts, New Jersey and New York, and Kentucky and West Virginia** were chasing funding from the USD 8 billion earmarked by the **IIAJA**.

The following map from [fuelcellworks.com](https://www.fuelcellworks.com) illustrates the States and Groups of States chasing the **USD 8 billion** of funding.



- **Land release:** On **April 21, 2022**, rechargenews.com reported that the **US Bureau of Land Management (BLM)** plans to green-light the development of **39 utility-scale photovoltaic solar projects**, together to have more than **29 GW of installed capacity**, on Federal lands in six western states.
- **Earth Day Executive Order:** On **April 22, 2022**, **US President, Mr Joe Biden**, signed an [Executive Order](#) to:
 - (a) safeguard mature and old-growth forests on Federal lands;
 - (b) strengthen reforestation initiatives across the US; and
 - (c) combat global deforestation, consistent with commitments made at **COP-26**; and
 - (d) enlist nature to address efforts to address climate change.
- **Pennsylvania powers ahead:** On **April 22, 2022**, the **US State of Pennsylvania** (responsible for 4% of US **GHG** emissions) published regulations to require power station owners to pay for each ton of carbon that they emit. As reported, both opponents and supporters of the regulations expect delay in the application of the regulations. The regulations are reported to be part of the Regional Greenhouse Gas Initiative, including 11 north eastern US States.
- **US on the road:** On **April 24, 2022**, the **World Resources Institute** shared a publication, [America is All In](#). The infographic below provides a helpful guide: while the US needs to reduce **GHG** emissions arising from transportation by 2030 - it is over half way there.



Source: [World Resources Institute LinkedIn](#)

- **Government of Canada – Emissions Reduction Plan:** During the first week of **April 2022**, it was reported that the Government of Canada (**GOC**) has released the **2030 Emissions Reduction Plan (ERP)** targeting a 40 to 45% reduction in **GHG** emissions by 2030.

At a more granular level, zero-emissions vehicles (**ZEVs**) are to comprise 20% of car sales by 2026, 60% by 2030, and 100% by 2035. The **GOC** is providing funding support in the form of its iZEV program (CAD 1.7 billion), providing incentives to businesses and households to buy **ZEVs**, and for the development of EV charging infrastructure (CAD 400 million).

France and Germany:

*This section considers news items within the news cycle of this **Edition 39** of Low Carbon Pulse relating to France and Germany. Within the news-cycle for this **Edition 37**, the news-items have come thick and fast.*

- **France committed to 40 by 50:** On **March 31, 2022**, and in early April, it was reported widely that the French Government had committed to the development of **40 GW** off-shore wind field capacity by 2050 (**40 by 50**).

As contemplated, the commitment envisages that the capacity will be installed across **50** off-shore wind fields. To reach **40 by 50**, France will have to auction a minimum of **2 GW** of off-shore wind field capacity a year from 2025. In today's Euros, the development of **40 by 50** will cost in the region **€40 billion**.

- On **March 31, 2022**, it was reported that the **Hy3 Project** study had been published jointly by **Forschungszentrum Julich, Dena**, and **TNO**. The author laid eyes on the **Hy3 Project** study in early April. As might be expected, the key finding of the **Hy3 Project** study is that cooperation between Germany and the Netherlands, in developing a common hydrogen market and common infrastructure, will boost opportunities to realise a decarbonised regional economy.

The **Hy3 Project** study is one of the best publications that the author has had the pleasure of reading in recent times: it aligns general principles to specific applications, supply and demand side driven. As such the **Hy3 Project** study is well-worth a read.

The **March and April Report on Reports** will consider the **Hy3 Project** study.

- **Germany committed to up to 215 by 30:**

- On **April 6, 2022**, it was reported widely that Germany intended to introduce and **EEG Easter Package** to accelerate the development and deployment of photovoltaic solar capacity and wind. A key element of this is to accelerate development and deployment across open-spaces and roof-tops, with the plan to expand deployment to **22 GW** by **2023**, and then to continue to increase installed capacity (at the same rate) so as to install **215 GW** of photovoltaic solar capacity by **2030 (215 by 30)**.

- On **April 7, 2022**, it was reported widely that Germany intended to change (as part of the **EEG Easter Package**) the targets for the installation of off-shore wind field capacity, stretching those targets to **30 GW** by **2030**, **40 GW** by **2040**, and at least **70 GW** by **2045**.

Australia:

*This section considers news items that have arisen within the news cycle of this **Edition 39** Low Carbon Pulse relating to Australia, a top-twenty **GHG** emitting country, and a developed country with the highest **GHG** emissions per capita. Australia is however progressing to **NZE** at a faster rate than many other developed countries, and, along with the **GCC** Countries, is one of four countries rich in solar resources (and wind resources) that appear likely to lead in the development of the hydrogen economy over the next five years (and beyond): Australia, Chile, the **PRC** and Spain.*

- **Federal Australian Government to fund Marinus Link:** On **April 3, 2022**, the **Department of Industry, Science and Resources** [announced](#) the funding support will be provided for the development of a 250 kilometre sub-sea interconnector between the States of Tasmania and Victoria, described as "unlocking" access to renewable electrical energy generation capacity in Tasmania, predominantly existing hydro-electric and on-shore wind.

- **Carbon Clusters and Hydrogen Hubs update:**

- On **April 10, 2022**, it was announced that **WSP** had been appointed as the **Lead Technical Adviser** for the **Electrolysis, Ammonia Synthesis** and **Export** and **Bunkering** assessment of the feasibility study being undertaken by the **Port of Newcastle**, in partnership with Macquarie Group, **Green Investment Group**, and the Australian Federal Government, **Australian Renewable Energy Agency (ARENA)**.

- As currently contemplated the first stage of the Hydrogen Hub at the Port of Newcastle will comprise the development of a 40 MW electrolyser, with a view to increasing electrolyser capacity to more than 1 GW overtime. The electrolyser capacity will produce Green Hydrogen and Green Ammonia for domestic use in the first instance and including export over time.

- **Federal Government of Australia announces further funding support:** On **April 19, 2022**, the Federal Government announced support for the critical minerals industry (**CMI**), the clean hydrogen industry (**CHI**) and **CCS**:

- **CMI: [Critical Minerals Accelerator Initiative](#)** was announced by the **Federal Minister for Resources and Water, Mr Keith Pitt**. This announcement builds on the loan to Iluka Resources to develop Rare Earths and Elements refinery (see **Iluka to develop REE refinery in Western Australia** below);

- **CHI:** The **Federal Minister for Industry, Energy and Emissions Reduction, Mr Angus Taylor**, announced the provision of further funding support to the clean hydrogen industry, including:

- the **H2Kwinana Clean Hydrogen Industrial Hub** – with up to **AUD 70 million**; [arrows]
- the **Pilbara Hydrogen Hub** – with up to **AUD 70 million**;

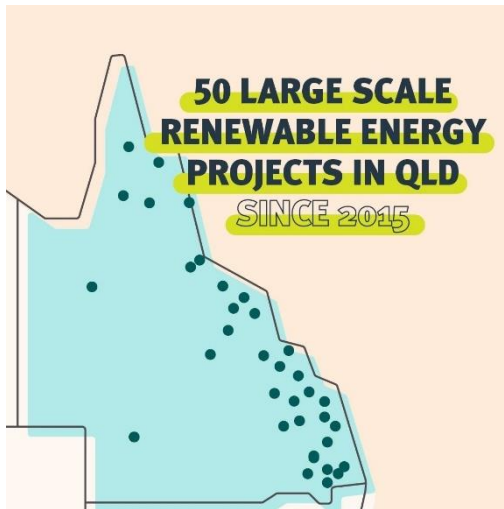
- **CCS:** The Federal Government announced funding support in respect of CCS projects:

- the **Woodside Energy multi-user CCS** hub on the **Burrup Peninsula, Western Australia** - with up to AUD 40 million;
- the **Mitsui E&P Mid-West CCS** hub – with up to **AUD 20 million**; and

- the **Buru Energy** for potential on-shore **CCS** – with up to **AUD 7 million**.

The Federal Government is to be commended for striking a balance between providing a helping hand, and a hand-out, to projects that are being development by the private-sector.

- **Queensland Government summarises investments in renewable energy:**



Editions 31 and 37 of Low Carbon Pulse reported on the progress of **Queensland Renewable Energy Zones - Central QREZ, Northern QREZ and the Southern QREZ**.

- On **April 4, 2022**, the **Department of State Development, Infrastructure, Local Government and Planning**, published details of the state of play in the sunshine state.

The headline is that:

"Queensland is invested in renewable energy"

Queensland has **50 large-scale renewable energy projects operating, under construction or financially committed**, amounting to **AUD 10.7 billion** and resulting in **5.744 GW** of renewable electrical energy capacity, which when combined with a little under **1.5 GW** of roof-top photovoltaic solar amount to **7.2 GW** of renewable electrical energy.

The attached [link](#) provides a more detailed electricity generation map for the State of Queensland.

- **AusNet renewable energy zone (REZ):** On **April 22, 2022**, it was reported widely that **AusNet (TSO)** had proposed the establishment of a **10 GW renewable energy zone** in the Gippsland region of Victoria (**GREZ**). As reported, if the **GREZ** is established it will be the first "industry-led" **REZ** in Australia.

Blue and Green Carbon Initiatives and Biodiversity

*This section considers news items that have arisen within the news cycle of this **Edition 39** Low Carbon Pulse relating to the Blue Carbon and Green Carbon initiatives and Biodiversity.*

To manage the length of this **Edition 39** of Low Carbon Pulse, **Edition 40** will include a bumper section on Blue and Green Carbon Initiatives, particularly in the context of the conferences taking place during May 2022.

Bioenergy and heat-recovery:

*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to bioenergy, being energy, whether in gaseous, liquid or solid form, derived or produced from biomass. **Bioenergy** includes any energy derived or produced from biomass (organic matter arising from the life-cycle of any living thing, flora or fauna, including from organic waste streams), whether in gaseous, liquid or solid form. In addition, recovered heat and waste heat (derived from any source, including waste water) has been added to this section.*

*From recent activity and reporting, it appears likely that the avoidance of waste heat energy, and the recovery of waste heat energy will become a priority under the first pillar as a part of Energy Efficiency (**IEA**) and Energy conservation and efficiency (**IRENA**). By some estimates, up to 67% of energy arising is wasted. The increased awareness of sourcing heat reflects increased awareness of the energy used to heat buildings, and its source: heating buildings results in around 25% of total final energy demand, with around 75% of the feedstock used to satisfy that energy demand derived from fossil fuels.*

- **Veolia and Waga Energy deploy France's largest biomethane production facility:** On **April 1, 2022**, the author came across reports in French outlining the deployment of a 120 GW h per year biomethane production facility deriving **biogas** from landfill (biogas comprising **CH₄** and **CO₂**, and trace compounds), and processing that **biogas** to produce biomethane. This will be largest **biomethane** production facility in France, at least for the time being.

By way of reminder:

- **Biogas and Biomethane:** As noted in **Edition 37** of Low Carbon Pulse, there are two legs to the **RePowerEU** policy settings, near to medium term energy security (through diverse sources of natural gas supply, delivered into the EU as liquified natural gas (**LNG**) and increased production of **biogas** and **biomethane** within the **EU**) and the dash into renewables.

The role that **biogas** and **biomethane** has to play is likely to increase, and to do so dramatically in the near to medium term as renewable sources of feedstock are sought and used to derive or to produce biogas / biomethane as part of the means of assuring near to medium term energy security in the **EU**. By some estimates, by 2030 up to 35 billion m³ of **biogas** / **biomethane** may be derived or produced, and by 2050 up to 100 billion m³.

Continuing the theme of clear policy settings, it would make sense for the Renewable Energy Directive to contemplate the role of **biogas** / **biomethane** specifically.

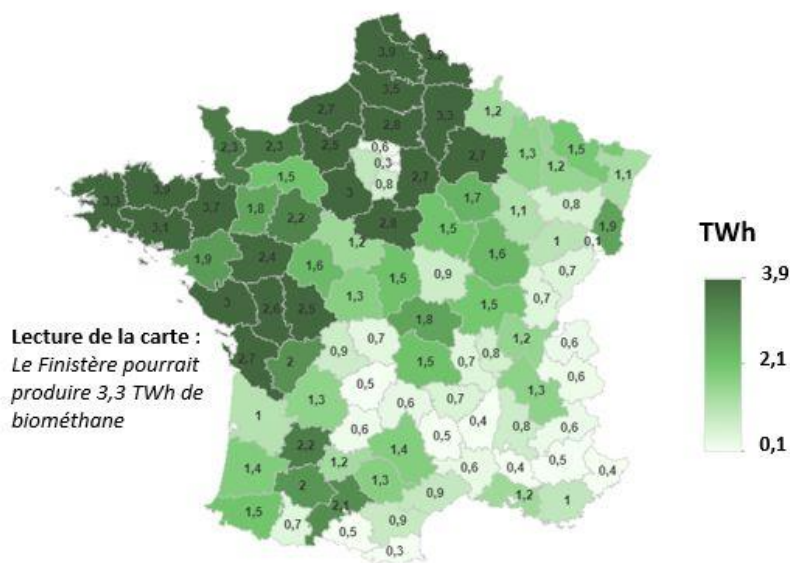
- **France's role in bio-gas and bio-methane production:** As noted in **Edition 37** of Low Carbon Pulse, the following map of France provides an indication of the potential for France to produce biogas and bio-methane.

The headline notes that France could derive up to 320 TWh of electrical energy a year from the use of various technologies to derive and to produce biogas and biomethane as follows: Methanization – 130 TWh; Pyro-gasification – 90 TWh; Hydrothermal gasification – 50 TWh; and Methanation 50 TWh.

It is understood that current natural gas energy use equates to 475 TWh a year. The sources of feedstock for the derivation and production of bigas / biomethane are organic, including from municipal solid waste, crop residues, livestock manure, agri-food industry waste, biowaste, and sludge from waste water.

Potentiel de gaz pouvant provenir de méthanisation en France

Potentiel réaliste de biométhane (en TWh) pouvant être produit par département (hors culture énergétique). Le cumul est égal à 130 TWh.



SOURCE : OPEN DATA RESEAU ENERGIE, 2022

[Note: For further information and background, please connect to the [Ashurst Waste Compendium](#)]

- **A word of caution:** On **April 1, 2022**, the [New Scientist](#) noted that care needs to be taken that progress towards bioenergy (including as contemplated by the **EU**) does not increase the area of land mass used for the growth of feedstock to derive bioenergy. This emphasises that waste of all forms should be the feedstock for bioenergy.
- **Veolia to develop world's largest biorefinery in Finland:** On **April 6, 2022**, [biofuels-news.com](#) reported (under [Veolia launches biorefinery project using alternative feedstock](#)) that **Veolia** is to develop a bio-refinery producing **CO₂-neutral methanol**. The **bio-methanol** will be produced from organic paper and wood waste sourced from the **Metsä Fibre's Äänekoski** pulp mill in Finland. It is understood that the **bio-methanol** plant will produce up to **12,000 metric tonnes of bio-methanol** a year. It is understood that production will commence in 2024.
One of the strong narratives emerging from the project is: "The advantage of our industrial concept is that it is replicable at around 80% of the pulp mills worldwide. It has the potential to unlock an additional, locally generated feedstock of CO₂-neutral bio-methanol for biofuel that could be an estimated 2 million tonnes" (Ms Estelle Brachilianoff, COO, Veolia).
- **NREL on top of biogas potential:** On **April 8, 2022**, **NREL** (the **National Renewable Energy Laboratory** of the US Department of Energy) published [Biogas Potential in the United States \(Fact Sheet\), Energy Analysis](#). The headline is the **CH₄** that could be derived and produced from waste that would otherwise be landfilled, animal manure, wastewater, and organic waste streams from commercial, industrial and commercial sources is estimated to be sufficient to provide 9% of the natural gas demand of the US. The by-product of the production of **biogas** is digestate using anaerobic technology, which is can be used, in processed form, as a fertiliser.

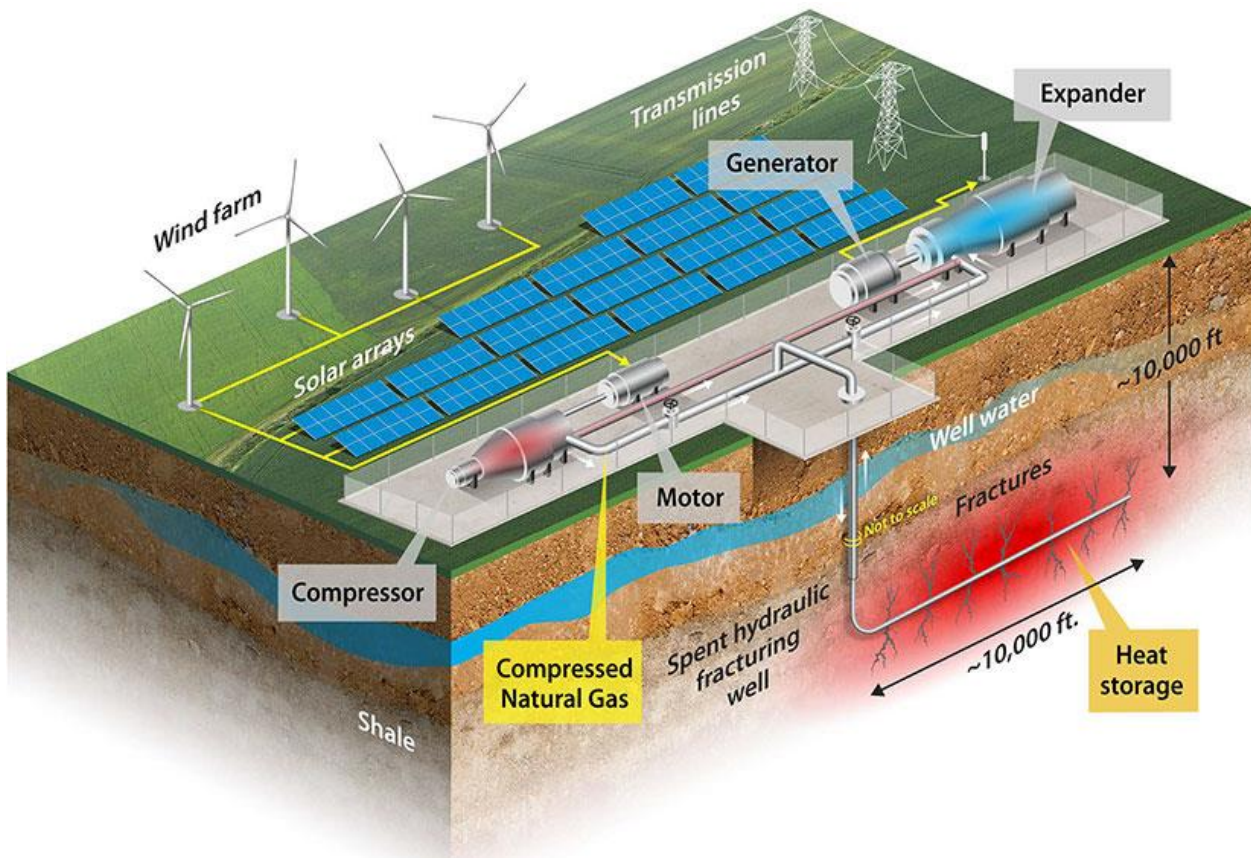
BESS and HESS (and energy storage):

This section considers news items that have arisen within the news cycle of this **Edition 39** of *Low Carbon Pulse* relating to battery electric storage systems (**BESSs**) and hydrogen energy storage systems (**HESSs**). In addition to **BESSs** and **HESSs**, other forms of energy storage systems are covered, including use of compressed air energy storage (**CAES**) and pumped storage. In this context, long duration energy storage (**LDES**) is considered, being energy technology that is able to allow the off-take electrical energy out of storage for a duration of more than four hours. In the brave new world described in **Edition 13** of *Low Carbon Pulse*: "**BESS** storage of 10/12/24 hours is being contemplated for business users, and up to 72 hours for telecommunications companies, including to guard against the consequences of land-borne weather events".

The **November and December Report on Report** provides a summary of the **LDES Council** and **McKinsey** report from November 2021 (see [Second Compendium of Low Carbon Pulse](#))

- **AboitizPower proceeds with BESS:** On **April 6, 2022**, [energy-storage](#) reported that **SNAP (SN Aboitiz Power Group)** had made a final investment decision to proceed with the procurement of a **20 MW / 20 MWh BESS**, and for this purpose had contracted with **Hitachi Energy** to supply and to install the **BESS**. The **BESS** is to be installed at the **360 MW Magat hydro-electric power station in Ramon, Isabela**, in the north Philippines, and is scheduled to come on line in 2024.

- **NREL underground storage solution:** On **April 8, 2022**, **NREL** (the **National Renewable Energy Laboratory** of the US Department of Energy) [announced](#) (under [NREL Researchers Plot Energy Storage Under Our Feet](#)) it is considering the use of depleted oil and gas wells as a reservoir for the storage of compressed natural gas. While at an early stage, modelling suggests that this may be feasible.



Source: [NREL](#)

- **Uniper back-to-the-future:** On **April 11, 2022**, **Uniper** [announced](#) that it was to test the former Krummhörn natural gas storage facility for suitability for use at a **HESS**. A demonstration **HESS** is to be developed, with storage capacity of up to **250,000 m³**.
- **Market control of BESS:** On **April 12, 2022**, it was reported widely that **EnergyAustralia** (one of Australia's Big Three Integrated energy corporations) signed a deal with **Edify** (leading renewable energy project development corporation) to take market control of **Edify's Darlington Point (25 MW / 50 MWh)** and **Riverina 2 (65 MW / 130 MWh) BESSs** in New South Wales, Australia. (Regular readers of Low Carbon Pulse will recall that the Riverina 1 BESS is the subject of contractual arrangement with Shell: see [Edition 18](#) of Low Carbon Pulse.)
EnergyAustralia operates **Edify's Gannawarra (25 MW / 50 MWh) BESS** in Victoria, Australia, and **Ausnet's Ballarat (30 MW / 30 MWh) BESS**, also in Victoria. **EnergyAustralia** is developing its own **BESS**, the **Wooreen (350 MW / 1400 MWh) BESS**, in the Latrobe Valley, Victoria.
- **Virtual BESS:** On **April 14, 2022**, **AGL** and **Neoen** [announced](#) that they had signed a virtual **BESS capacity contract (BESS CC)**. Under the **BESS CC** **Neoen** (leading renewable electrical energy corporation) provides **AGL** (one of Australia's Big Three integrated energy corporations) with **70 MW / 140 MWh** of virtual **BESS** capacity in New South Wales, Australia. The **BESS CC** allows **AGL** to charge and to dispatch the **BESS**, providing **AGL** with flexibility in respect its customer load.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to carbon accounting and carbon dioxide removal (CDR), including bioenergy carbon capture (BECCs), bioenergy carbon capture use and storage (BECCUS), carbon capture and storage (CCS), carbon capture use and storage (CCUS) and direct air capture (DACs). Effective accounting for carbon arising and CDR go hand-in-hand. By way of background CDR is recognised in the 2021 Report as including: afforestation, soil carbon sequestration, bioenergy with carbon capture and storage (BECCS), wet land restoration, ocean fertilisation, ocean alkalisation, enhanced terrestrial weathering and direct air capture and storage (DACs) are all means of CO₂ removal. The IEA pathway to NZE estimates that in order to achieve NZE it will be necessary to capture and to remove up to 7.6 giga-tonnes of CO₂ each year through CCS, CCUS and CDR. CCS and CCUS (and BECCS and BECCUS) involve the capture at the source of CO₂, preventing release to the climate system. The following provides a helpful overview of carbon capture as things currently stand.*

- **Stockholm Exergi's BECCS project receives €180 million of EU support funding:** On **April 1, 2022**, it was announced by **Stockholm Exergi** that the **Climate, Infrastructure and Environment Executive Agency (CINEA)** had committed to provide funding support, in the form of a grant, to allow the installation of **BECCS** technology for **Stockholm Exergi's** project will capture **800,000** metric tonnes of biogenic carbon dioxide a year, capturing nearly 90% of the biogenic carbon dioxide arising.

The biogenic carbon dioxide project is in addition to the existing bio-cogeneration plant in Hjorthagen, Stockholm. **Stockholm Exergi**, among other things, considers that the biogenic carbon dioxide project will be "a catalyst for establishing a market in negative emissions".

On **May 17, 2022**, the **Ashurst Global Towards Net-Zero Emissions Team** will publish an article on **Future-Fuels** (the primary author being the author of Low Carbon Pulse). Among other things, the article on **Future-Fuels** will consider the concept and practicalities of negative emissions, and as such will provide a stepping-stone to the **Carbon Credits** article due to be published by the end of June 2022.

- **Hanson CCS project and HeidelbergCement leadership:**

- On **April 6, 2022**, [constructionnews.co.uk](https://www.constructionnews.co.uk) reported that **Hanson** (part of the **HeidelbergCement Group**) is to spend **GBP 400** to install carbon capture technology at its cement manufacturing plant at **Padewood**, near **Mold, North Wales (Padeswood Project)**.

The stated purpose of the **Padeswood Project** is to allow Hanson to make net-zero cement. This is explained by Hanson's Head of Process and Sustainability, Mr Iain Walpole as follows: "If you replace the [Portland] cement component with **GBBS** [ground granulated blast-furnace slag, which is a lo-carbon cement] ... that brings CO₂ per cubic metre of concrete down; [the **Padeswood Project**] is making the bit that is left behind net-zero".

The bit that is left behind is to be stored permanently in the **Eni UK** depleted natural gas field in **Liverpool Bay**, part of the **HyNet North West**.

- On **April 11, 2022**, **HeidelbergCement Group** announced that the **Concrete Sustainability Council** had certified **16** of its cement manufacturing plants using the new **CO₂** module. This marks further progress in transparency of monitoring and reporting on **CO₂** arising from the manufacture of cement through to the pour of concrete.

- On **April 11, 2022**, the **HeidelbergCement Group** cement manufacturing plant at which **CO₂** is to be captured and then transported for storage in the **Northern Lights Project** was featured in an article in [chemindigest.com](https://www.chemindigest.com) (under **Capturing Carbon Dioxide through Cement**). While the title to article may be a little confusing, the article itself is excellent, featuring the Heidelberg cement manufacturing plant at **Brevik, Norway**, and the way in which **HeidelbergCement Group** is working with **Aker Carbon Capture** and **Aker Solutions**.

- **ExxonMobil pre-FEED:** During the week beginning **April 11, 2022**, it was reported widely that **ExxonMobil** had commenced pre-FEED work to assess the potential for the use of the **Gippsland Basin** (located in the south east of Australia) for the storage of carbon. The pre-FEED work is understood to be focussing on the use of existing infrastructure to store **CO₂** in the depleted Bream field off the coast of Gippsland, Victoria, with a view to commencing operations in 2025 (subject to commercial and technical feasibility).

News of the pre-FEED work arose at the same time that **ExxonMobil** provided a strong narrative around the scale of use of CCS and CCUS, and the likely cost of CCS / CCUS. As reported by Reuters on **April 22, 2022**, ExxonMobil estimates that there will be a USD 4 trillion market for CCS by 2050.

As reported in previous editions of Low Carbon Pulse, the US **DOE** is assessing five forms of subsurface **CO₂** storage: **1.** basalt formation; **2.** oil and gas reservoirs; **3.** organic rich shales; **4.** saline / salt formations; and **5.** unmineable coal seams.

- **Technip Energies selected for Kasawari CCS project:** On **April 19, 2022**, **Technip Energies** [announced](#) that it and **NPCC (National Petroleum Construction Corporation)**, had been selected by **Petronas Carigali Sdn. Bhd** (a subsidiary of **PETRONAS**) to undertake **FEED** for one of the world's largest off-shore **CCS** projects. As reported, the CCS project, located in the **Kasawari gas field off Sarawak, Malaysia**, will process up to 3.7 million metric tonnes of **CO₂** a year, commencing in 2025.

- **CCS / CCUS Databases:**

Previous editions of Low Carbon Pulse have included databases, which are included here for ease of reference.

- US **DOE** National Renewable Energy Laboratory (**NREL**) [Carbon Capture and Storage Database](#), which includes information on active, proposed and discontinued CCS projects around the world.
- US **DOE** [Carbon Storage Atlas](#).
- [Atlas of Carbon and Hydrogen Hubs from the Great Plains Institute](#)
- **CO₂ Value** launched a [New CCU Project Database](#), provides reference for CCS / CCUS projects across Europe.
- The **Clean Air Task Force Carbon Management Tracker**, maps Middle East and North Africa CCS / CCUS.

Carbon Credits and Hydrogen Markets and Trading:

*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the creation of carbon credits, the role of carbon credits, and the trading of them.*

Also this section covers the development of hydrogen markets and trading (bilateral and likely wholesale).

Physical hydrogen trading: On **April 12, 2022**, [hydrogen-central.com](https://www.hydrogen-central.com) reported that during a visit to the North Sea Port in Terneuzen the Dutch **Minister of Climate and Energy** Mr Rob Jetten, had received the first certificated for Green Hydrogen from **HyXChange**.

The hydrogen exchange initiative has been developed by **Gasunie, Port of Rotterdam Authority, Port of Amsterdam, Gronigen Seaports, and North Sea Port**). The **HyXChange** is a trading platform that will allow the physical trading of hydrogen, with each certificate required to trade a Guarantee of Origin.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the development of production capacity to derive and to produce **E-fuels** (energy carriers derived or produced using renewable energy) and **Future Fuels** (energy carriers derived and produced that are characterised as clean carbon or low carbon fuels). **E-fuels** include Green Hydrogen and Green Ammonia, and **Future Fuels** include Blue Hydrogen and Blue Ammonia.

• Neste nest egg and perfect plastic:

- On **April 4, 2022**, Neste [announced](#) that it had signed a funding support agreement with the **Climate, Infrastructure and Environment Executive Agency (CINEA)** under which **CINEA** commits to provide **€88 million** in grant funding to allow **Neste** to continue the development and deployment of its renewable hydrogen and carbon capture and storage project (**SHARC**) at its **Porvoo refinery in Finland**. As currently contemplated, the **SHARC** will allow carbon neutral production of fuels at the **Porvoo refinery** by 2035.
- On **April 1, 2022**, it was reported widely that **Neste** intends to conduct a feasibility study to consider whether it was possible to process liquified feedstock derived from plastic waste at the **Porvoo refinery**.
- **Air Liquide safe bet in Las Vegas:** On **April 4, 2022**, **Air Liquide** (one of the Big Three industrial gas giants) announced that it is to develop a landfill gas-to biogas-to clean-gas project near **Las Vegas, Nevada** (the **Nevada Hydrogen Factory**). The **Nevada Hydrogen Factory** will produce 30 metric tonnes of liquid hydrogen (**LH2**) a day. In the first instance, it is understood that the **LH2** will be transported to California for sale into the mobility market.

By way of reminder **Edition 36** of Low Carbon Pulse reported that:

- "**Air Products** (one of the Big Three industrial gas giant globally, with Air Liquide and Linde) is to develop a 10 metric tonne a day liquid hydrogen (**LH₂**) production facility in **Casa Grande, Arizona**, with the **LH₂** to be used in the California mobility market. The **LH₂** production facility will comprise two **thyssenkrupp nucera electrolysers** to produce gaseous hydrogen and **Air Products** technology to liquify to produce **LH₂**"; and
- "**Samsung Ventures** had joined **Chevron Corporation, Itochu Corporation** and **Ascent H2 Fund** in backing **Raven SR** in respect of its first waste to hydrogen plant in northern California. Under the deal between **Samsung Ventures** and **Raven SR**, **Raven SR** is to work with **Samsung C&T** (a sibling corporation of Samsung Ventures) to "advance the scalability" of the **Raven SR** technology to develop and to deploy it in the Asian market.
- "**Raven SR** was to develop a hydrogen from waste facility in **Aragon, Spain**. As reported, the facility will treat 75 metric tonnes of organic waste a day to produce 1,600 metric tonnes of hydrogen a year".

It is clear that hydrogen from landfill gas is "now a thing": click [here](#) for the first feature in the **Hydrogen for Industry (H24I)** features published in June 2021. As noted in previous editions of Low Carbon Pulse, the technologies used to derive and to produce hydrogen from waste in landfill or the landfill gas arising from waste in landfill, gives rise to **CO₂** unless that **CO₂** is captured and stored for captured and used, and as is not carbon neutral of itself.

• Bakken Energy and Mitsubishi Heavy Industries continue to progress:

- On **April 5, 2022**, [asia.nikkei.com](#) reported (under [Mitsubishi Heavy taps US partner for \\$2 bn hydrogen project](#)) that **Mitsubishi Heavy Industries** was continuing to work with **Bakken Energy** develop the largest clean hydrogen project in North America to date, the **300,000 metric tonnes** a year **North Dakota Clean Hydrogen Hub Project**. The feedstock for the production of clean hydrogen is natural gas.
- On **April 10, 2022**, [asia.nikkei.com](#) updated early reporting (under [Mitsubishi Heavy's U.S. hydrogen hub to receive \\$90 million in aid: governor](#)) that the US State of **North Dakota** was to provide USD 90 million of funding support, including subsidies and low-interest financing for the development of the **North Dakota Clean Hydrogen Hub Project**.

By way of reminder:

- **Edition 19** of Low Carbon Pulse reported:

"**Great Plains take-off:** On June 2, 2021, Bakken Energy and Mitsubishi Power Americas, Inc., announced that they had signed a strategic partnership agreement to create a clean hydrogen hub in North Dakota, US (**CHH**). The **CHH** is to comprise clean hydrogen production, storage, and transportation facilities, to deliver clean hydrogen to the point of use. The intention of Bakken Energy is to produce Blue Hydrogen from natural gas, so as to become, in the words of Bakken Energy CEO, Mr Mike Hopkins: "the largest and lowest cost producer of clean hydrogen in the United States".

[Mitsubishi](#) has been active in the development of hydrogen hubs in the US, with the Californian Project (City of Los Angeles), **Magnum Development** in **Delta, Utah**, and the Texas Brine project".

- **Edition 25** of Low Carbon Pulse reported:

"**Bakken back plain sailing:** **Edition 19** of Low Carbon Pulse reported on Bakken Energy and Mitsubishi Power Americas Inc's strategic partnership to create a clean hydrogen hub in North Dakota, US.

On August 19, 2021, HydrogenCentral, reported (under [Bakken Energy to Purchase Dakota Synfuels Plant and Convert to Blue Hydrogen, \\$ 2 B Hydrogen Hub Project](#)) that Bakken Energy had agreed terms with Basin Electric Power Corporation to purchase the gas assets of the Dakota Gasification Company, including its Synfuels facility.

It is reported that Synfuels facility will be expanded and repurposed, and that it will incorporate advanced autothermal reforming (**ATR**) technology, rather than steam methane reforming (**SMR**) technology, to increase and to maximise the capture of **CO₂** arising during the production of clean hydrogen (being hydrogen using carbon intensive feedstock that is then reformed).

The **ATR** technology to be deployed is reported as capturing of 95% of carbon emissions arising. It is hoped that that Bakken will seek to address the 5% not covered by capture through a sequestration strategy".

- **Mitsubishi and Shell aligned:** On **April 7, 2022**, [h2-view.com](#) reported that **Mitsubishi Corporation** (Japanese conglomerate) and **Shell plc** (leading global international energy corporation) had agreed to work together to develop

and to deploy **Green Hydrogen** production capacity using renewable electrical energy sourced from **4 GW** of off-shore wind fields off the Netherlands.

As currently contemplated, together **Mitsubishi** and **Shell** plan to produce **400,000** metric tonnes a year of Green Hydrogen by 2030, and is expected to be used for fertiliser production and for heating. Mitsubishi Corporation will invest through its subsidiary Eneco Groep N.V.

• **Atura Power on the move:**

• **Niagara Falls to produce Green Hydrogen:** On **April 8, 2022**, [h2-view.com](https://www.h2-view.com) reported (under **Niagara Falls to integrated a Hydrogen Centre with 20 MW capacity**) that **Atura Power** (Ontario gas producer) plans to develop the **Niagara Hydrogen Centre** to house a **20MW** electrolyser to produce Green Hydrogen.

The Green Hydrogen produced by the **Niagara Hydrogen Centre** may be used to balance the Ontario, Canada, electricity grid in real time.

• **HES:** On **April, 21, 2022**, it was reported widely that **Atura Power** and **Plains All American** had signed a memorandum of understanding to work together on FEED to analyse the commercial and technical feasibility of the development of a **20 MW** electrolyser, the hydrogen from which would be stored in a **HES** in a subsurface structure – the **Windsor salt-cavern**.

• **Lhyfe aligned wpd and Mitsui:**

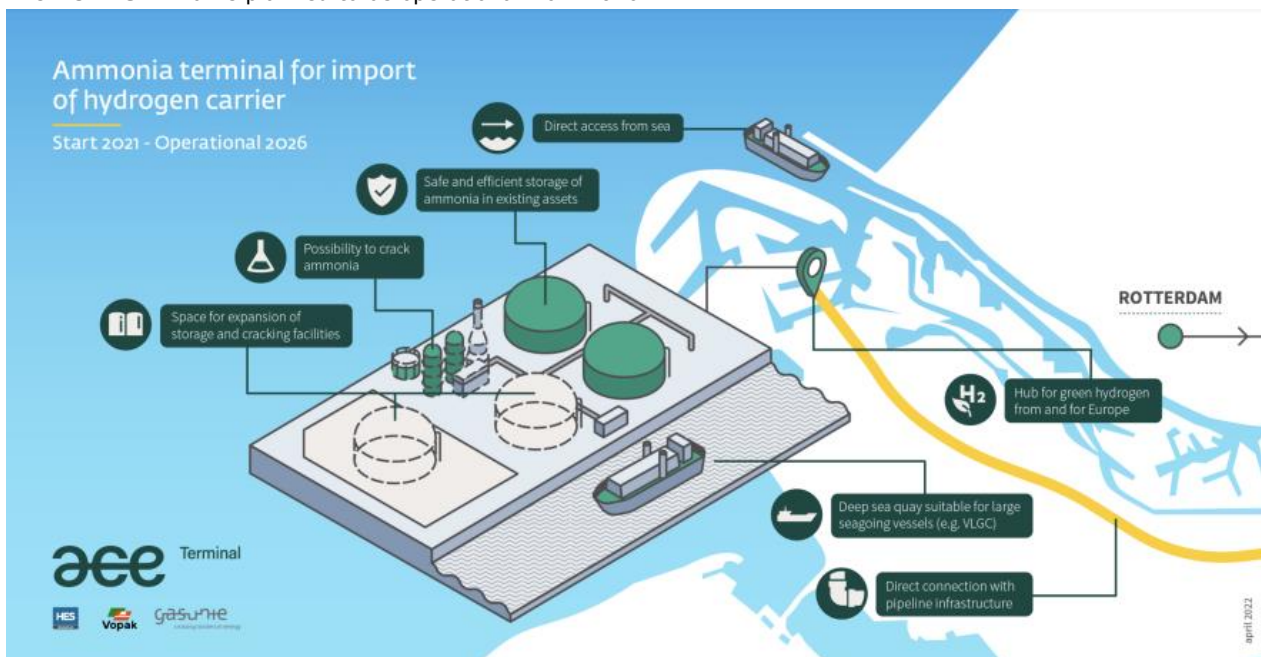
• On **April 11, 2022**, [h2.view.com](https://www.h2-view.com) reported that **Lhyfe** (French green hydrogen producer) and **wpd** (German wind and solar energy producer) have agreed to work together to develop and to deploy a large-scale Green Hydrogen production facility, of up to **600 MW**, using renewable electrical energy sourced from a planned **1 GW** off-shore wind field.

The agreement is reflected in a memorandum of understanding (**MOU**), and it is understood contemplates connection to the **Nordic Hydrogen Backbone**.

• On **April 13, 2022**, **Mitsui & Co., Ltd** [announced](https://www.mitsui.com) that it had invested in **Lhyfe**, on the basis that it is aligned the sustainability goals of **Mitsui**, critically, to allow **Mitsui** to import Green Hydrogen into European markets.

• **ACE Terminal progressing:** On **April 11, 2022**, **Vopak** provided an update in respect of the **ACE Terminal**.

The **ACE Terminal**, being developed by **Gasunie** (energy infrastructure company in the Netherlands and Germany), **HES International B.V.** and **Vopak**. The Green Ammonia import terminal is being developed in the Port of Rotterdam. The **ACE Terminal** is planned to be operational from 2026.



• **Gladstone to get another hydrogen production facility:** On **April 12, 2022**, it was reported widely that **The Hydrogen Utility (H2U) Group** (Australian green hydrogen infrastructure developer) and **Orica** (explosives supplier) are to assess the first stage of the development of a **3 GW Green Hydrogen Hub**, capable for producing up to 5,000 metric tonnes of Green Hydrogen a day, the electrolysers powered by renewable electrical energy sourced from photovoltaic solar and wind sources.

• **Desert Bloom progresses:**

• On **April 11, 2022**, it was reported widely that **Osaka Gas** had agreed to develop **Desert Bloom** jointly with **Aqua Aerem** (air-to-water technology developer). The involvement of **Osaka Gas** is telling, providing support for both the project and the technology.

• **By way of reminder:**

Edition 32 of Low Carbon Pulse reported on **Desert Bloom** as follows:

"On December 13, 2021, it was reported widely (and enthusiastically) that the Desert Bloom Green Hydrogen production facility project in the Northern Territory, Australia, had been given Major Project Status.

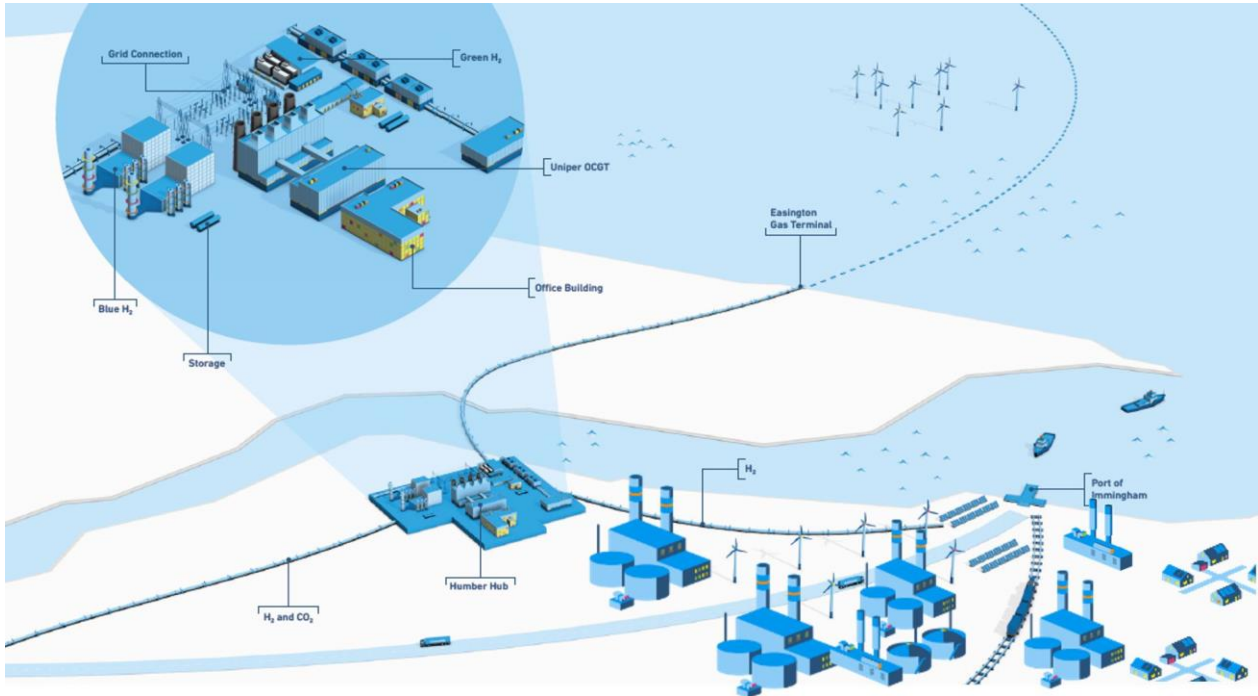
In any State or Territory in Australia, Major Project Status allows for coordination of approvals and permitting, and in so doing increases the rate at which a project is able to progress to development and deployment. Project

proponent, Aqua Aerem (water air in Latin), has indicated that Major Project Status will allow a 8 MW pilot to commence in 2022, ahead of the planned 10 GW, AUS 10.75 billion, staged development.

On completion the Desert Bloom Green Hydrogen production facility will produce 410,000 metric tonnes of Green Hydrogen a year at a projected cost of less than USD 2/kg.

Desert Bloom is a game changer because it uses "air-to-water" technology: some areas of the world with world class solar resources are areas that are also subject to water stress, and as such require the use of desalinated sea-water or process and treat waste water to provide the H₂O feedstock for the production of Green Hydrogen using electrolyzers, adding cost, both capital and operating. The "air-to-water" or "water-from-air" technology will allow arid environments to be developed for Green Hydrogen production. Aqua Aerem is majority owned by Sanguine Impact Investment".

- **Shell and Uniper progress:** On **April 12, 2022**, **Shell** [announced](#) (under [Shell and Uniper to work together on Blue Hydrogen production facility in the UK](#)) the signature of a cooperation agreement with **Uniper** to progress plans for low-carbon hydrogen production at Uniper's **Killingholme Site** in North Lincolnshire, England.



Source: [Uniper LinkedIn](#)

As contemplated, the low-carbon hydrogen produced will be used by heavy industry, land transport mobility, and heating and power across the Humber region (and beyond). As noted in **Edition 37** of Low Carbon Pulse, the project satisfied the eligibility criteria for the Phase-2 carbon capture, usage and storage Cluster Sequencing Programme.

- **Seoul Sludge to Hydrogen:** On **April 12, 2022**, it was reported that **Seoul Water Recycling Corporation** is working with **Plagen** (a pyrolysis and renewable fuel production corporation) to develop jointly technology to source **biogas** from the sludge arising from waste water treatment to produce hydrogen from the **biogas**.

In addition to outlining the production of hydrogen from waste, **Hydrogen for Industry (H24I)** (entitled [Hydrogen from Waste](#)) feature published in June 2021 outline the production of hydrogen from waste water.

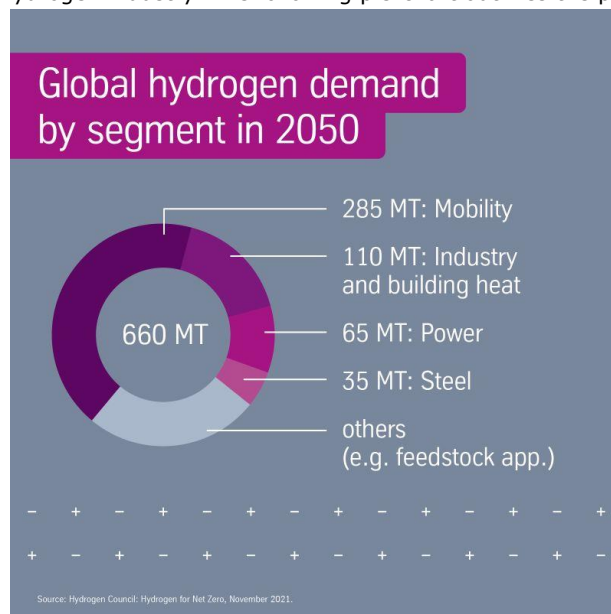
As noted in previous editions of Low Carbon Pulse, if water, derived from the waste water, is electrolysed, the hydrogen produced will be Green Hydrogen. If biogas is derived from the waste water and is subject to steam methane reforming or pyrolysis the hydrogen derive or produced will not be Green Hydrogen, because as a matter of chemistry **CO₂** will arise even if in the form of carbon black in the case of the use of some pyrolysis technologies.

- **Total Eren chilled:** On **April 14, 2022**, it was reported that **Total Eren** is progressing with the development of its **8 GW** Green Hydrogen production facility in the **Magallanes** region, Southern Chile (see **By way of reminder below**) with the reported appointment of Wood (leading global consulting and engineering corporation) to undertake conceptual design and engineering work.

By way of reminder: Edition 32 of Low Carbon Pulse reported that: "Total Eren (a leading renewable energy corporation part owned by TotalEnergies) plans to develop a **10 GW** on-shore wind project to supply renewable electrical energy to power Green Hydrogen and Green Ammonia production facilities in the Magallanes region of southern Chile (**H2 Megallanes**): it is reported that **H2 Megallanes** will comprise a desalination facility, **8 GW** of electrolyser capacity, and ammonia production facilities. First production is expected by 2027, with the expectation that **H2 Megallanes** will produced **800,000** metric tonnes of Green Hydrogen a year, and **4 million** metric tonnes of Green Ammonia".

- **Project Global Hydrogen Supply by 2030:** On **April, 13, 2022**, **EDF Group** (global leading electrical energy corporation) [announced](#) (under [The EDF Group launches a new industrial plan to produce 100% low-carbon hydrogen](#)) that it aims to develop "3 GW of electrolytic hydrogen projects worldwide by 2030. These projects will involve between €2 and €3 billion of investment, will be developed and co-financed through industrial partnerships and by drawing on national and European support mechanisms". The hydrogen produced will be both Green and Pink.

- Sun Cable continues to progress:** On **April 20, 2022**, the Australian Broadcasting Corporation (**ABC**) on-line news feed, abc.net.au reported that the **environmental impact assessment (EIS)** for **Sun Cable** had been lodged. As regular readers of Low Carbon Pulse will know, the **Sun Cable** (and the **Australia-Asia PowerLink**) projects have been covered in Low Carbon Pulse from the earliest editions (see **Editions 2, 3, 13, 26, 28, 32**). As reported by the **ABC**, the **EIS** identifies a range of potentially negative environmental impacts, characterised as minor to moderate.
 - CIP and Madoqua Renewables progress in Portugal:** On **April 20, 2022**, renews.biz reported that **Copenhagen Infrastructure Partners' Energy Transition Fund** is working with **Madoqua Renewables** and **Power2X** to develop a **€1 billion 500 MW** Green Hydrogen and Green Ammonia production facility to be located in **Sines, Portugal** (the **MadoquaPower2X** project). The **MadoquaPower2X** project will produce **50,000** metric tonnes of Green Hydrogen and **500,000** metric tonnes of Green Ammonia a year.
 - Advanced Methanol Rotterdam (AMR):** On **April 24, 2022**, as reported the **AMR** facility will produce up to **90,000** metric tonnes of renewable methanol a year from feedstock comprising **180,000** metric tonnes of non-recyclable waste, currently being treated thermally. The **AMR** facility will capture all **CO₂** arising, and it will be used in local greenhouses, and the bottom ash will be used for cement production, with other residual streams (including ammonia and salts) to be sold.
 - Aker Horizons and Nordkraft shape the north:** On **April 25, 2022**, it was reported widely that **Aker Horizons** and **Nordkraft** plan to develop, in joint venture, a large-scale hydrogen production facility in **Narvik, Norway**. It is understood that common use infrastructure will be developed to provide sites for energy intensive industries. A key driver for the development of the hydrogen hub in **Narvik** is the surplus renewable electrical energy that arises regionally, that will allow relatively low-cost renewable electrical energy to power electrolyzers for Green Hydrogen production.
 - Permacand and RES to develop Green Hydrogen production facility:** On **April 25, 2022**, it was reported widely that **Permacand** (an electrode supplier) and **RES** (a global renewable energy company) had signed a letter of intent (**LOI**) to develop a Green Hydrogen production facility in **Alby, Ånge Municipality, Sweden**.
 - US DOE lends to the Advanced Clean Energy Storage Hub Project:** On **April 26, 2022**, it was reported that the **US DOE Loan Program Office** had committed, conditionally, to provide up to **USD 504.4** million of debt funding in respect of the **Advanced Clean Energy Storage Hub Project**. The **Advanced Clean Energy Storage Hub Project** is to be developed by **Magnum Development LLC** and **Mitsubishi Power Americas Inc**, and it expected to commence operations in 2025.
- On **April 27, 2022**, it was reported that **Black & Veatch** had been selected as an EPC provider for the Project.
- By way of reminder:** Edition **19** of Low Carbon Pulse reported on the **Advanced Clean Energy Storage Hub Project** as follows: "Advanced Clean Energy Storage (**ACES**) project in Delta, Utah, developed by Mitsubishi Power Americas and Magnum Development. The project contemplated will comprise a 1 GW electrolyser facility, producing 450 metric tonnes per day of clean hydrogen, with salt-caverns to store hydrogen".
- Approvals to energise HyEx Project:** On **April 28, 2022**, renewablesnow.com reported that **Engie Latam SA** (ammonium and nitrate producer) and **Enaex SA** (explosives supplier) had received environmental approval to commence their complementary Green Hydrogen production facility and Green Ammonia synthesis facility in the city of **Tocopilla, Antofagasta, Chile**. While the **HyEx Project** it is not world scale of itself, it provides a model project in terms of participants and replicability.
 - Projected Global Hydrogen Demand by 2050:** Various editions of Low Carbon Pulse have reported on the estimated projected demand for hydrogen by 2025. A **Hydrogen Council** report (published on **November 2021**) provides estimates from the hydrogen industry. The following pie-chart outlines the projected demand by sector:



Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the development of:

- areas in which: **1. infrastructure** will be developed and deployed to support the development and deployment of hydrogen production capacity and use (**Hydrogen Hubs**), the capture of carbon dioxide, and the consolidation of captured carbon dioxide for storage or use or both (**Carbon Clusters**); and **2. technologies** facilitating energy transition will be concentrated and supported (**Hydrogen Corridors and Valleys**); and
- **giga-factories** that fabricate and manufacture photovoltaic solar panels (and associated equipment), wind-turbine blades and towers (and associated equipment), electrolyzers (and associated equipment), electric batteries and hydrogen fuel cells, and transmission cabling (including HVDC transmission cabling).

Also the section considers developments in cities to decarbonise (including using waste heat), and to cool, cities. The development of infrastructure at ports and installation and support vessels for off-shore wind developments are considered in the **Ports Progress and Shipping Forecast** section of each edition.

- **Enel receives funding support for expansion of giga-factory:** On **April 1, 2022**, the **Enel Green Power** (subsidiary of Enel, leading international renewables and utility corporation) [announced](#) that it had signed a grant agreement with the **Climate, Infrastructure and Environment Executive Agency (CINEA)** under which it will receive **€118 million** to be contributed to the cost of the expansion of its 200 MW bifacial photovoltaic module factory in Catania, southern Italy, into a **3 GW** Giga-factory. The total cost of expansion is understood to be **€600 million**.
- **John Cockerill and Greenko Group roost:** On **April 11, 2022**, [rechargenews.com](#) reported the **John Cockerill Group** (leading electrolyser technology corporation) is to develop a **2 GW** electrolyser giga-factory in India in conjunction with a subsidiary of **Greenko Group** (a leading renewable energy corporation). The **John Cockerill Group** manufactures alkaline electrolyzers.

[Recharge news](#) notes that this is the 14th Giga-factory for electrolyser manufacture in the past year or so, and the second in India after Ohmium.

ELECTROLYSER GIGA-FACTORIES

Cummins 1 GW x 2 *	FFI – 2 GW	ITM Power – 5 GW	McPhy – 1 GW	NEL – 2GW +
Ohmium – 0.5 to 2 GW \$	Plug Power 1 GW x 2 #	Siemens Energy – 1 GW	Sunfire – 1 GW	Thyssenkrupp – 5 GW

* Cummins has announced two Giga-Factories, one with Iberdrola, and one with Sinopec,

Plug Power has announced two Giga-Factories, one in the US, one in ROK.

\$ Ohmium International announced on April 18, 2022 that it is to increase electrolyser manufacturing capacity to 2 GW by the end of 2022 at its giga-factory in Bangalore, India.

+ NEL ASA announced on April 20, 2022, that its fully automated electrolyser manufacturing facility in Herøya, Norway, was on-line.

- **Republic of Ireland's first Hydrogen Valley:** On **April 14, 2022**, [renews.biz](#) reported that the **Port of Galway** and **SSE Renewables** (leading developer and operator of renewable energy across the UK and Ireland) had unveiled plans for Ireland's first Hydrogen Valley (the **Galway Hydrogen Hub**).

The **Galway Hydrogen Hub** was announced by An Taoiseach, Mr Micheál Martin.

In addition to the **Port of Galway** and **SSE Renewables** and other members of the **Galway Hydrogen Hub** are reported to be Aer Arann Islands, Aran Islands Ferries, Bus Eireann, CIE Group, Lasta, and NUI Galway. It is understood that a Green Hydrogen production facility will be developed at Galway Harbour to produce Green Hydrogen for use within the Hydrogen Valley, the primary use being to fuel private and public transport.

- **100 cities to participate in EU Missions:** On **April 28, 2022**, the **EC** announced the [100 EU cities](#) that will participate in the [EU Mission](#), the so called **Cities Mission**.

The cities comprise cities located in the 27 Member States and 12 other cities associated with the EU research and innovation programme. As noted in previous editions of Low Carbon Pulse, urban areas are home to 75% of EU citizens.

Globally cities consume over 65% of energy and give rise to more than 70% of GHG emissions.

EU CITIES



Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the extraction of metals and minerals necessary for the decarbonisation of activities to progress towards achievement of **NZE**, the use of **E-fuels** and **Future Fuels** to power and to propel vehicles used to extract and to transport metals and minerals, and the use of E-fuels and Future Fuels to process and to treat those metals and minerals. Also this section considers the Difficult to Decarbonise industries, including the iron and steel sector.

- **Highlight for HYBRIT:** On **April 1, 2022**, **LKAB**, **SSAB** and **Vattenfall** [announced](#) the signature of the funding support agreement with the **Climate, Infrastructure and Environment Executive Agency (CINEA)**, in the form

of a grant. The funding support is to allow the scaling up and commercialisation of the value chain for the use of hydrogen to produce green iron and steel.

By way of reminder: Low Carbon Pulse has covered the **HYBRIT** project as follows:

- **Edition 13:** "On March 24, 2021, it was announced that **HYBRIT** is to develop a new Green Steel mill in Gallivare, Sweden, to produce fossil-free sponge iron (also known as direct reduction iron). The Gallivare Green Steel mill will have a total steel-making capacity of 2.7 million metric tonnes per annum by 2030. The Gallivare Green Steel mill will join the pilot Green Steel mill at Lulea that has proved up the technology. In addition, there are plans to develop an underground storage facility to store Green Hydrogen. The project is part of an integrated supply chain, from "mine-to-mill-to-manufacturer", among the **HYBRIT** partners (LKAB, SSAB and Vattenfall), to transform their respective businesses: for LKAB as the supplier of iron ore, SSAB as the steel mill owner and operator, for Vattenfall as a producer, and retailer, of electrical energy and heat, and the producer and supplier of Green Hydrogen. (Vattenfall is ultimately a Swedish state-owned company.) **Hybrit Development AB**, owned by LKAB, SSAB, and Vattenfall, was established to develop technology to enable the production of steel using hydrogen, rather than coal. Significant support has been provided by the Swedish Energy Agency, through *Industriklivet*".
- **Edition 16:** "Edition 13 of Low Carbon Pulse, outlined the **HYBRIT project**. On April 7, 2021, it was reported that SSAB, LKAB and Vattenfall have commenced the development of a cavern storage facility to store Green Hydrogen produced for use at the **HYBRIT Green Steel mill**. As noted in other editions of Low Carbon Pulse, the use of cavern storage for Green Hydrogen will provide the means to produce Green Hydrogen (or Blue Hydrogen for that matter), and to store it, providing both inventory for the facility at which it is used, and energy storage. Also as hydrogen infrastructure networks develop, surplus inventory may be sold or traded, and dispatched".
- **Edition 20:** "Editions 13 and 16 of Low Carbon Pulse reported on the development of what is billed as the world's first fossil free steel plant located at Svartoberget, in Lulea, Sweden (**HYBRIT**). The development of **HYBRIT** is being undertaken in alliance with SSAB, LKAB, and Vattenfall (see Editions 13 and 16 of Low Carbon Pulse). Effectively, the **HYBRIT** partners have developed a "mine-to-mill-to-manufacture" supply chain.
 - **Pilot to commercial scale:** The **HYBRIT** plant at Svartoberget, in Lulea, is a pilot plant which had proved up green sponge iron production. **HYBRIT Development AB**, owned by SSAB, LKAB, and Vattenfall, is developing a commercial, world scale, plant at Gallivare (see Edition 13 of Low Carbon Pulse).
 - **Production assurance:** On June 17, 2021, it was announced that to achieve more efficient storage of the hydrogen produced for use in the manufacture of Green Steel hydrogen, that hydrogen will be compressed, and for this purpose **HYBRIT** has contracted with Howden Group (leading air and gas handling company) for the supply by Howden of a high-pressure diaphragm compression system. Depending on which information source is used, the production of steel is responsible for between 7 and 9% of global **GHG** emissions (see second article in **The Shift to Hydrogen (S2H2): Elemental Change** series entitled [What needs to be decarbonised? And what role can hydrogen play?](#) for the scope, size and shape of the global steel industry.)
 - **High Light – world first:** On June 21, 2021 it was announced that **HYBRIT** had completed the first production test of sponge iron (or direct reduction iron (DRI): see Edition 10 of Low Carbon Pulse), using hydrogen instead of coking coal to remove oxygen thereby avoiding the **CO₂** arising. This is a world first".
- **Edition 25:** Under **HYBRIT's Clean Steel on the road:**
 - **The concept:** Previous editions of Low Carbon Pulse (see Editions 13 and 16, and summarised in Edition 20, of Low Carbon Pulse) have reported on **HYBRIT Development AB's** (established and owed by SSAB (steel mill owner and operator), LKAB (iron ore supplier) and Vattenfall (state-owned energy company, producer and supplier of Green Hydrogen)) development of a "mine-to-mill-to-manufacture" supply chain, including the development of a pilot plant at Svartobret, in Lulea, billed as the world's first fossil free steel plant, using hydrogen for high-temperature heat processes to produce steel, rather than metallurgical coal.
 - **The execution:** Edition 20 of Low Carbon Pulse reported that SSAB and Volvo Group had entered into a letter of intent for the supply and purchase of Green Steel, and on the production of the first sponge iron at the pilot plant in Lulea. In July 2021, SSAB rolled the first steel using the **HYBRIT** technology.

On August 18, 2021, it was widely reported that SSAB had supplied the world's first 100% fossil free steel to Volvo Group. President and CEO of SSAB, Mr Martin Lindqvist, said: "The first fossil-free steel in the world is not only a breakthrough for SSAB, it represents proof that it's possible to make the transition [and reduce significantly] the global carbon footprint of the steel industry."

As noted in Edition 13 of Low Carbon Pulse, the **HYBRIT** technology is to be deployed at the Gallivare Green Steel mill, to have Green Steel production capacity of up to 2.7 million metric tonnes per annum by 2030.
 - **The significance:** As noted in Edition 22 of Low Carbon Pulse, one of the joys of authoring Low Carbon Pulse is "following both the connectedness of change, and the pace of change".

Following the progress of the **HYBRIT** partnership, and technology, illustrates this perfectly.

Why is this significant?

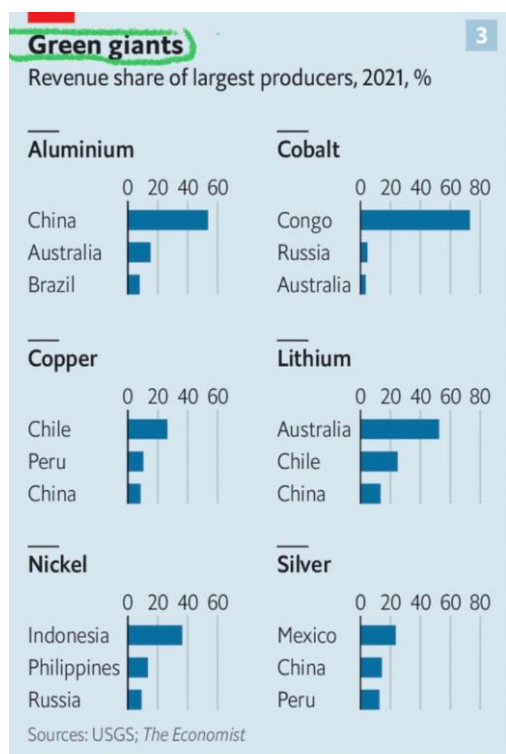
Article 2 in the **S2H2** series, it was noted that: "The production of steel may be regarded as giving rise to between 7 and 10% of global **GHG** emission or between 3,500 and 5,000 mmt (or 3.5 to 5 billion tonnes) of **GHG** emissions a year [Note: This does not include the **GHG** emissions arising to extract, transport to iron ore to mill, and from mill to point of use]. Global crude steel production is around 1,900 mmt (1.9 billion tonnes) a year. The best estimate is that between 1.9 and 2.1 tonnes of CO₂ arises in respect of each tonne of steel produced ... On metrics discernible consistently, it is estimated that a little over 3,500 mmt (3.5 billion tonnes) of CO₂ arise each year from steel production. The **EU** has this higher at close to 4,000 mmt (4 billion tonnes)."

Progress towards the decarbonisation of the iron and steel industry is to be welcomed, warmly.]; and
- **Edition 26:** "Edition 25 of Low Carbon Pulse reported, with enthusiasm, on the greening of the iron and steel sector (under **HYBRIT's Clean Steel on the road**). The cement and concrete industry gives rise to a greater mass of GHG emissions than the iron and steel industry: between 3,500 to 4,000 billion tonnes of GHG emissions arise each year from the production of cement.

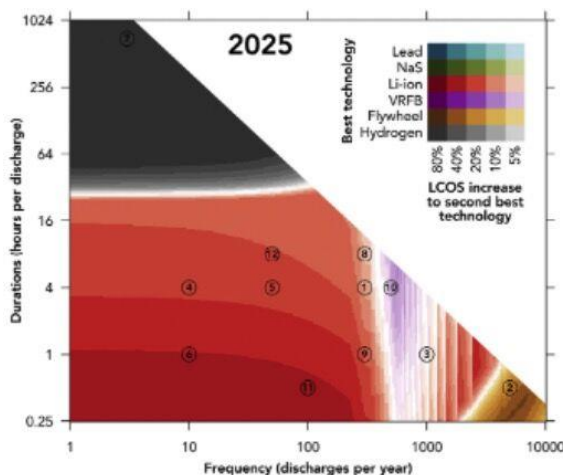
In an [article](#) in Fast Company, Mr Mark Wilson provides an overview of the possible storage of CO2 in concrete. This concept will be considered in the August Report on Reports (in the summary of the CUR) as the Appendix to **Edition 27** of Low Carbon Pulse.

Clean Steel a thing: **Edition 25** of Low Carbon Pulse reported that (under **HYBRIT's Clean Steel on the road**) SSAB delivered the "first fossil-free steel in the world" to Volvo Group from the **HYBRIT** mill, using HYBRIT technology. On September 1, 2021, SSAB announced that it is to partner with Daimler's Mercedes-Benz to introduce fossil-free steel to the production of vehicles. As a reminder, **HYBRIT** is a shortening of Hydrogen Breakthrough Ironing Making Technology, developed jointly by LKAB, SSAB and Vattenfall".

- **By way of a further reminder:** **Edition 37** of Low Carbon Pulse reported that the **Green Steel Tracker** had been released. The **Green Steel Tracker** has been developed by the Stockholm Environment Institute and the Leadit Secretariat. A link to the internet site with the **Green Steel Tracker** is included [here](#). The **Green Steel Tracker** is a helpful tool for those wishing to follow green iron and steel projects globally.
- **POSCO and Hancock testing feasibility of HBI plant:** On **April 1, 2022**, the author picked up on reporting in the **ROK** press that **POSCO** had announced the execution of a memorandum of understanding (**MOU**) between **POSCO** and **Hancock** to Produce Low Carbon Steel Raw Materials, with the **MOU** focusing on testing the feasibility of a **hot briquette iron (HBI)** production facility, and, depending on the outcome of the testing of feasibility, the development of an iron ore mine to provide dedicated iron ore to produce **HBI**. To some with long memories, and longer in the tooth, **HBI** has long been a good idea the time for which may be nigh.
- **Critical metals and minerals:** The bar chart below illustrates how metal and mineral prices performed during 2021. The message is clear – higher demand = higher prices, the best sure for higher prices, is increased supply. As such, as has been clear for a while, it seems likely that a mining boom is ever-more likely.



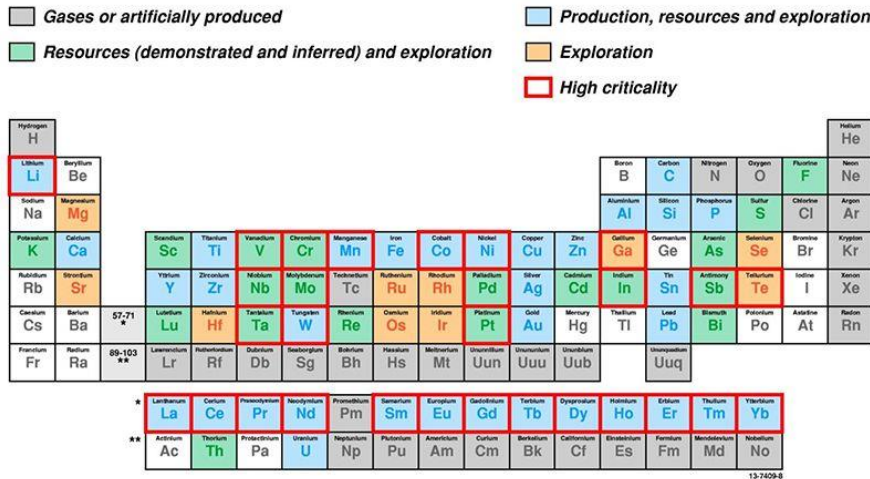
The Economist



- **Battle of the batteries - BEV versus FCEV:** The dynamics and thinking informing the debate around the use of **BEV** and **FCEV** is becoming more nuanced, helped by ever more research and work. The above graph (at the right hand side), prepared by the team at **Imperial College, London**, demonstrates that frequent and rapid recycling tends to prefer the use of li-on technology **BEV** technology, whereas less frequent and more extended cycles tend to prefer the use of **FCEV** technology.

This has been the instinctive, possibly intuitive, sense for many, but the Imperial College, team have provided a firm basis for the use of both technologies.

- **Iluka to develop REE refinery in Western Australia:** On **April 3, 2022**, **Iluka Resources** [announced](#) that the Australian Federal Government had approved an **AUD 1.25** billion loan to allow **Iluka Resources** to develop a rare earths and elements (**REE**) refinery. As many readers will know, Australia is a leading miner of bauxite (for alumina and aluminium), cobalt and nickel, copper and gold, iron ore, lead, lithium, manganese, and zinc, it also has the potential to be a leading miner and producer of **REEs**.



Source: [Pedram Danesh-Mand LinkedIn](#)

- **Green Steel expansion awaiting Green Hydrogen:** On **April 8, 2022**, [InnovationAus.com](#) reported that aluminium and iron and steel magnate, and chair of the **GFG Alliance**, **Mr Sanjeev Gupta**, speaking at an AmCham meeting in Adelaide, South Australia, announced the intention to expand iron and steel production capacity, to increase capacity by up to 2.5 million metric tonnes a year. To facilitate the expansion Mr Gupta encouraged Australia, to become "a world leader in .. clean hydrogen, not on by exporting green hydrogen, but using it to produce green projects such as steel".
- **Rio Tinto to strengthen social licence:** On **April 10, 2022**, it was reported widely that **Rio Tinto** is to focus on mining metals and minerals that are key to the achievement of energy transition, critically, copper, lithium and nickel, alongside the continued mining of iron ore.
- **The urban ore body / urban mining:** Back in the early days of waste projects (2000), the author used to work with **Dr John White** who coined the phrase, the "urban ore body" to refer to the waste that arose in urban environments. In recent months the author has read a number of pieces referring to "urban mining". In passing, this section could be included in most sections of Low Carbon Pulse, because waste includes organic and inorganic material, in gaseous, liquid and solid form. The piece headed **Landfills to be minded** provides an example of "urban mining". Bringing thinking together, it is clear that policy makers are moving towards acceptance of waste as a resource. Those involved in the waste collection and management industry have long regarded waste of all kinds as a resource. In this context there is a role for government in providing or supporting that development of waste collection infrastructure to maximise the capture of waste arising in the urban environment to allow maximisation of recycling and reuse of all waste streams arising in an urban context. The policy settings need to be developed with policy settings that reduce the amount of waste arising, and that maximise the prospect of recycling and reusing the waste streams that do arise. For example, **Edition 36** of Low Carbon Pulse reported as follows:

"With the presentation of the **Circular Economy Action Plan**, the **EC** is proposing [new regulations and rules](#) in respect of good and products, including to addressing energy efficiency over the life-cycle of those goods and products, and to design their recycling and repurposing at the end of their design life. In addition, the EC presented proposals in respect of textiles, construction materials and products, and to ensure that customers are informed fully as to the sustainability of the goods and products."

Wind round-up, on-shore and off-shore:

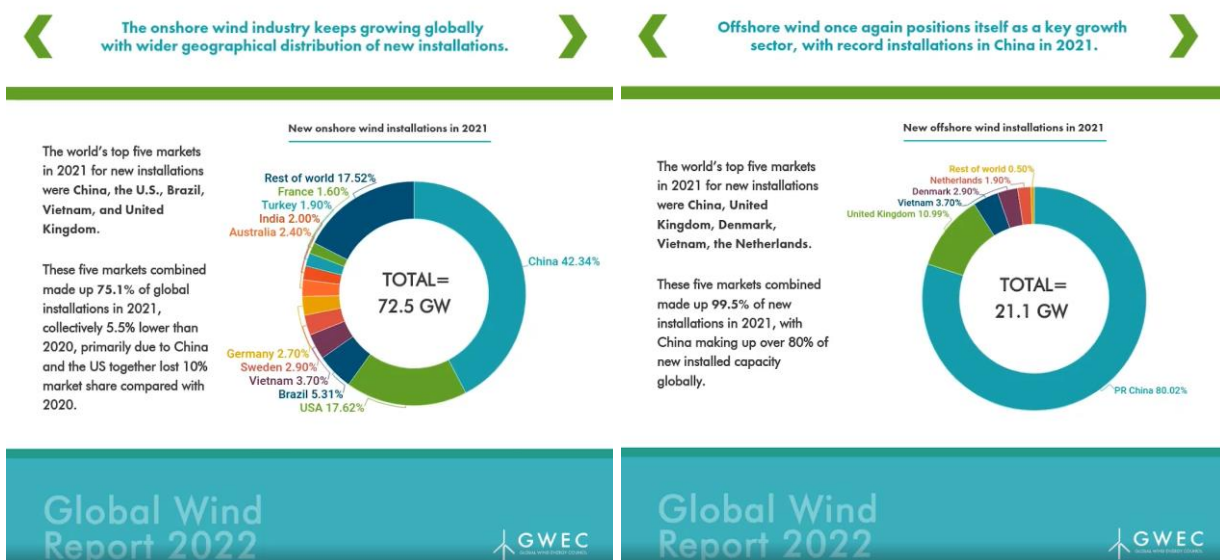
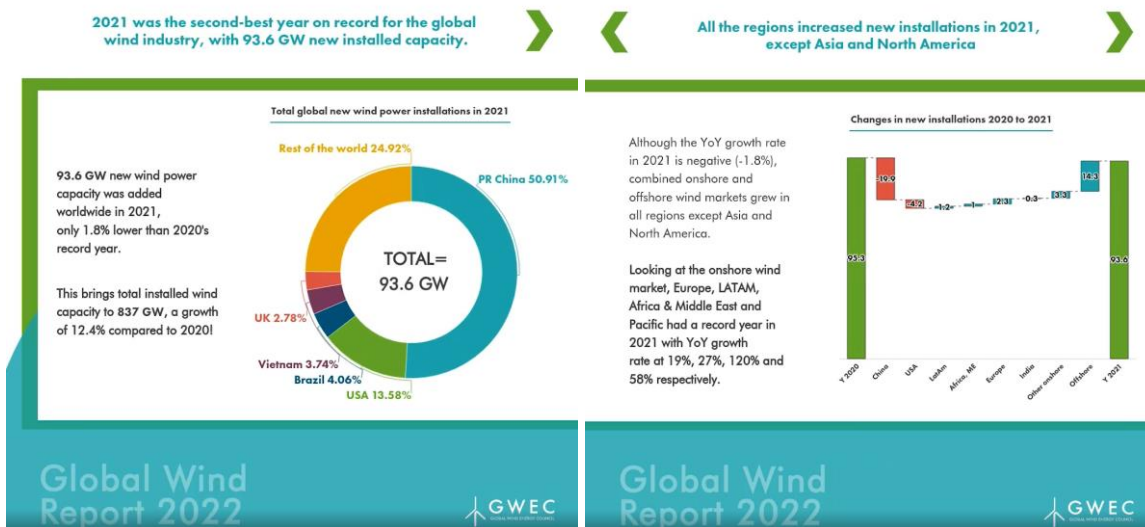
*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the development of wind power generation capacity, on-shore and off-shore (fixed bottom and floating).*

- **Lithuania moves to off-shore:** On **April 1, 2022**, it was reported widely that on **March 31, 2021**, the **Lithuanian Parliament (Seimas)** had approved laws to allow the development of the off-shore wind field capacity in the **Lithuanian sector** of the **Baltic Sea**. The laws will enter into force on signature of the President. As reported, the first off-shore wind field progress to development during Q3 of 2023, and is to have **700 MW** of installed capacity, with first electrical energy in **2028**.
- **Australia's first off-shore wind project starts heavy lifting:** On **April 1, 2022**, it was reported widely that the developers of the **2.2 GW Star of the South Project**, off the coast of **Victoria, Australia**, were progressing to undertake detailed ground investigations (with work starting on April 4, 2022) along the route of the on-shore transmission route. See **Editions 13, 14, 16** and **31** for earlier reports on the **Star of the South**.
- **GWEC – Global Wind Report:** On **April 4, 2022**, the **Global Wind Energy Council (GWC)** released the [Global Wind Report 2022](#).

The headlines from the Report are:

- The global wind industry had its second-best year in 2021, with almost 94 GW of capacity added globally, trailing behind the 2020's record growth by only 1.8%.
- Europe, Latin America and Africa & Middle East had record years for new onshore installations, but total onshore wind installations in 2021 were 18% lower than the previous year. The decline was driven primarily by the slow-down of onshore wind growth in the world's two largest wind power markets, China and the US.

- 21.1 GW of offshore wind capacity was commissioned last year, three times more than in 2020. making 2021 the best year in offshore wind history, bringing its market share in global new installations to 22.5% in 2021.
- China made up 80% of offshore wind capacity added worldwide in 2021, bringing its cumulative offshore wind installations to 27.7 GW. This is an astounding level of growth, as it took three decades for Europe to bring its total offshore wind capacity to a similar level.
- Total global wind power capacity is now up to 837 GW, helping the world avoid over 1.2 billion tonnes of CO₂ annually – equivalent to the annual carbon emissions of South America.
- Wind auction activities bounced back in 2021 with more than 88 GW of wind capacity awarded globally, 153% higher than in 2020.
- After a year in which net zero commitments gathered global momentum, coupled with renewed urgency for achieving energy security, the market outlook for the global wind industry looks even more positive. 557 GW of new capacity is expected to be added in the next five years under current policies. That is more than 110 GW of new installations each year until 2026.
- However, this growth needs to quadruple by the end of the decade if the world is to stay on-course for a 1.5°C pathway and net zero by 2050.



By way of reminder: Edition 37 of Low Carbon Pulse (under **Global Wind Energy Council (GWEC) highlights five countries**) reported as follows: "On **March 11, 2022**, the **GWEC** published **Floating Offshore Wind – a Global Opportunity** identifying five countries as comprising the chasing pack (in the sense of chasing to catch France, Japan, **ROK** and the UK), Ireland, Italy, Morocco, the Philippines and the US, being five countries that are likely to spearhead the next wave of floating off-shore wind field developments".

- **Eni and CIP JV proceeds to floating off-shore:** On **April 6, 2022**, it was reported widely that **Plentitude** (a joint venture between **Eni SpA, CDP Equity** and a fund managed by **Copenhagen Infrastructure Partners**) was to proceed to develop **two floating off-shore wind fields** off the coast **Marsala, Italy**, in combination the two off-shore wind fields will comprise **750 MW** of installed capacity. This continues the on-going progress of the development

of off-shore wind capacity off the coast of Italy (see **Editions 28, 29, 30 and 31** of Low Carbon Pulse to track progress to date of development of off-shore wind field projects in Italian waters).

By way of more recent reminder: Edition 37 of Low Carbon Pulse reported on **BlueFloat** and **Falck Renewables** as follows:

- **Orda Energia Concession Granted:** On **March 8, 2022**, it was reported widely that BlueFloat Energy and Falck Renewables had been granted a 40 year maritime concession to allow the development of the 1.35 GW Orda Energia floating off-shore wind field project (**Orda Energia OWP**). The **Orda Energia OWP** is to comprise 90 turbines located in waters with depths of 100 to 200 metres.

As will be apparent from the below, this is the fifth off-shore wind field development of BlueFloat Energy and Falck Renewables in off-shore Italy.

- **By way of reminder:** Previous editions of Low Carbon Pulse have reported on the plans of BlueFloat (leading renewable energy corporation) and Falck Renewables to develop off-shore wind field capacity off the coast of Italy as follows:

- **Edition 29** reported that the first project between Falck and BlueFloat was the 1.2 GW OWF project off Brindisi (Kailia Energia Project), with projected annual generation dispatch of up to 3.5 TWh.

On October 26, 2021, it was reported widely that the joint venturers are not seeking a permit in respect of a further 1.3 GW of OWF projects off the southern coast of the province of Lecce. For the projects to proceed, authorisations will have to be obtained from the Ministero per la Transizione Ecologica and maritime concessions granted by the Ministero delle Infrastrutture and the Port Authority of the Southern Adriatic Sea.

- **Edition 28** of Low Carbon Pulse reported that Falck Renewables (leading Italian renewable energy developer) and BlueFloat Energy (leading off-shore wind developer) had announced that they have entered into a 50:50 joint venture for the purposes of developing off-shore wind field (OWF) projects off the coast of Italy.

- **Current projects progressing:** By the reckoning of the author, the following off-shore wind field progress are progressing: the 675 MW Minervia Energia project in the Gulf of Squillace, 1.4 GW Nora Energia 1 and 2 wind fields in Gulf of Cagliari and 1.2 GW Kailia Energia of Brindisi.

- **Floating off-shore hydrogen production facility:** On **April 7, 2022**, [pv-magazine.com](https://www.pv-magazine.com) reported (under [Renewable offshore floating hydrogen production](#)) that **Scottish Development International** and **J-DeEP** (Japan Offshore Design and Engineering Platform Technology Research Association) plan to develop a **floating off-shore Green Hydrogen production facility** off the coast of Scotland.

For these purposes, **ClassNK** (ship classification society) had issued an approval in principle (**AiP**) for a floating off-shore hydrogen production facility. The hydrogen production facility will be powered by renewable electrical energy arising as surplus electrical energy from off-shore wind fields, and will use desalinated sea-water as feedstock for the electrolyzers.

- **Equinor unveils USD 23 billion plans:** On **April 22, 2022**, [maritime-executive.com](https://www.maritime-executive.com) reported that **Equinor** (leading global international energy corporation) intends to invest **USD 23 billion** in off-shore wind projects in the near term (over the next five years), with the intention of having **16 GW** of installed off-shore wind field capacity by 2030.

- **Iberdrola approval for next phase of USD 4 billion project:** On **April 25, 2022**, [rechargenews.com](https://www.rechargenews.com) reported that **Iberdrola** (leading global international energy corporation, and renewable energy giant) had received approval from the **Federal German Government** authorities to develop the second of three off-shore wind field projects in the **German sector of the Baltic Sea**. The Federal German **Maritime and Hydrographic Agency** approved the development of the **476 MW Bald Eagle project**.

- **Dutch continuing to double-up:**

- On **April 13, 2022**, it was reported widely that the ruling political parties in the Netherlands (WD and D66) want the Netherlands to more than double its goal for the production of **Green Hydrogen**.

In the [2019 National Climate Agreement of the Netherlands](#), the commitment was to establish **4 GW** of **Green Hydrogen** production capacity by 2030, the **increase to 8 GW** would go hand in hand with the planned increase scaling up of off-shore wind field capacity.

The sentiment to double Green Hydrogen production capacity is entirely consistent with the news items reported in **Edition 37** of Low Carbon Pulse (under **Double Dutch**) as follows: "The Dutch Government had doubled its forecasts for off-shore wind field capacity: an additional 10.7 GW of off-shore wind field capacity is to be installed, doubling current planned capacity, to 21 GW of installed capacity by 2030".

- **Edition 37** of Low Carbon Pulse reported that: "The Ministry of Economic Affairs and Climate Policy had issued regulations detailing rules for the upcoming licensing of Hollandse Kust (west) Wind Farm Zone, which comprises Hollandse Kust (west) VI and Hollandse Kust (west) VII in the Dutch sector of the North Sea. The licence areas are located 53 kms off the west coast of the Netherlands".

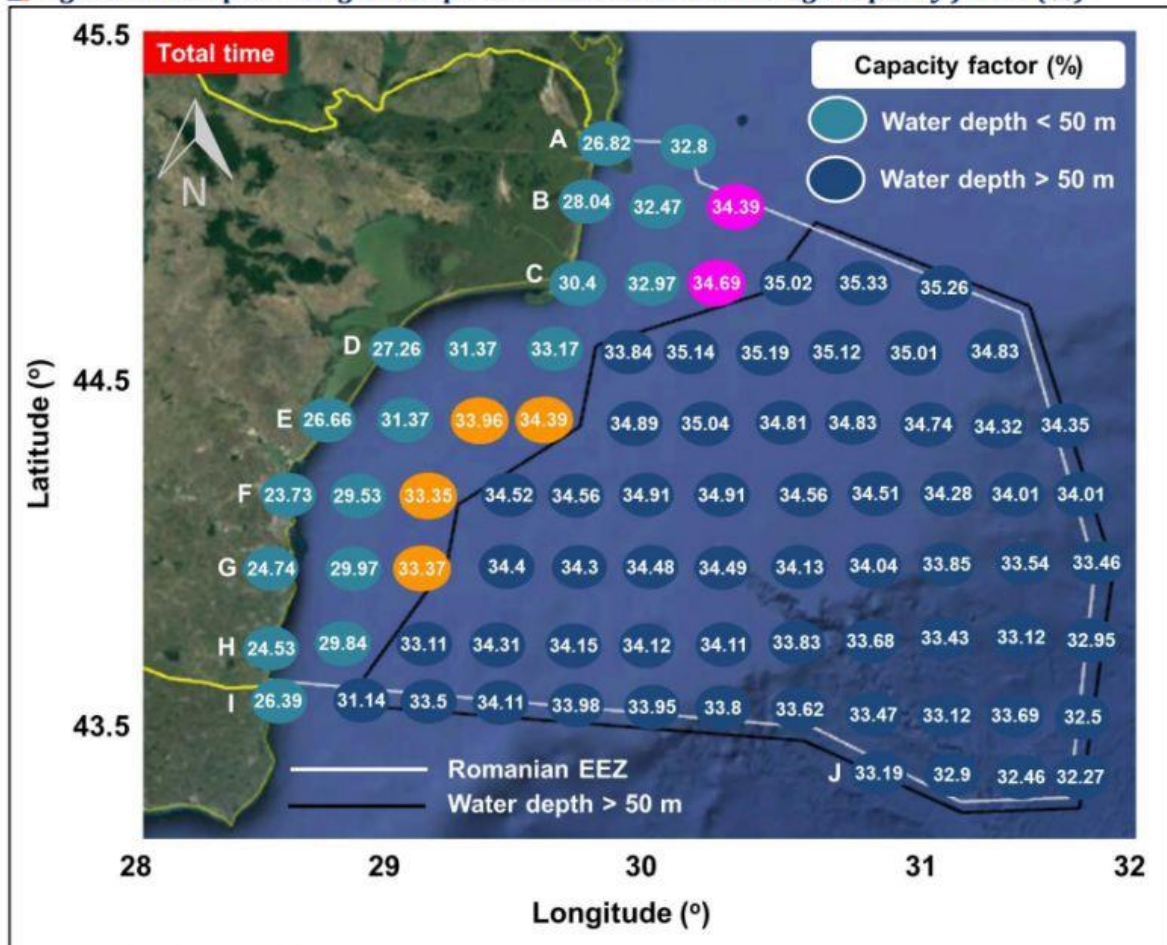
The **auction** for the **two licenses** opened on **April 12, 2022** and will close on **May 12, 2022**. There have been many news items reporting on the level of interest in the licensing, including on the likely bidders and bidding combinations. **Edition 40** of Low Carbon Pulse will report on the outcome of the licensing.

- **Enefit Green progress in Estonia:** On **April 29, 2022**, [offshorewind.biz](https://www.offshorewind.biz) reported on the progress being made towards the development of the **1.1 GW Hiiu** (or **Loode-Eesti**) off-shore wind field development to be located 12 kms north of the second largest island in the Estonia sector of the Baltic Sea (**Hiiumaa**).

For regular readers of Low Carbon Pulse, this project will not ring any bells, because it has been a project that has taken time to develop, and will continue to take time to develop, with construction by 2030. The author has been following the project for over 10 years. Recent developments in progress towards the realisation of the project are significant, including the environmental impact survey being close to finalisation, and the appointment of Ramboll to undertake preliminary design work.

- **Black Sea off-shore wind field development:** On **April 29 and 30, 2022**, it was reported widely that the Bulgaria and Romania intend to develop jointly off-shore wind fields in the Black Sea. The following map provides an indication of the prospective scope of the development:

Figure 6. Most promising development areas based on average capacity factor (%)



Source: EPG assessment

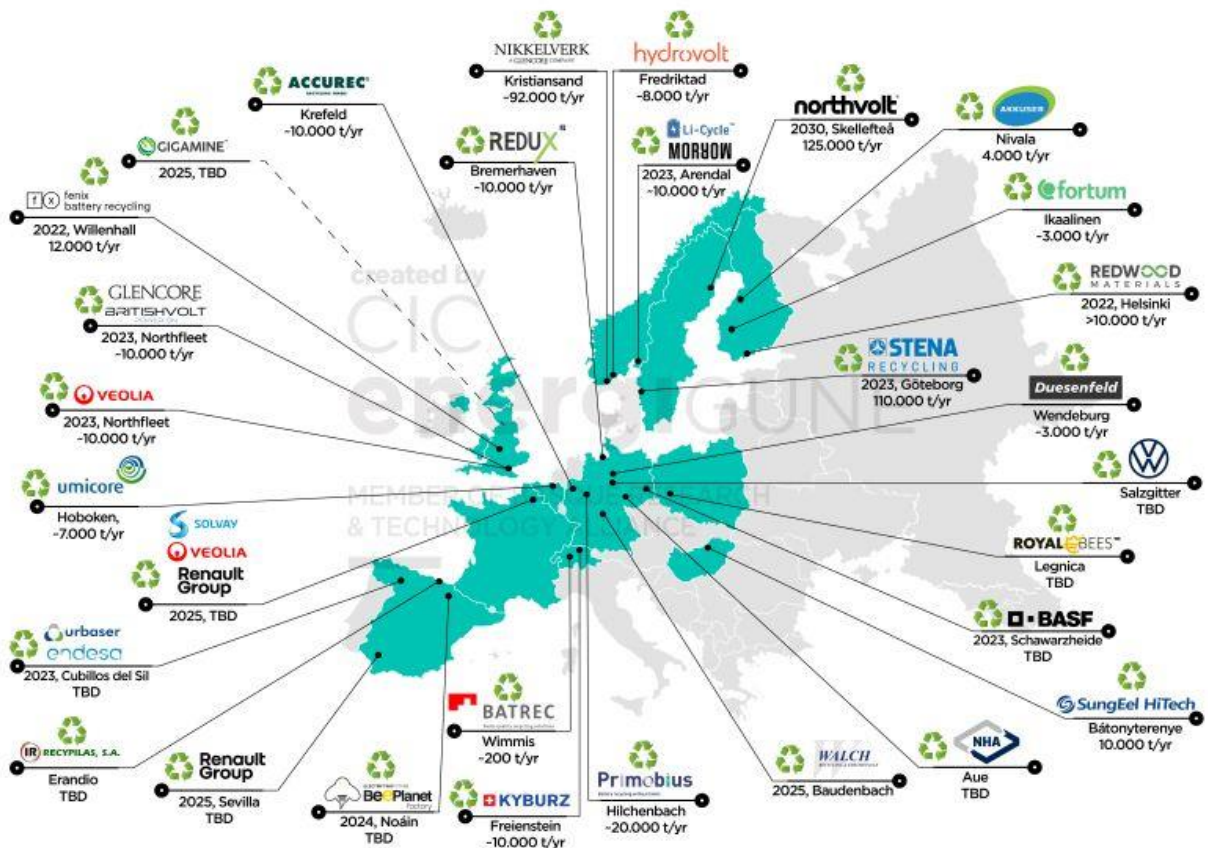
Solar and Sustainability (including NZE Waste):

This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the development of solar power generation capacity, on-shore (photovoltaic and concentrated) and floating. Also this section covers news items relating to the development of facilities and technologies to process and to recycle **NZE Waste**. Also this section considers the treatment of residual **NZE Waste**.

- **Second life and recycling:** On **April 7, 2022**, **CIC energigUNE** published a map-graphic (entitled **Second Life and Recycling – Companies in Europe**) providing a snap shot of the battery recycling plants across Europe and the UK. As ever, thanks to the good folk at **CIC energigUNE**.

SECOND LIFE & RECYCLING COMPANIES IN EUROPE

by CIC energigUNE
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE



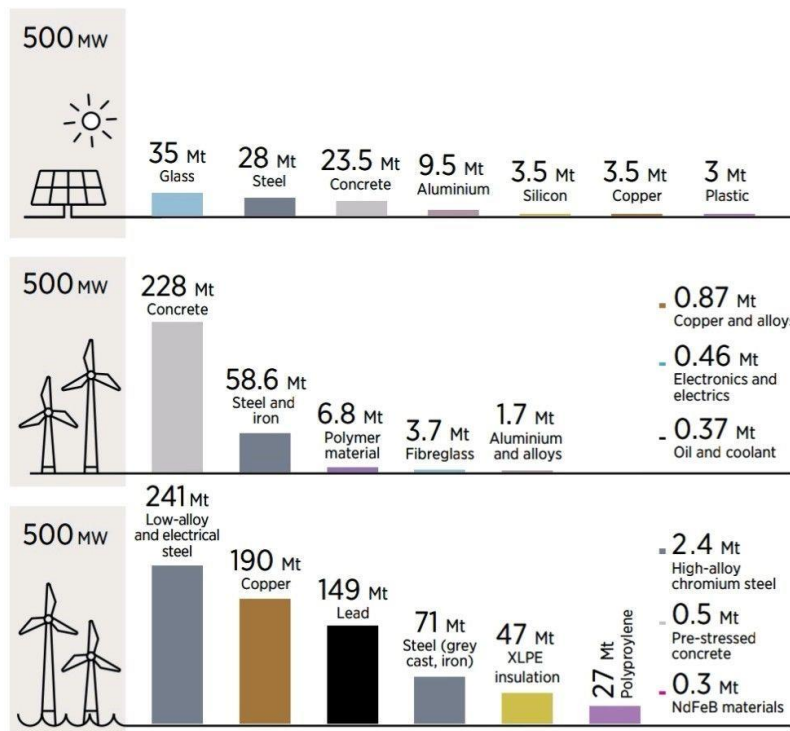
Source: Own elaboration from public information

- **ENEOS and TotalEnergies aligned:** On April 13, 2022, it was reported widely that **ENEOS** (leading hydrocarbon importer and refiner in Japan) and **TotalEnergies** (leading global energy corporation) had established a **50:50 joint venture** to develop up to **2 GW** of decentralised photovoltaic solar capacity over the next five years. It is contemplated that the joint venture will contract business-to-business for the supply of renewable electrical energy (principally to commercial and industrial customers).
- **Chile tenders nearly 2,800 hectares:** On April 14, 2022, pv-magazine.com reported that Chile's **Ministry of National Property** announced a tender for nearly **2,800 hectares** of land located in the **Commune of Santa Elena**, 27.5 km northwest of **Quillagua**, in the **Antofagasta** region of **Chile**. Those interested in tendering for the land must do so by May 25, 2022. The land must be used to develop large-scale renewable energy generation capacity.
- **Gemini Project closes:** On April 26, 2022, rechargenews.com reported on financial close of the US's largest-ever photovoltaic solar-plus **BESS** project (the **Gemini Project**): the **Gemini Project** comprises **690 MW** of photovoltaic solar and **380 MW / 1,417 MWh** of **BESS**.

Primergy Solar (leading renewable electrical energy project developer) and **Quinbrook Infrastructure Partners** (leading infrastructure investor, headquartered in Australia) are reported to have closed the **USD 1.9 billion** construction debt (circa **USD 1.3 billion** in debt) and tax equity financing for the **Gemini Project** to be located in the **Mojave Desert, Nevada**.

The four coordinating lead-arrangers are **Bank of America**, **KeyBanc Capital Markets**, **MUFG Bank** and **Norddeutsche Landesbank Girozentrale**. It is reported that **Bank of America** and **Truist Bank** provided **USD 532 million** in tax equity financing, believed to be the largest tax equity financing for a photovoltaic solar project in the US.

- **JERA to deploy 1 GW of photovoltaic solar:** On April 27, 2022, rechargenews.com reported that it intends to develop and to deploy up to **1 GW** of photovoltaic solar by 2025 to provide electrical energy to **JERA's** domestic market.
- **Insight to what is in sight:** The following infographic provides a sense of the materials required to manufacture photovoltaic solar and wind renewable power generation capacity. For those in the recycling industry, and for all, the need for recycling capacity is upon us. A future standalone article from the author of Low Carbon Pulse will consider all aspects of the recycling industry.



- **Recycling in the shipping to steel industry:** On **April 7, 2022**, **A.P. Moller – Maersk** announced that it had joined **SteelZero**, a global initiative that brings together leading organisations to accelerate transition to a net-zero steel industry in partnership with **ResponsibleSteel**. The basis for the initiative is clear: "Global ship recycling volumes are projected to double by 2023, and quadruple by 2033. Recycled steel will be recognised progressively as a viable raw material for steel consumers with net-zero emission targets".
- **MENA Climate Week: Edition 37** of Low Carbon Pulse reported that: "From **March 28 to March 31, 2022**, the first-ever Middle East and North Africa Climate Week (**MENACW**) conference took place in Dubai, United Arab Emirates, under the auspices of the UNFCCC.

On **March 31, 2022**, the UN released the following [press release](#) (titled **MENACW Galvanises Regional Momentum for COP-27**). At the half way point between **COP-26** and **COP-27**, **MENACW** is reported to have built on one (held in Glasgow, Scotland), and prepared for the next (to be held in Sharm El Sheikh, South Sanai, Egypt).

In the context of **COP-27**, the Foreign Minister of Egypt, and incoming **COP-27** President, Mr Sameh Shoukry said: "Holding the Climate Week for the first time in the Arab region has been clear evidence of the priority that the countries in the region give to international climate action and ways to combat the negative effects of a phenomenon that has seen its repercussions and impacts extend to multiple aspects of life in our countries. Egypt seeks to make the twenty-seventh session of the United Nations Framework Convention on Climate Change a milestone in the field of international climate action, in which pledges and promises are transformed into actual implementation on the ground".

The press release provides the facts and stats around the number of participants, meetings and sessions.

Edition 30 of Low Carbon Pulse reported on the **UN High Level Climate Action Champions** initiative, and in Dubai the **COP-26** Champion, Mr Nigel Topping, and the **COP-27** champion, Mr Mahmoud Mohieldin, announced their [vision](#).

As the **MENACW 2022** report on outcomes is published, a future edition of Low Carbon Pulse will report on them.

Land Mobility / Transport:

*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the development and deployment of land vehicles, buses and coaches, cars, industrial vehicles and trucks, and trains.*

- **Buses and coaches:**
 - **Solaris Bus & Coach continues its roll:** During **April 2022**, **Solaris Bus** and **Coach** continued to agree sales of its **Solaris Urbino** electric bus with the following sales: **12** electric buses to **JGSP Novi Sud** (Serbian bus operator), and accompanying supply of electric charging infrastructure; **17** electric buses to **MZK Grudziadz** (Polish bus operator in the City of Grudziadz); **10** hydrogen buses (Urbino) are to be mobilised for use by two operators (five to each), **Busreisen Ettenhuber GmbH** and **Martin Geldhauser GmbH & Co. KG**.
 - **NY School Buses electric by 2035:** On **April 8, 2022**, it was reported widely that **Governor Ms Kathy Hochul** is to propose legislation to require 100% of all school buses to be electric by 2035 in the State of New York.
 - **Spain's hydrogen fuel celled buses:** On **April 8, 2022**, it was reported widely that **Transports Metropolitans de Barcelona (TMB)** begun operating a **CaetaniBus** powered and propelled by fuel cell technology. In addition, it is understood that another seven **CaetaniBuses** will enter into service by the end of 2022. The hydrogen to fuel the fuel cell buses is to be supplied by **Iberdrola** (Spanish renewable energy company).

- German operator receives grant funding:** On **April 11, 2022**, fuelcellbuses.eu reported (under [RVK received grant of 108 hydrogen-powered fuel cell hybrid buses](#)) that a German public transport operator, **Regionalverkehr Köln GmbH (RVK)**, is to receive funding support from the German Federal Government Ministry of Digital Affairs and Transport. The funding support will allow the mobilisation of 108 hydrogen-powered and propelled buses, which will be added to the **RVK** fleet by 2024.
RVK provides public transport services in the areas surrounding Bonn and Cologne. The 108 buses will comprise 79 individual buses in the first procurement phase (with the first 20 buses on target for delivery in December 2022), and 29 articulated buses in the second phase.
- BEV Bus Depot:** On **April 13, 2022**, the **Government of Queensland**, Australia, [announced](#) (under [A one-way ticket to low-emissions public transport](#)) that **Australia's first 100%** electric bus depot was now open, and would be providing battery charging for **30 electric buses**.
 [Note: The author recognises that there have been other news items in respect of the mobilisation of buses and coaches, and that as such this news items included is a representative sample]
- Cars (including taxis and air-taxis):**
 - Airborne taxis and airports:**
 The author is still working out whether to include new items about air-taxis in this section or in the **Airports and Aviation** section (of Low Carbon Pulse). For the time being, the author has decided to leave in this section. Since the start of 2022, the number of news items on air taxis has increased, and April 2022 saw an increase in the level of coverage. The author has chosen two articles from April that illustrate the progress being made:
 - Hyundai plans hydrogen powered and propelled air taxis:** On **April 1, 2021**, it was reported widely that **Hyundai** is progressing with plans to develop and to deploy air-taxi by 2030 – using advanced air mobility technology, and having established an **Advanced Air Mobility Unit** to develop the **eSTOL** aircraft.
 - AFC Energy fuels cells showcased:** On **April 29, 2021**, hydrogen-central.com reported (under [AFC Energy Hydrogen Fuel Cell to be Showcased at Flying Taxi Airport](#)) that "one of the hydrogen batteries" of **AFC Energy PLC (AFC Energy)** "will be used to charge Air One's fleet of electric vehicles" based at "the flying taxi airport that opened in Coventry" during April 2022. The flying taxi airport is the location of the world's first fully operational hub for electric airborne vehicles (the **Urban-Air Port**).
 - Paris electrolysis:**
 - Edition 4** of Low Carbon Pulse reported that: "In Paris, over 500 fuel cell electric vehicles (**FCEV**) provide taxi services, using hydrogen supplied by **Air Liquide** via 4 hydrogen re-fuelling stations (**HRS**). On November 11, 2020, the **European Network of Transmission System Operators for Electricity (ENTSO-E)**, announced a proposal to develop **10** hydrogen storage facilities at locations around Paris. The proposed €1 billion project would provide total storage for up to 11 GWh of hydrogen. As a result of the project, Parisian transport company, **Societe du Taxi Electrique Parisian**, estimates that **50,000** taxis could provide taxi services using **FCEV** technology. The Paris **HRS** project is one of 25 energy storage projects and schemes identified by **ENTSO-E** across the **EU**".
 - On **April 4, 2022**, **Cummins Inc.** announced that its affiliate, **Hydrogenics Europe N.V.**, had signed a contract to supply a **2.5 MW** electrolyser to **Hysetco** (a mobility corporation owned by **Air Liquide, Korous, TotalEnergies** and **Toyota**) to allow production of hydrogen in **Paris, France**. The **hydrogen** will be **delivered** to **12** sites with hydrogen refuelling infrastructure. The electrolyser is a 2.5 MW HyLYZER®-500 PEM, capable of producing 380 metric tonnes of hydrogen a year.
 - On **April 25, 2022**, euractiv.com published an article (under the excellent title, **Fleets of hydrogen taxis are picking up across Europe**) focussing on the activity in France, both policy setting and private sector progress. It is noted in the article that hydrogen is an ideal source for "random intensive uses like taxis". The article notes that France has introduced a law mandating the procurement and use of low-emission vehicles (whether **BEV** or **FCEV**). Also the article mentions that **EU** initiatives are supporting initiatives across Europe, including initiatives resulting in the progress that has been made with the **ZEFER** project (see below under **Hike in taxi plans**).
 - BMW Group to use cast aluminium wheels:** On **April 11, 2022**, it was reported the **BMW Group** is to use cast aluminium wheels cast and manufactured using renewable electrical energy for its **BMW** and **MINI** brands starting in 2024.
 - Hike in taxi plans:** On **April 21, 2022**, [zefer](https://zefer.eu) reported that two pan-European projects have worked together to bring zero-emission hydrogen taxis and hydrogen refuelling infrastructure to the **Copenhagen**. The two pan-European projects are: **ZEFER** (Zero Emission taxi Fleets for European Rollout) and **H2ME2** (Hydrogen Mobility Europe), funded by the **EU** Clean Hydrogen Partnership, and they have mobilised **100** zero emission taxis.
- Fuel Cell and Battery Supply and Technology:**
 During **April 2022**, the author had not come across any news items that may be regarded as material or significant in the area of fuel cell and battery supply and technology. Then on **April 30, 2022**, it was reported widely that **Stellantis** (an automotive manufacturing corporation, and see [Edition 37](#) of Low Carbon Pulse) planned to invest **€30 billion** by the end of 2025 to support electrification and software strategies. The statement from Stellantis is well-worth a read.
- Industrial Vehicles and Trucks:**
 - Wholesale switches:**
 - On **April 2, 2022**, it was reported widely that **Lidl** (retail giant) is transitioning its entire battery electric fleet (used in its logistics centres) to fuel cell technology, using Green Hydrogen.
 - On **April 20, 2022**, **Plug Power** announced that it had agreed with **Walmart** to supply Green Hydrogen (in liquid form) to power and to propel material handling lift trucks across the **Walmart distribution and fulfilment centers** in the US.

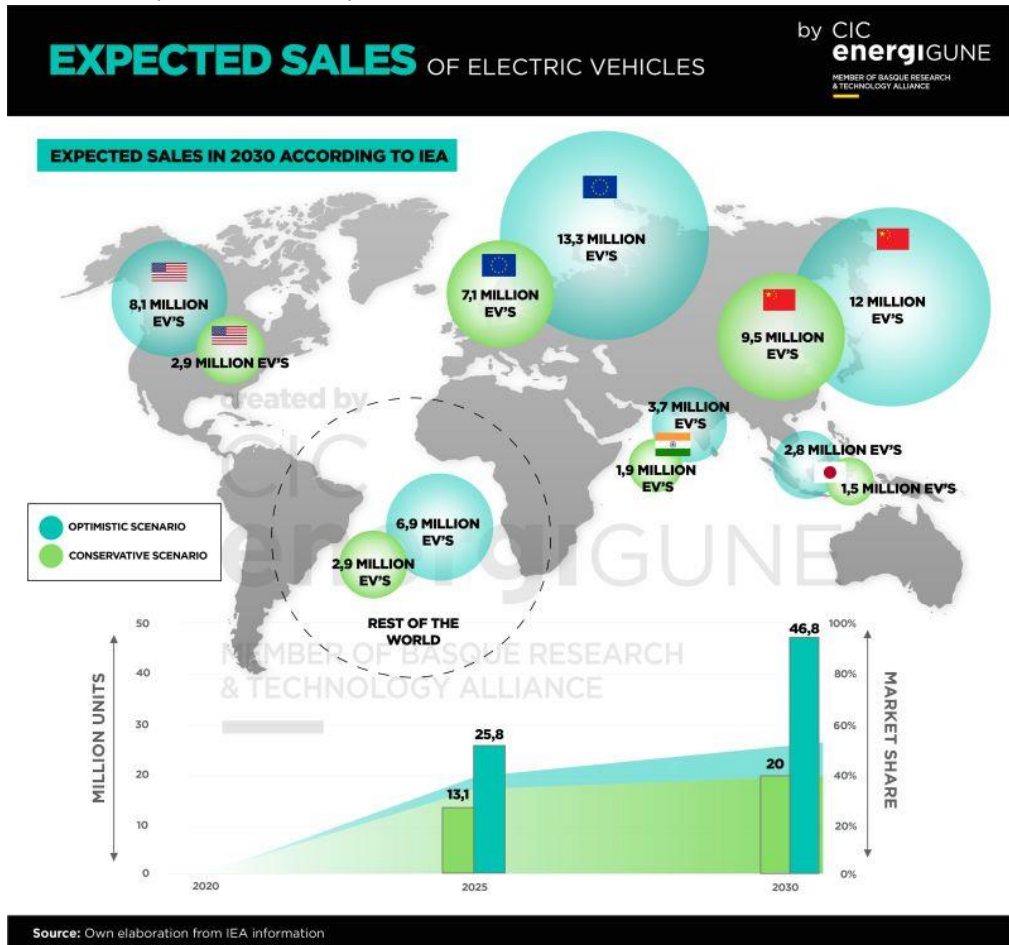
- **Scania and Cummins aligned:** On **April 8, 2022**, it was announced that **Scania** (Swedish manufacturer of commercial heavy vehicles) is working with **Cummins, Inc** (leading primary mover manufacturer and electrical generator technology corporation) to develop 20 fuel cell electrical trucks to be fuelled by Green Hydrogen (for the **HyTruck Project**).

Scania (part of the Volkswagen Audi Group) will manufacture the trucks, and **Cummins** will supply and install the fuel cells. The trucks will be delivered to **Air Liquide** and the **Port of Rotterdam Authority (PORA)** for deployment and use as part of the **HyTrucks Project** undertaken jointly by **Air Liquide** and **PORA**.

By way of reminder: Edition 18 of Low Carbon Pulse outlined the **HyTruck Project** as follows: "The **HyTruck Project** involves putting 1,000 hydrogen-powered trucks on the roads of Belgium, western Germany and the Netherlands.

(**Edition 5** of Low Carbon Pulse, reporting on European Hydrogen Week, noted the broader initiative to deploy 100,000 hydrogen-powered trucks and 1,000 hydrogen refuelling stations.)

- **Edmonton International Airport to convert to hydrogen:** On **April 27, 2022**, flyeia.com reported **Edmonton International Airport** was to participate in the **VEXSL Hydrogen Project** using **Hydra Energy's** retrofit solution and technology to convert trucks powered and propelled by diesel power plants to co-combust with hydrogen.
- **On EVs expected by 2030:** On **April 14, 2022**, the good folk at **CIC energigune** published the following infographic estimated expected sale EVs by 2030.



- **Recharging and refuelling infrastructure:**

- **Eni and Linde aligned:** On **April 15, 2022**, it was reported widely that **Eni** (leading international energy corporation) has opened the first hydrogen refuelling station in **Venice, Italy**, with equipment and infrastructure supplied and installed by **Linde** (on the Big Three industrial gas giants).

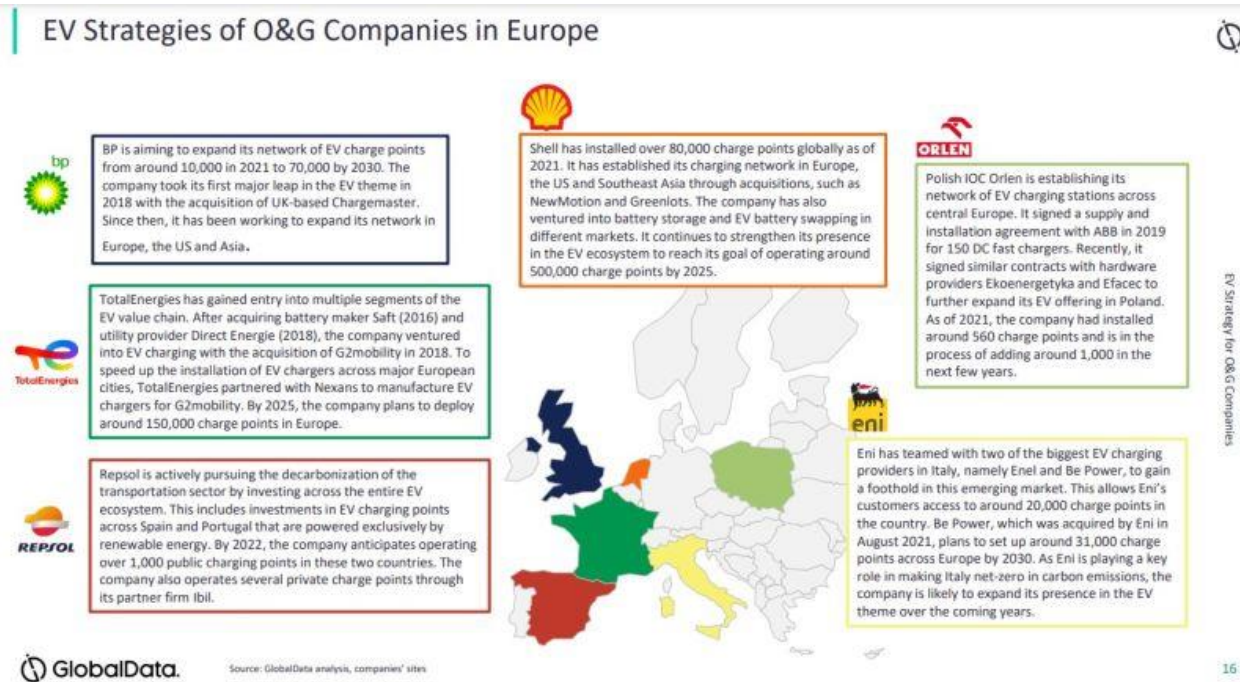
- **Ever active Everfuel:**

- **Everfuel to develop heavy-duty hydrogen station in Germany:** On **April 8, 2022**, it was reported widely that **Everfuel GmbH** had been awarded the contract to develop and to deploy hydrogen refuelling infrastructure (including stations) to serve a fleet of fuel cell buses. The contract was awarded following a Europe wide procurement process involving an open tender. The contract is between **Everfuel GmbH** and **WSW mobil GmbH**. WSW mobil GmbH is one of the pioneers in the deployment of fuel cell buses in public transport in Germany (and Europe for that matter).

- **Everfuel to develop largest HRS in Denmark:** On **April 21, 2022**, Everfuel [announced](#) that, with Taulov Dry Port, it was to expand the green logistics hub at Fredericia to establish the largest hydrogen refuelling station in Denmark.

- **Electric Charging Ahead:** On **April 27, 2022**, the following infographic was published summarising progress made by major oil and gas corporations in the development and deployment of electrical charging / recharging

infrastructure across Europe. The infographic illustrates the criticality of oil and gas corporations to energy transition.



The infographic illustrates the rate of progress being made, both in terms of the number of charging points and their geographical spread.

- **BP and VW launch strategic roll-out:** On **April 28, 2022**, **BP** and **Volkswagen Group** announced (click [here](#) for bp's press release; click [here](#) for Volkswagen's press release) that they are to work together to boost the use of electric vehicles (**EVs**) across Europe, and to mark this opened the first EV charging station in Dusseldorf, Germany.
- **On BEVs and battery manufacturers:** On **April 13, 2022**, the good folk at **CIC energigune** published an excellent article, [Major Automakers Behind Giga-factory Projects](#). The article is well-worth a read. The article contains a great infographic providing an overview of who is who, with the **attached link** connecting to it.
- **Trains:**
To manage the length of this **Edition 39** of Low Carbon Pulse, **Edition 40** of Low Carbon Pulse will include two months' of new items on trains.

Ports Progress and Shipping Forecast:

*This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the development and deployment of production and storage capacity, and infrastructure, at ports for **E-Fuels / Future Fuels** (including **Hydrogen Hubs**) and to capture and to store or to use carbon, or both (including **Carbon Clusters**), and the connection of port infrastructure to the hinterland. Also this section considers news items that relate to the development of infrastructure at ports, including to allow the development of off-shore wind fields.*

- **Ferries and other craft:**
 - **Electric on blue:** On **April 1, 2022**, [Norwegian Ship Design](#) reported **Cemre Shipyard** and **Torghatten Nord** As had entered into a contract to build a new ferry for the Bognes – Lødingen route, in northern Norway. The new ferry will be powered and propelled by battery technology, and is configured as a double-ended car and passenger ferry (each end having its own power and propulsion with system), with capacity for 399 passengers. The new ferry will have back-up bio-diesel power and propulsion.
 - **Training dressed in blue:** On **April 6, 2022**, it was reported widely that a training vessel, **Ab-Initio**, is in development by **Concordia Damen** and **STC Group**. The **Ab Initio** is a 67 metre training vessel, powered and propelled by hydrogen fuel cell technology, and it to be used to train maritime professional in the navigation and operation of fuel cell technology vessels.
 - **Sea Change edging closer to the water:** On **April 21, 2022**, it was reported widely that the launch of the **Sea Change** was ever closer, with a launch date of mid-May 2022 reported.
- By way of reminder:**
Editions 19 and **26** of Low Carbon Pulse reported on the development and prospective deployment, and testing, of the hydrogen powered and propelled ferry in San Francisco Bay Area - the Sea Change.
Edition 32 of Low Carbon Pulse reported that Switch Maritime was commissioning and undertaking trials of the ferry, that refuelling had been undertaken successfully.
Also it was reported that BAE Systems was the supplier of the propulsion system for the Sea Change. Further, it was reported that the fuel cell technology for Sea Change is supplied by Zero Emission Industries, and the BAE propulsion system will interface with the fuel cell technology, providing an all-electric powered and propelled vessel.

- **Green Ports:**

HyTransPortRTM get first customer: On **April 14, 2022**, it was reported widely that **Shell** is the first customer for the **hydrogen transportation pipeline** in the **Port of Rotterdam** – the **HyTransPortRTM**. **Shell** is developing a **Green Hydrogen production facility** at the **Conversion Park, Maavlake** (see [Edition 27](#) of Low Carbon Pulse for the most recent coverage), with the Green Hydrogen will be transported through the **HyTransPortRTM** to allow the delivery of Green Hydrogen into networks to deliver Green Hydrogen to customers.

- **Green Corridors:**

- **Australia to East Asia Green Corridor LoI:** On **April 6, 2022**, it was reported widely that a letter of intent had been signed by **BHP, Rio Tinto, Oldendorff Carriers** and **Star Bulk Carriers Corp** to assess the development of a Green Corridor between Australia and East Asia, with the assessment being led by the **Global Maritime Forum**.

By way of a reminder:

- **Edition 19** of Low Carbon Pulse included the following narrative, providing the broader context of the **Global Maritime Forum** and **Green Corridors**.

"In the world of hydrogen, cooperation is key: As part of **MI 2.0**, on June 2, 2021, the **Zero-Emission Shipping Mission (ZESM)** was outlined. The **ZESM** is intended to accelerate international public-private collaboration to scale-up and to deploy new green maritime solutions. The Governments of Denmark, Norway and the US are to lead the **ZESM**, working with the **Global Maritime Forum**, and the Maersk McKinney Møller Center for Zero Carbon Shipping (see [Edition 16](#) of Low Carbon Pulse). The roles of Denmark, Norway and the US are key, both as shipping nations, and as countries that offer fertile ground for technological innovation. US Secretary of Energy, Ms Jennifer Granholm stated: "Through fearless technological innovation, ambitious clean energy deployments, and constructive international collaboration, we can build a net-zero carbon economy ...".

Goals of **ZESM**: The **ZESM** has three principal goals:

1. to develop, demonstrate and deploy zero-emission fuels, ships and fuel infrastructure in a coordinated fashion along the full value chain;
2. by 2030, to have developed ships capable of running on hydrogen-based fuels (being zero-emission fuels) – such as Green Hydrogen, green ammonia, green methanol, and advanced biofuels – that make up at least 5% of the global deep-sea fleet, measured by fuel consumption; and
3. by 2030, to have at least 200 of these "well-to-wake" zero-emission fuelled ships in service and utilizing these fuels across their main deep-sea shipping routes.

Global Maritime Forum: Managing Director of **Global Maritime Forum**, Ms Johannah Christensen (noting that the role of the **Global Maritime Forum** is key to the **ZESM**) said: "*Shipping is on the verge of a clean energy revolution. To set the global maritime industry on a climate-aligned course and meet the goals of the Paris Agreement, zero-emission vessels need to be the dominant and competitive choice by the end of the [current] decade. The Zero Emission Shipping Mission will accelerate public and private efforts around the world to make a zero-emissions fleet a reality by 2030*".

Global Hydrogen Ports Coalition launched: Finally, also on June 2, 2021, at the **Innovating to Net Zero Summit** in Santiago, Chile, the Global Hydrogen Ports Coalition was launched. An industry, headed to hydrogen based fuels.

- **Edition 30, Clydebank Declaration:** On November 10, 2021, the [Clydebank Declaration](#) was agreed at **COP-26**. The **Clydebank Declaration** emphasises the importance of limiting "the increase in global average temperature to **1.5°C** above pre-industrial levels", expressed great concern that if "no further action is taken, international shipping emissions are expected to represent 90% to 130% of 2008 emissions levels by 2050", and recognised that "a rapid transition in the coming decade to clean maritime fuels, zero-emission vessels, alternative propulsion systems, and the global availability of landside infrastructure to support these, is imperative for the transition to clean shipping". In addition the signatories to the **Clydebank Declaration** commit to facilitate the development of **Green Corridors**, with at least six **Green Corridors** by "the middle of this decade ... [and] many more corridors ... by 2030". A **Green Corridor** is a route between two or more ports that are "zero-emission maritime routes".

The signatories to the **Clydebank Declaration** are: Australia, Belgium, Canada, Chile, Denmark, Fiji, Finland, France, Germany, Republic of Ireland, Italy, Japan, Republic of the Marshall Islands, Morocco, the Netherlands, Norway, Spain, Sweden the UK, and the US".

- **Chilean Green Corridors Network:** On **April 14, 2022**, **Maersk McKinney Møller Center for Zero Carbon Shipping** [announced](#) that it had signed a formal agreement with the **Ministerio de Energía Chile** (Ministry of Energy In Chile) to establish a network of Green Corridors allowing for green maritime transportation of goods in and out of **Chile**. **Chile** was among the first countries to sign the **Clydebank Declaration**.

Maersk McKinney Møller Center for Zero Carbon Shipping is to undertake and to complete by the end of 2022 the assessment and mapping of the most promising Green Corridors, and will route the way for the development of **Green Corridors** identified.

- **Green Shipping:**

- **The World Bank values carbon:** On **April 1, 2022**, **The World Bank** published [Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition-Technical Paper](#).

The **Technical Paper** asks and answers the following **four questions**, the **first question setting-up questions 2, 3 and 4**.

1. Question: Why a technical paper on the use, recipients, and management of, carbon revenues from shipping?
Answer: Because it is likely that revenue will arise from policy settings intended to decarbonise the International Shipping industry. See [Editions 19](#) and [27](#) of Low Carbon Pulse.

2. Question: What could carbon revenues from International Shipping be used for?

Answer: This question is answer fully, and summarise in the following table:

TABLE 1: REVENUE USES, THEIR POTENTIAL ALIGNMENT WITH THE INITIAL IMO GHG STRATEGY AND OTHER SELECTED DESIRABLE KEY FEATURES

CRITERIA		① FINANCING IN-SECTOR CLIMATE CHANGE MITIGATION	② ENHANCING MARITIME INFRASTRUCTURE AND CAPACITY	③ FINANCING BROADER CLIMATE AIMS	④ FINANCING BROADER DEVELOPMENT AIMS	⑤ FINANCING THE GENERAL BUDGET	⑥ COVERING ADMINISTRATIVE AND ENFORCEMENT COSTS	⑦ IMPLEMENTING A REVENUE-NEUTRAL FEE/BATE
Potential Alignment with the Initial IMO GHG Strategy Principles	Narrow CBDR-RC*	Green	Amber	Green	Amber	Red	Green	Red
	Broad CBDR-RC*	Green	Green	Green	Amber	Green	Green	Red
	Avoiding DNI	Green	Green	Red	Red	Red	Amber	Red
	Remedying DNI	Green	Green	Green	Green	Green	Green	Red
	Polluter Pays	Green	Amber	Green	Amber	Red	Green	Red
	Highest Possible Ambition	Green	Amber	Green	Amber	Red	Green	Amber
Selected Desirable Key Features	Potential Climate Benefits**	Green	Amber	Green	Amber	Red	Green	Amber
	Potential Development Benefits**	Green	Green	Green	Green	Amber	Green	Amber
	No Need for Active Management	Red	Red	Red	Red	Red	Amber	Green
	Political Feasibility – Industry Perspective	Green	Green	Amber	Red	Red	Amber	Green
	"Unique value proposition"	Opportunity to lower the carbon price level needed to decarbonize shipping	Extension of the options to address DNI through sector-specific but not necessarily climate-related financing	Highest potential climate benefits	Highest potential development benefits	Greatest flexibility for recipient countries to use carbon revenues	Instrumental for proper functioning of carbon pricing instrument	Only option that does not require active management of revenues

* "Broad CBDR-RC" is understood as encompassing "narrow CBDR-RC". Thus, any carbon revenue use that satisfies the latter appears also aligned with the former.

** Note: The results presented in this table describe the potential of each revenue use option to deliver climate and development benefits and align with the Initial IMO GHG Strategy under the assumption that carbon revenues are adequately spent (e.g., corruption and poor governance do not lead to carbon revenue misuse).

Under a Red-Amber-Green (RAG) matrix, options are marked, with green indicating a more positive evaluation, red a less positive evaluation, and amber an evaluation between green and red. Green = highly aligned | Amber = partially aligned | Red = less aligned.

Source: [Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition- Technical Paper](#)

3. Question: Who could be the recipients of carbon revenues from International Shipping?

Answer: Three groups of potential recipients are identified: **1.** Governments, **2.** The shipping industry, and **3.** The private sector in a broader sense. The basis of distribution of carbon revenues are stated to be best determined

applying the following principles: achieving maximum climate and development outcomes, supporting an equitable transition, and ensuring an adequate function of the medium terms measure and distribution of revenues.

4. Question: How could adequate governance and management of carbon revenues from International Shipping be implemented?

Answer: This question is considered as follows: **1.** Whether revenues should be disbursed by an existing fund or a new fund; **2.** The role of the IMO in the governance of carbon revenues from shipping; **3.** How to address challenges of managing carbon revenues; **4.** If a new fund is established, how to select revenue distribution criteria, and **5.** How to ensure that no country is left behind in the distribution of carbon revenues.

The author is chosen not to seek to summarise the answers, they are nuanced. The **Technical Paper** is well-worth a read, both for specific consideration of the International Shipping industry, in the context of policy settings generally.

- **Bulk: Cement and Grain: Edition 20** of Low Carbon Pulse reported on the development of a bulk carrier to transport cement for **HeidelbergCement** and grain for **Felleskjøpet AGRI**. **Egil Ulvan Rederi AS** is to build the bulk carrier.

On **April 5, 2022**, it was announced by **HeidelbergCement** and **Felleskjøpet AGRI** that **ENOVA** (Norwegian government enterprise owned by the Ministry of Climate and Environment) had provided funding support for these purposes. (see ENOVA [press release](#)): this means that Egil Ulvan Rederi will build the zero-emission cargo ship **With Orca**. A cargo ship that will sail under a long-term contract for HeidelbergCement and Felleskjøpet Agri, and is scheduled to be put into operation in 2024.

In addition to the funding support for the build of the bulk carrier, **ENOVA** has provided support for the development and deployment of the bunkering solution and technology provided by **Statkraft** and **Skagerak Energi** (hydrogen will be stored in compressed form in replaceable containers, with bunkering taking place by lifting empty containers off the ship, and replacing them with containers full of compressed hydrogen).

By way of reminder: Edition 37 of Low Carbon Pulse reported that "**Egil Ulvan Rederi AS** had received Approval in Principle (**AiP**) from Lloyds Register for its zero-emission self-discharging hydrogen-fuelled bulk carrier – the **With Orca**. The **With Orca** is designed by **Norwegian Ship Design**."

As reported, the **With Orca** will be powered and propelled by hydrogen, with propulsion and energy capture provided by two rotor sails as well as hydrogen. The hydrogen will be stored in the **With Orca** in compressed form and a hydrogen combustion engine for use in higher load conditions, and a fuel cell electric system for use in lower load conditions. The hydrogen is to be supplied by Statkraft (global leader in hydropower and Europe's largest generator of renewable electrical energy)".

- **Nordic Roadmap being developed:** On **April 7, 2022**, **DNV** (global leading advisor for the maritime industry) [announced](#) that it had been appointed by the **Norwegian Ministry of Climate and Environment** to develop a roadmap for the introduction of **sustainable zero-carbon fuels** across the Nordic region (the **Nordic Roadmap**), with the focus being the **sustainable zero-carbon fuels** from "**Well-to-Wake**". **DNV** will work with **Chalmers, IVL, Litehauz Aps, MAN Energy Solutions** and **Menon Economics** in the development of the **Nordic Roadmap**. The DNV announcement is well-worth a read.

The **Nordic Roadmap** will plot the means, and the basis to accelerate, the transition to **zero-carbon fuels**, including by identifying any barriers to accelerated transition, and how to avoid, navigate or remove them. The **Nordic Roadmap** is centred around the establishment of a **Nordic Cooperation platform** to facilitate: **1.** Sharing of knowledge; **2.** Undertaking of pilot projects; **3.** Establishment of Green Corridors; **4.** Development of enabling infrastructure.

- **DSME LCO2 carrier headed for the water:** On **April 8, 2022**, [Ingprime.com](#) reported that **Daewoo Shipbuilding & Marine Engineering (DSME)** that **DSME** had received classification society basic design approval for its 250 / 44 metre dimensioned vessel to carry **liquid carbon dioxide (LCO2)**. The basic approval in principle is understood to make the **DSME** vessel the largest dimensioned **LCO2** carrier to receive approval in principle to date, with containment tank capacity stated to be **70,000 m³**.
- **Ammonia and LCO2 carrier updates:** On **April 14, 2022**, the **Ammonia Energy Association** posted an [update](#), including the following **Approvals in Principle (AiP)**: the concept design for a **50,000 m³** ammonia and **LCO2** carrier from **Mitsui O.S.K Lines, Ltd.** and **Mitsubishi Heavy Industries**, the **AiP** from **DNV** for an ammonia powered and propelled **7,000 car** carrier designed by **China State Shipbuilding Corporation**, and the **AiP** for the **7,500 m³** ammonia carrier, the **MS Green Ammonia**, designed by **Grieg Edge** and using a Wärtsilä W25dF ammonia engine.

The development of ammonia and **LCO2** carriers has become a particular focus of a number of participants in the shipping industry, reflecting the perspective of likely cargoes, **LCO2** into storage, and ammonia to export markets.

- **NZE emission carriers:** In addition to the cargoes that are to be carried, the carriers carrying those cargoes are progressing to become **NZE** emissions carriers. **Mitsui O.S.K Lines, Ltd** is reported to be aiming to deploy 110 **NZE** carriers by 2035.
- **Yara bookends the month of April:**
 - **Yara International pacesetting:** On **April 1, 2022**, [h2-view.com](#) reported that **Yara International** was continuing to develop the world's first carbon-free ammonia fuel bunker network in Scandinavia. As will be apparent to regular readers of Low Carbon Pulse, ammonia is a **Future-Fuel**, which is being considered by the international shipping industry as one of a number of fuels to displace heavy fuel oil.
On **May 17, 2022**, the **Ashurst Global Towards Net-Zero Emissions Team** will publish an article on **Future-Fuels** (the primary author being the author of Low Carbon Pulse).
 - **Yara Birkeland wetted:** On **April 29, 2022**, the **Wilhelmsen Group** [announced](#) the official christening of the **Yara Birkeland**, the world's first autonomous and zero-emission container vessel: the **Yara Birkeland** was developed in collaboration with Kongsberg Group and was built by VARD, and will transport mineral fertiliser between Porsgrunn and Brevik.

By way of reminder: Edition 31 of Low Carbon Pulse reported that: "On November 19, 2021, the Yara Birkeland departed for its maiden voyage – the Yara Birkeland is the first container vessel to be powered and propelled by electric technology. CEO of Yara, Mr Svien Tore Holsether said: "[Yara is] proud to be able to show case the world's first fully electric and self-propelled container ship. It will cut 1,000 tonnes of CO2 and replace 40,000 trips by diesel-powered trucks a year".

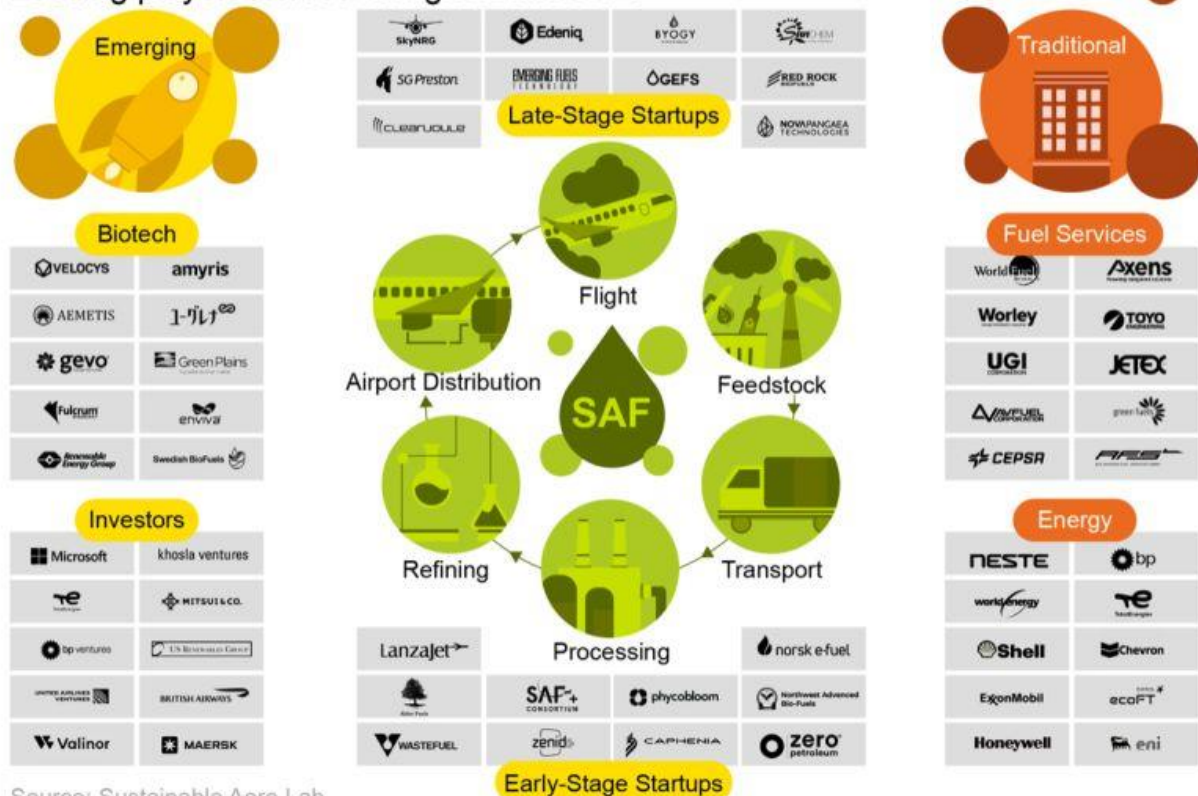
Airports and Aviation:

This section considers news items that have arisen within the news cycle of this **Edition 39** of Low Carbon Pulse relating to the development and deployment of technology at airports and in the aviation sector to decarbonise the airports and the aviation industry.

- **SAF represented in infographic:** The following infographic provides a snap-shot of the **SAF** ecosystem:

THE ECOSYSTEM ADVANCING SUSTAINABLE AVIATION FUEL

Leading players across categories in 2022



Source: Sustainable Aero Lab

- **HyPoint – another high point:**
 - **Edition 37** of Low Carbon Pulse reported that: "HyPoint (technology corporation) had developed a need technology that would allow the carriage of liquid hydrogen (**LH2**) using ultra-light weight fuel tanks". This news item has received considerable further coverage throughout April as the implications of the development of this technology are reflected upon.
 - In early **April 2022** it was announced that **HyPoint** had agreed to work **Gloyer-Taylor Laboratories (GTL)** to integrate **HyPoint's** ultra-light weight fuel tanks with **Gloyer-Taylor Laboratories (GTL)**.
- **Airbus Industries and Kawasaki Heavy Industries aligned:** On **April 12, 2022**, it was reported widely that **Airbus** and **Kawasaki** have agreed to work together to develop supply hydrogen supply chains to deliver hydrogen and hydrogen-based fuels to airports, and to develop the accompanying hydrogen eco-systems. For these purposes, the two global giants, signed a memorandum of understanding (**MOU**). Through working together **Airbus** and **Kawasaki** will develop jointly a roadmap to address the challenges and define an advocacy plan to ensure the timely development of hydrogen supply and demand, and delivery, for the aviation industry.
- **ENEOS and TotalEnergies align:** On **April 14, 2022**, [biofuel-news.com](https://www.biofuel-news.com) reported that **ENEOS Corporation** (a Japan-based integrated energy company) and **TotalEnergies** (global leading international energy corporation) had agreed to work together to assess the feasibility of a **SAF** production facility at **ENEOS' Negishi** refinery in Japan. (**ENEOS** and **TotalEnergies** had previously commenced studies on supply).
As reported (and as will be familiar to regular readers of Low Carbon Pulse), the feedstock for the **SAF** would be animal fats and cooking oils (and possible other residues and waste), with the intention to produce up to **300,000 metric tonnes** of **SAF** a year.

- **Air Products, Honeywell and World Energy SAF and sound:** On April 25, 2022, it was reported widely that **Air Products** (one of the Big Three industrial gas corporations), **Honeywell** (a leading solutions and technology corporation) and **World Energy** (a producer and supplier of **SAF**) are to work together to develop North America's first commercial scale **SAF** production facility in **Paramount, California**.

The **USD 2 billion SAF** production facility (with current nameplate production capacity of **340 million gallons** a year) is to be located at the production hub of **World Energy**, using hydrogen supplied by **Air Products**, with **Honeywell** continuing to work with **World Energy** to continue to develop more efficient and new processes.

As a reminder, **Edition 35** of Low Carbon Pulse noted in respect of **SAF**:

1. commercial aircraft are not permitted to use **SAF** on its own to propel aircraft (a maximum blend ratio of 50% fossil fuel to 50% **SAF** is permitted);

2. the process to produce **SAF** – there is only one commercially scalable production process – the use of fatty acids and hydrogenated acids as feedstock to produce synthetic paraffinic kerosene. As such, while there are seven approved means of production of **SAF**, only one means is currently commercially scalable; and

3. there is limited available feedstock (i.e. fatty and hydrogenated acids) from which to produce **SAF**. The primary sources of feedstock are animal fats and used cooking oils. As a result, current supply (200,000 metric tonnes of **SAF** annually) is a drop in the ocean of demand for aviation fuel (300 million metric tonnes annually). There is a market for **SAF**, not least because the aviation industry gives rise to around 1 billion metric tonnes of **CO₂-e** each year.

In addition to the reports in **Edition 35** of Low Carbon Pulse on **SAF** on the use of animal fats and used cooking oil, Stuttgart Airport and Schwenk Zement and SkyNRG are progressing with plans to develop synthetic aviation fuel, in the form of synthetic kerosene. The feedstock to produce this **SAF** is **CO₂**, captured from the production of cement, combined with **H₂**.

- **Future publications:**

- **Carbon Credits, Article 6 and the Paris Rulebook:**

The demand for carbon credits is increasing at pace in the **Voluntary Carbon Market / Voluntary Carbon Credit Market**. In the **Voluntary Carbon Market / Voluntary Carbon Credit Market**, carbon credits have value to corporations that have committed to achieving **GHG** emission reductions and, in the longer term, **NZE**, on the basis of carbon neutrality.

In a stand-alone article, the author of Low Carbon Pulse will outline Carbon Credits, Article 6 and the Paris Rulebook, and the near, medium and long term role of carbon credits, including as deforestation is curtailed and ceases, and afforestation and reforestation continues, and possible regulation of the **Voluntary Carbon Markets / Voluntary Carbon Credit Markets**.

- **E-Fuels / Future Fuels, including derived from biomass and bioenergy:**

The focus on fuels that are not derived or produced from fossil fuels is increasing. Low Carbon Pulse covers E-Fuels / Future Fuels and bio-energy. In addition to the focus on hydrogen and hydrogen based fuels (including ammonia and methanol), including hydrogen derived from biomass, there is a focus on the derivation and production of Renewable Natural Gas (**RNG**), derived from biomass, including biogas / biomethane, both for use as pipeline gas and for use as bio-compressed natural gas (**Bio-CNG**) and bio-liquified natural gas (**Bio-LNG**).

In a stand-alone article, Michael Harrison and Richard Guit will outline the sources of fossil fuels and non-biomass fuels (including crop fuels), and the feedstocks and technologies used to produce each E-Fuel / Future Fuel, and each form of bio-energy, and of course the **GHG** arising from their derivation and production, and use.

- **EU Taxonomy:**

The format of Low Carbon Pulse does not allow detailed coverage of the various regulations relevant to progress to **NZE** across the **EU**. In anticipation of the expiry of the four month scrutiny and objection period (which started at the end of January 2022) expiring without an effective objection to the **Taxonomy Complementary Climate Delegated Act**, the author of Low Carbon Pulse will provide a summary of the key regulations and their effect over coming months in a standalone article hopefully by the end of June 2022.

Reference Materials:

The purposes of this Reference Material section is keep live, reference material that readers may find most useful on an ongoing basis without the need to search for that material:

- **Background on electrolyzers:**

At the moment around 61% of electrolyzers use **AE** technology and around 30% use **PEM** technology.

ANATOMY OF AN ELECTROLYSER

Alkaline electrolyzers (**AE**) produce H₂ using a liquid electrolyte, using nickel electrodes and stainless steel for the stack.

Polymer Electrolyte Membrane or Proton-Exchange Membrane (**PEM**) electrolyzers operate in an acidic environment, using iridium coated anodes and platinum coated cathodes, both the anode and cathode are made from titanium.

AEs and **PEMs** have similar electrical energy efficiency, with the consumption of electrical energy being almost the same. PEM's operate at a higher electrical current, and as such are more productive per unit of stack mass.

Low Carbon Pulse - Edition 40 (short-form)

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to the **Short Form Version** of **Edition 40** of Low Carbon Pulse – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Sunday May 1, 2022** to **Tuesday May 31, 2022**. The **Long Form Version** of **Edition 40** was published on **Friday June 3, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering October 7, 2021 to March 31, 2022), and click [here](#) for the **Third Compendium of Low Carbon Pulse**.

Headlines:

Burning Platform:

The month of May has been a month of mixed news:

- On **May, 5 2022**, it was reported widely that in **April 2022**, the US **National Oceanic & Atmospheric Administration (NOAA)** observatory at **Mauna Loa, Hawaii** recorded the highest level of **CO₂** in the atmosphere – **420 ppm**. (For more on this news item see **CO₂ at highest levels** under **Climate Change Reported and Explained**.)
- On **May 9, 2022**, the **World Meteorological Organisation (WMO)** released a press-release reporting on the [Global Annual to Decadal Climate Update / State of the Global Climate 2021](#).

The headline from the press-release is as follows:

*"There is a 50:50 [actually expressed as: "about as likely as not (48%)"] chance of the annual average global temperature temporarily reaching **1.5°C** above the pre-industrial level for at least one of the next five years – and the likelihood is increasing with time".*

The source of the headline is the **Global Annual to Decadal Climate Update**, produced by the **Met Office** in the UK (the **Met Office** being the **WMO's** lead advisory organisation for predictions of this kind).

As reported in previous editions of Low Carbon Pulse (and sibling publications), in 2021 the global average temperature was **1.1°C** above the pre-industrial level. (For other key findings, see **Key Findings from [Global Annual to Decadal Climate Update / State of the Global Climate 2021](#)** below under **Climate Change Reported and Explained**.)

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven to those displaced.

Ministers meet:

On **May 12**, and **13, 2022**, a meeting of Ministers from more than 40 countries (convened by the Presidencies of **COP-26** and **COP-27**) took place in **Copenhagen, Denmark (May Ministerial)**.

The **May Ministerial** marked six months since **COP-26** and six months until **COP-27**, and was co-chaired by the President of **COP-26 Mr Alok Sharma**, and the incoming President of **COP-27, Mr Sameh Shoukry**. The [communiqué](#) from the **May Ministerial** is worth a read.

Biodiversity Day 2022:

Sunday May 22, 2022, was **Biodiversity Day 2022**. There was considerable coverage before, on and after [Biodiversity Day 2022](#) about all aspects of the environment, including the need to cease activities giving rise to degradation, and to undertake activities that will remedy degradation that has occurred. The [Blue and Green Carbon and Biodiversity](#) section of this **Edition 40** of Low Carbon Pulse provides some background.

The Month in the rear view mirror:

- **May 2 to 6, 2022:** The **XV World Forestry Congress (Congress)** was held in Seoul, Republic of Korea (**ROK**) under the theme of **Building a Green Healthy and Resilient Future with Forests**.

For the author of Low Carbon Pulse, the progress made at the **Congress** is key, both for forestry and land use. During the first four months of 2022, there has been a clear uptick in interest in the role that land-management and optimal land-use can have on increased absorption of **CO₂**, i.e., its negative **GHG** emission impact.

Outcomes from the **Congress**:

- Participants at the **Congress** endorsed the [Seoul Forest Declaration](#), identifying areas for action as a priority;
 - Ministerial Call on Sustainable Wood; and
 - Youth Call for Action.
- **May 9 to 20, 2022:** The **15th United Nations Conference to Combat Desertification (UNCCD)** was held in Abidjan, Côte d'Ivoire. **COP-15 of UNCCD** was accompanied by the second edition of the [Global Land Outlook – Land Restoration for Recovery and Resilience](#) published by the **UNCCD**.

Outcomes from **COP-15 UNCCD**:

- Concluded with a global pledge to boost drought resilience and to invest in land restoration for future prosperity, with agreement to establish an **Intergovernmental Working Group for 2022-2024** to consider solutions; and
- Included the adoption of [38 decisions](#) including on migration and tenure, highlighting the role of land in addressing the degradation that has occurred (with up to 40% of land mass degraded), including as a result of climate change.

The theme that emerged from **XV World Forestry Congress** and **COP-15 of UNCCD** was how to address deforestation, reforestation, afforestation, and land restoration, and land-management and land-use generally.

30th anniversary of UN Framework Convention on Climate Change:

May 9, 2022 was the **30th anniversary** of the adoption of the [UN Framework Convention on Climate Change](#). Considerable progress has been achieved since **May 9, 1992**, critically the [Paris Agreement](#) and the **Paris Rule Book** that underpins the **Paris Agreement**.

To mark the **30th anniversary**, **UN Climate Change Executive Secretary, Ms Patricia Espinosa** made a statement, and the following three pages convey, in short form, the essence of that statement.

The Month Ahead:

- On **June 2 and 3, 2022**, the **Stockholm+50** conference will be held in Stockholm, Sweden. The **Stockholm+50** conference marks the **50th anniversary** of the **world's first conference** on the environment – **United Nations Conference on the Human Environment** held in Stockholm, Sweden, June 5 and 6, 1972, which gave rise to the establishment of the **United Nations Environment Programme (UNEP)**.

The agenda for the **Stockholm+50** conference is **Immediate action for people, planet and prosperity will create a better future for all**. **Edition 41** of Low Carbon Pulse will report on **Stockholm+50**; and

- Also in June:
 - On **June 26 to 28**, the **G7 Summit** will be held at Schloss Elmau, Bavaria, Germany;
 - On **June 26 to 30**, the **World Urban Forum** will be held in Katowice, Poland; and
 - On **June 27 to July 1**, the **UN Ocean Conference** will be held in Lisbon, Portugal.

Edition 41 of Low Carbon Pulse will report on the Summit, Forum and Conference.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

- **REPowerEU detailed plans released:** As reported in **Edition 37** of Low Carbon Pulse, on **March 8, 2022**, the **European Commission (EC)** outlined its **REPowerEU** plan.

On **May 18, 2022**, the **EC** presented its detailed [REPowerEU Plan](#). The key points [REPowerEU Plan](#) are as follows:

- First, the **Recovery and Resilience Facility (RRF)** will continue as the core of the [REPowerEU Plan](#), with the **RRF Regulation** to be amended to reflect the [REPowerEU Plan](#);
- Secondly, **Energy savings (improved energy efficiency)** offers the cheapest and quickest means of mitigating the impacts on the energy market in the **EU**, and to reflect this the **EC** will increase the **Energy Efficiency Target** under [Fit-for-55 package](#) from 9% to 11%. To accompany the [REPowerEU Plan](#), on **May 18, 2022**, the **EC** published [EU Save Energy Communication](#);

By way of reminder: The **Fit-for-55** package was presented in mid-July 2021 (see **Edition 32** of Low Carbon Pulse) to reduce **GHG** emissions by at least **55% by 2030**, compared to 1990 **GHG** emission levels;

- Thirdly, **Diversifying energy imports (diversified supply)** is a key element to the policy settings in the **EU**, with natural gas and LNG in the near to medium term (as a transition energy source) and hydrogen as the medium to long-term solution, as reflected in the [EU Energy Platform](#). In line with editorial comment provided by Low Carbon Pulse (and sibling publications), the **EC** is contemplating that Member States of the **EU** may purchase natural gas and LNG and hydrogen jointly. In the context of the deployment of hydrogen, arrangements of this kind will accelerate the development and deployment of hydrogen capacity.
- Fourthly, **Substituting fossil fuels and accelerating clean energy transition (acceleration of renewable energy deployment)** is the core of progress towards **NZE** globally, and the **EC** policy settings, including the following:

- to increase the deployment of renewable renewable from **40% to 45% by 2030**;
 - the [EU Solar Strategy](#) is to provide a pathway to **doubling photovoltaic capacity by 2025**, and to deploy **600 GW of photovoltaic capacity by 2030**, with an obligation to install photovoltaic panels on new commercial, public and residential buildings under the **Solar Rooftop** initiative;
 - **Heat pump deployment** is to double, with policy settings to integrate geothermal and solar thermal energy across communal / district heating systems;
 - the **Renewable Energy Directive** is to be amended to allow the development and deployment of renewable projects at a quicker rate, and on a simplified basis;
 - targeting the production of **10 million** metric tonnes of **Renewable Hydrogen** within the **EU** and the import of **10 million** metric tonnes of Renewable Hydrogen into the **EU by 2030**.
 - the [Biomethane Action Plan](#) targeting the production of **35 billion cubic metres of biomethane by 2035**. The **Biomethane Action Plan** is covered in more detail below, under [Bioenergy and Heat Recovery](#).
- **EC publishes technical regulations: Edition 39** of Low Carbon Pulse reported that on **May 18, 2022**, the **EC** intends to publish technical regulations that will provide the parameters by which hydrogen will be classified as renewable under the [EU RED II](#).
On **May 18, 2022**, among other things, the **EC** published two [draft Delegated Acts](#) to clarify **EU** rules applicable to renewable hydrogen under the **2018 Renewable Energy Directive**. The **two Delegated Acts** are: the **Delegated Act** on the production of renewable transport fuels – share of renewable electricity (requirements) and the **Delegated Act** on renewable energy – method for assessing **GHG** emission savings from certain fuels. The **Delegated Acts** work together:
A number of participants in the hydrogen industry (and the broader energy industry) have noted that the requirements for **additionality** and **coupling** may have unintended consequence of slowing the pace of development of Green Hydrogen production capacity. The form of the **two delegated acts** are [open for consultation](#) until **June 17, 2022**, having commenced on **May 20, 2022**. **Edition 41** of Low Carbon Pulse will consider each **Delegated Act**.
 - **Green Hydrogen Organisation defines Green Hydrogen:** On **May 17 2022**, the **Green Hydrogen Organisation** or **GHO** published [The Green Hydrogen Standard](#): the **GHO** has defined Green Hydrogen as:
"hydrogen produced through the electrolysis of water with 100% or near 100% renewable energy with close to zero greenhouse gas emissions (less than or equal to 1kg of CO₂-e per kg of H₂ taken as an average over a 12 month period".
The **Green Hydrogen Standard** imposes environmental, social and governance obligations on producers of Green Hydrogen, and Green Hydrogen produced must be assessed by **Independent Assurance Providers** to verify compliance. Each assessment and compliance report of **Independent Assurance Provider** will be submitted to the **Accreditation Body** of the **GHO** which will make the final determination as to compliance, and, if compliant, accredit as Green Hydrogen.
 - **Clean Air Task Force framework for CCS in Europe:** On **May 10, 2022**, the **Clean Air Task Force** or **CATF** (**an environmental organization**) published [A European Strategy for Carbon Capture and Storage](#), effectively providing a policy setting framework for carbon capture and storage across Europe.
 - **Unlocking the hydrogen economy:** During **May** the **European Commission (EC)** and the **European Investment Bank (EIB)** published [Unloading the hydrogen economy - stimulating investment across the hydrogen value chain](#). The publication highlights the key takeaways from an investor consultation with 46 market participants conducted by the **EIB** Advisory Services Group at the request of the **EC**.
 - **McKinsey & Co:** On **May 16, 2022**, **McKinsey Sustainability** published a collection of analyses – [Decarbonizing the world's industries: A net-zero guide for nine key sectors](#) (Power, Oil and Gas, Automotive, Aviation and shipping, Steel, Cement, Mining, Agriculture and food and Forestry and land use).
As is always the case with McKinsey publications, each analysis provides rich reading: each analysis provides a pithy piece on momentum and acceleration, underpinned by rich factual and statistical information.
 - **Global CCS Institute publishes inaugural report:** On **May 17, 2022**, the **Global CCS Institute** (a CCS "think-tank") published [State of the Art: CCS Technologies 2022](#). The publication is welcome, and very helpful.
 - **Council of European Union (CEU) revises Trans-European Networks for Energy (TEN-E) Regulation:** On **May 16, 2022**, the **CEU** adopted the revised **TEN-E Regulation**. The press release (from [consilium.europa.eu](#)) provides background and details on the next steps.
The headline from the revised **TEN-E Regulation** is the introduction of mandatory sustainability criteria for all projects across the **EU**, and the end to support for natural gas and oil projects.
The revised **TEN-E Regulation** prioritises **11 corridors** for the **Trans-European Network**, and **three thematic** areas for development and interconnection.

Climate change reported and explained:

CO₂ at highest levels:

- On **May, 5 2022**, it was reported widely that in **April 2022**, the US **National Oceanic & Atmospheric Administration (NOAA)** observatory at **Mauna Loa, Hawaii** recorded the highest level of **CO₂** in the atmosphere – **420 ppm**.
- On **May 14, 2022** it was reported widely that a new daily record of **421.37 ppm** had been recorded by the **Scripps Institution of Oceanography** at the **University of California, San Diego**, with similar record levels confirmed by the **NOAA**.

Middle East including GCC Countries:

- **EWEC procuring 1.5 GW of photovoltaic solar:** On **May 11, 2022**, it was reported widely that **Emirates Water and Electricity Co. (EWEC)** was accepting expressions of interest to develop a **1.5 GW** photovoltaic solar project in Abu Dhabi (the **AL Ajban PV** project).
- **ADNOC and BP continue cooperation:** On **May 24, 2022**, it was reported widely that **ADNOC** (Abu Dhabi National Oil Company) and **Masdar** (Abu Dhabi Future Energy Company) had agreed to invest in **bp's** Blue Hydrogen and Green Hydrogen projects, **H2Teesside**. **ADNOC** will work with **bp** on the Blue Hydrogen project, and **Masdar** will work with **bp** on the Green Hydrogen project (**HyGreen Teesside**).
- **JDA for World Scale Future Fuels project:** Previous editions of Low Carbon Pulse reported that in late 2021, **ACWA Power, Air Products** and **OQ** had signed a memorandum of understanding (**MOU**) in respect of an integrated photovoltaic solar, wind, and **BESS**, Green Hydrogen production facility, and nitrogen separation facility, and a Green Hydrogen and nitrogen synthesis plant (to be located in the Salalah Free Zone, Oman) to produce Green Ammonia. On **May 26, 2022**, it was reported widely that the parties to the **MOU** had progressed to the execution of a joint development agreement (**JDA**).

Africa:

- **Continued flow of Suez projects:** On **May 11, 2022**, english.ahram.org.eg reported that Egyptian Prime Minister, Mr Mostafa Madbouly attended a signing ceremony for a memorandum of understanding (**MOU**) among the **General Authority for Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**, and a consortium comprising **Total Eren** and **Enara Capital**. Under the **MOU**, facilities are to be developed to produce Green Hydrogen and Green Ammonia to produce up to **300,000 metric tonnes** of Green Ammonia a year initially, but with the expectation of expansion of up to **1.5 million metric tonnes** a year.
- **And another one!:** On **June 1, 2022**, it was reported widely that the **General Authority for Suez Canal Economic Zone (SCZONE)** and **H-2 Industries** plan to develop a **USD 4 billion waste-to-hydrogen facility** at **Port Said**. As reported, the waste-to-hydrogen facility will process **4 million metric tonnes** of **municipal solid waste** as feedstock, and produce **300,000 metric tonnes** of hydrogen annually.
- **African Green Hydrogen Alliance launched:** On **May 20, 2022**, it was reported widely that **Egypt, Kenya, Morocco, Namibia, Mauritania**, and **South Africa** had established the **African Green Hydrogen Alliance (AGHA)**. The **AGHA** is supported by the **African Development Bank**, the **Green Hydrogen Organisation**, and the **UN Climate Change High-Level Champions**, and the **UN Economic Commission for Africa**.
- **Africa Day: May 25, 2022**, marked **Africa Day 2022**. **Africa Day 2022** marks the **20th anniversary** of the establishment of the **African Union**. The theme for **Africa Day 2022** was nutrition.
- **First of its kind BESS:** On **May 31, 2022**, energy-storage reported that **JCM Power** and **InfraCo Africa** had announced that the **20 MW Golomoti Photovoltaic Solar** and **BESS** project in the **Dedza** district of **Malawi** was operational- said to be the first grid-connected utility scale co-located project in sub-Saharan Africa.

India and Indonesia:

- **Hindustan Salts seeks bids for 1 GW of solar:** On **May 5, 2022**, pv-magazine.com reported that **Hindustan Salts Ltd** (a Government of India state-owned corporation) had invited bids to develop **1 GW** of photovoltaic solar capacity located on **5,000** acres of disused land in the Indian State of Gujarat.
- **1 GW Photovoltaic solar farm at Hengjaya Mine and Industrial Park:** **Ib vogt** (a solar energy engineering company and developer) and **Quantum Power Asia** announced the development of a **1 GW photovoltaic solar farm** to provide renewable electrical energy at the **Hengjaya Mine** (nickel and cobalt), contracting with **Nickel Mines Limited** for this purpose, and to provide renewable electrical energy to Morowali Industrial Park.
- **587 GW of renewable energy by 2060:** On **May 23, 2022**, kaiser.antaranews.com reported that Indonesia plans to develop clean energy power plants with capacity of **587 GW** by 2060, including **361 GW** of photovoltaic solar capacity, **83 GW** of hydroelectric power, and **39 GW** of wind capacity. In addition, the plans include the development of **37 GW** of biomass capacity, **35 GW** of nuclear capacity, **18 GW** of geothermal capacity, and **13.4 GW** of ocean current and wave capacity. To complete the clean energy mix, there will be **energy storage capacity of 140 GW** of **BESS**, **52 GW** of **HESS** and **4.2 GW** of **pumped storage**. As reported in previous editions, the decarbonisation of the electrical energy sector will cost an estimated USD 1,177 billion (or USD 1.177 trillion).
- **Giga-factory planned by Exide Industries:** On **May 27, 2022** Benchmark Mineral Intelligence reported that **Exide Industries** is in "advanced stages" of securing land for its first lithium-ion giga-factory. As reported, the giga-factory is to be located in the **state of Karnataka**, with initial production capacity of **six GWh** a year, increasing to **12 GWh** by 2030. It is understood that the giga-factory will be co-developed with **SVOLT**.
- **Hybrid photovoltaic solar and wind operational:** On **May 28, 2022**, **Adani Green** announced at adanigreenenergy.com that it had commissioned the **390 MW hybrid plant** in the **state of Rajasthan**. As reported, this is the first hybrid renewable energy project in India. The **Solar Energy Corporation of India** or **SOCI** (a state-owned corporation) is to off-take the renewable energy from the project with a tariff of **R2.69** per kWh.
- **Large scale solar park opens in India:** On **May 30, 2022**, **Statkraft** announced that its **Nellai** photovoltaic solar farm had commenced operation. The **Nellai** photovoltaic solar farm is located in the southern **state of Tamil Nadu**. **Tamil Nadu** has world class solar resources, with an average of **300 days** of sunshine a year.

Japan and Republic of Korea (ROK):

- **Air Liquide and Lotte Chemical aligned strategically:** On **May 2, 2022**, **Air Liquide** (one of the Big Three Industrial Gas Giants), announced that it had entered into a strategic joint venture with **Lotte Chemical** under which **Air Liquide** (as a 40% participant) and **Lotte Chemical** (as a 60% participant) are to co-invest through joint venture in new generation, large-scale, hydrogen refuelling stations in the industrial basins of **Daesan** and **Ulsan**.

- **Japan's plans to issue USD 157 billion of green transition bonds:** On **May 19, 2022**, [reuters](#) reported that Japanese **Prime Minister, Mr Fumio Kishida** had outlined plans to issue an estimated **¥ 20 trillion** (USD 157 billion) of green transition bonds to assist Japan in financing the investment required to achieve carbon neutrality.
- **Japan and US align further at QUAD:** On **May 23, 2022**, the **White House** released a [Fact Sheet: US – Japan Climate Partnership](#). The Fact Sheet outlines the increasing granularity in alignment between the Japan and the US.
- **SolarEdge opens:** On **May 25, 2022**, [energy-storage](#) reported that **SolarEdge** has opened its **2 GW** battery cell giga-factory (**Sella 2**). **Sella 2** has been developed by **SolarEdge**, working with **Kokam**, and is located in **Eumseong Innovation City, Chungcheongbuk-do Province, ROK**.

PRC and Russia:

- **Enhancing ETS for PRC:** On **May 25, 2022**, the **IEA** and **Tsinghua University** held an expert discussion in respect of how an enhanced emissions trading system in the **PRC** could assist in providing momentum in progress towards the achievement of **NZE**.
On **May 25, 2022**, the **IEA** published [Enhancing China's ETS for Carbon Neutrality: Focus on the Power Sector](#). The publication analyses five policy setting scenarios for the electricity sector for 2020 to 2035, consistent with China's 14 Five-Year Plan (2021-2025), and the Long Range-Range Objectives through the Year 2035.
- **PRC NEA predicts 108 GW of new photovoltaic manufacturing capacity in 2022:** On **May 31, 2022**, [pv-magazine](#) reported that the **National Energy Administration** of the **PRC** expects **108 GW** new photovoltaic manufacturing capacity during 2022.

Europe and UK:

- **North Sea Countries 65 by 2030 and 150 by 2050:** On **May 18, 2022**, at the **North Sea Summit, Belgium, Denmark, Germany and the Netherlands**, consolidated their collective thinking around the development of off-shore wind field capacity development and Green Hydrogen production, with thinking around use of the **North Sea** as the **Green Power Plant of Europe** – the thinking includes the development of **65 GW** of **OWF** capacity **by 2030** and **150 GW** of **OWF** capacity **by 2050**.

For these purposes, each of the countries signed the [Esbjerg Declaration](#) (formally, **The Declaration of Energy Ministers on The North Sea as a Green Power Plant for Europe**).

ESBJERG DECLARATION - NORTH SEA OWF TARGETS

Belgium: 8 GW by 2040	Denmark: 35 GW by 2050	Germany: 70 by 2050	The Netherlands: 21 GW by 2030
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- **Alliance Investment Management and CIP to assess feasibility of energy island:**
 - On **May 19, 2022**, it was reported widely that **Allianz Investment Management** and **Copenhagen Infrastructure Partners** or **CIP** had agreed to conduct a feasibility study to determine how to build an **energy island** in the **German sector** of the North Sea.
 - On **May 20, 2022**, [rechargenews.com](#) reported that **CIP** intended to develop **Brintø Island** (or Hydrogen Island) in the **Danish sector** of the North Sea, in the area of **Dogger Bank**, located on an extensive sandbank. As reported **Brintø Island**, would locate Green Hydrogen production facilities, powered by renewable electrical energy from up to **10 GW** of **OWF** capacity, with production capacity of up to **1 million metric tonnes** of Green Hydrogen a year.

Americas:

- **Load matched by 100% renewable electrical energy:** On **May 2, 2022**, it was reported widely that between **2.45 pm** and **3 pm** on **April 30, 2022**, the electrical energy load of the US State of California was matched by the dispatch of electrical energy sourced from renewable electrical energy sources. This was a first for California: load was **18 GW** and renewables electrical energy was **18.6 GW**.
- **Battery funding:** On **May 2, 2022**, the US Department of Energy (**DOE**) announced **USD 3.1 billion** of funding support under the [Battery Materials Processing and Battery Manufacturing](#) initiative and **USD 60 million** of funding support under [Battery Manufacturing and Electric Drive Vehicle Battery Recycling and Second Life Applications](#) initiative.

These initiatives are provided for under the **Infrastructure Investment and Jobs Act (IIAJA)** also known as the Bipartisan Infrastructure Law (**BIL**). In addition to funding for these initiatives, the **BIL** provides for funding support of **USD 7.5 billion** for electrical vehicles charging infrastructure, **USD 5.5 billion** for electric buses, and **USD 5 billion** for clean and electric school buses. The **BIL** funding support is intended to accelerate the development of the supply chain for electrical vehicles in the US.

As noted in previous editions of Low Carbon Pulse, there is **USD 8 billion** to provide support for **at least four hydrogen hubs** that are able to demonstrate that their development and deployment will contribute to production of clean hydrogen and to multiple uses of that clean hydrogen.

- **CCS funding:** On **May 5, 2022**, the US **DOE** announced more than **USD 2.3 billion** of funding support for three initiatives to support the abatement, reduction and storage of **CO₂** emissions.
 - First, USD 2.25 billion** (under the **BIL**) to accelerate carbon storage projects – **BIL: Storage Validation and Testing (Section 40305): Carbon Storage Assurance Facility Enterprise (CarboSAFE) Initiative: Phases II, II.5 and IV;**
 - Secondly, USD 45 million** to increase the number of **CO₂** storage sites – **CarboSAFE: Phase II - Storage Complex Feasibility;** and
 - Thirdly, USD 46 million** to develop technology to remove, capture, convert and store **CO₂** – **Carbon Management.**

France and Germany:

- **A progress check on FSRUs: Editions 37 and 39** (Long Forms) of Low Carbon Pulse reported on the procurement of floating storage regasification units (**FSRUs**) across Europe so as to address energy security concerns by allowing the import of liquified natural gas (**LNG**). As at the end of **May 2022**, the situation is as follows:
 - **Germany chartering four FSRUs:** On **May 5, 2022**, German Federal Government Economic Minister, Mr Robert Habeck announced that the **German Federal Government** had committed to charter **four FSRUs**, a commitment of **€2.04 billion (USD 3 billion)** to allow the import of sufficient LNG to provide 20% of the demand for natural gas in Germany;
 - **Gasunie chartering FSRUs:** On **May 10, 2022**, it was reported widely that **Gasunie** had agreed to charter an FSRU from **New Fortress Energy** to allow the import of LNG at the **EEM Energy Import Terminal**.
 - **Gasrid chartering FSRU:** On **May 20, 2022**, marinelink.com reported that **Gasgrid Finland Oy** had entered into a 10 year charterparty with **Excelerate Energy** to allow the import of LNG for regasification to provide natural gas to the **Baltic Sea Region**, including **Finland and Estonia**. In addition, Estonia plans to develop an on-shore LNG receiving and re-gasification terminal at Paldiski; and
 - **Lithuania Klaipeda FSRU:** **Latvenergo** has indicated that hopes to import LNG through the **Klaipeda FSRU**. In addition, Latvia has indicated an intention to develop an on-shore LNG receiving and re-gasification terminal at the Port of Skulte.
- **LNG demand curve above supply curve:** On **May 9, 2022**, the excellent folk at **Rystad Energy** published an excellent article - [A perfect and unavoidable storm: LNG supply crisis to make landfall in winter 2022](#). The title of the article says it all, but the article is well-worth a read.
- **France and Ireland committed to HVDC:** On **May 23, 2022**, the irishexaminer.com reported that approval had been given for the development of the **Celtic Interconnector** allowing for the exchange of electricity between France and the Republic of Ireland using a **€1 billion 575 km subsea-cable**, from the coast of **Brittany** to the coast of **Cork**.

Australia:

- **Three consortiums short-listed on Central-West Orana:** On **May 4, 2022**, the **State Government of NSW** announced the short-listed tenderers to develop the **Central-West Orana REZ**.
As announced, the short-listed consortiums are:
 1. **ACE Energy**, comprising Acciona, Cobra and Endeavour Energy;
 2. **Network REZolution**, comprising APA Group, CPB Contractors, Pacific Partnerships, and UGL; and
 3. **NewGen Networks**, comprising Elecnor, Essential Energy, Plenary Group, and Secure Energy.As stated by the **State Government of NSW**, the next step in the process will involve **Energy Corporation of NSW** inviting the short-listed consortiums to respond to a request for proposal, with contract award during 2023.
- **Australia and Germany likely to accelerate hydrogen chain development:** On **May 27, 2022**, Reuters (under [Germany looks to speed up green hydrogen development in Australia](#)) reported that Germany wants to speed up the development of the Green Hydrogen value chain between **Australia** and **Germany**. As has been reported in previous editions of Low Carbon Pulse and this **Edition 40** (Long Form Version), Germany will not have domestic supply capacity to satisfy its domestic demand for Green Hydrogen.
- **Microsoft Blue Print for Australia:** During **May 2022**, **Microsoft** published [Accelerating the Journey to Net Zero – A Blue Print for Australia](#). The publication provides a helpful overview of the progress that needs to be made in Australia.

Blue and Green Carbon Initiatives and Biodiversity

- **May 22, 2022**, was **Biodiversity Day**. **Biodiversity Day** is intended to increase awareness of the benefits of **biodiversity** and the importance of preserving **biodiversity**. In the broadest sense, **biodiversity** describes the variety of the fauna and flora globally, and in any particular area. At the highest level, **biodiversity** is important. The preservation of **biodiversity** is therefore a key policy setting. In this context, human activities and the clearing of land to undertake agricultural, forestry or other land use (**AFOLU**) is a key focus of policy settings. Desertification and deforestation are key concerns (both as a result of **AFOLU**), as is the broader impact of climate change on habitats, critically, the impact on change in temperature on land and in the ocean.

There is a balance in habitats, with eco-systems that have developed overtime, and that continue to develop. The balance of habitats and their eco-systems are impacted by **AFOLU** and climate change. There are many examples, but a consistent example (that many will recognise) is the need to preserve the habitats of bees and other pollinators, and to avoid loss of bees and other pollinators. As a policy setting, the rewilding of habitats is one element of preservation, and, in some cases, restoration of eco-systems. As a broad statement, preserving wilderness areas, and rewilding of areas, and reducing old growth forestry, and afforestation and reforestation, are key to the preservation and restoration of **biodiversity**. These are policy settings over which we have control in the near, medium and long term. In addition, overtime, policy settings may extend to addressing optimal use of land, optimal in the sense of preserving or restoring **biodiversity** while at the same time addressing climate change. As always, what is needed is known. As always, the challenge is acting upon it.

Climate change will impact the effectiveness of these policy settings (in particular coastal habitats, and areas of increased drought and desertification, driven by rising sea-levels and changes in weather patterns, as a result of climate change), but they are policy settings that are necessary and need to be progressed in the near term. In addition, acting to preserve and to restore **biodiversity** is likely to yield benefits, economic and social.

Existing impact: It is widely understood that **75%** of the Earth's **land** and **66%** of its **oceans** have been altered by human activity, with associated impact on eco-systems. It is against this background that there is considerable anticipation of **Part 2** of the **15th meeting of the Conference of Parties (COP-15)** to the **Convention on**

Biological Diversity (CBD) to be held in Kunming, PRC, "tentatively scheduled" for between **August 29** and **September 9, 2022** (**Part 1 of COP-15** took place virtually from **October 11 to 15, 2021**).

COP-15 will review the achievement and delivery on the **CBD Strategic Plan for Biodiversity 2011 – 2020**. Also it is anticipated that conclusions will be reached in respect of the **post-2020 global diversity framework**.

Bioenergy and heat-recovery:

- **Anaergia commissions first of seven:** On **May 3, 2022**, **Anaergia** announced that it had commissioned its **Easy Energia Ambiente** facility in **Pontinia, Italy**. The **Easy Energia Ambiente** facility will process organic waste to derive biogas, which will then be upgraded (by the removal of **CO₂** and **CO**, and trace compounds) to produce **biomethane** or **renewable natural gas (RNG)**.
- **Up to USD 2 billion committed to RNG:** On **May 12, 2022**, **S&P Global** reported that:
 - **Waste Management** (US' largest waste management corporation) is to invest **USD 825 million** to develop and to deploy **RNG** plants at **17** landfills across the US; and
 - **Republic Services** (US solid waste disposal company), with biofuels corporation, **Archaea Energy**, announced a **USD 1.1 billion** joint venture to develop and to deploy **39 RNG** plants across the US.
- **Biomethane Action Plan for the EU:** On **May 18, 2022**, as part of the **REPowerEU Plan**, the **EU** proposed a **Biomethane Action Plan**, with the objective of producing **35 billion cubic metres (BCM)** of **biomethane** by **2030**.

BESS and HESS (and energy storage):

- **Maoneng continues roll-out of BESS:** On **May 2, 2022**, it was reported widely that **Maoneng** proposes to develop the **Merriwa Energy Hub** in the **Hunter Region** of **New South Wales, Australia** (located 180 kms north-west of Newcastle on the coast of New South Wales).
- **Powin Energy powers on and up:** On **May 4, 2022**, it was reported widely that **Powin Energy** is to supply **120 MW / 524 MWh** of **BESS** capacity to **Idaho Power**.
- **Compressed Air Storage preferred for Broken Hill:** On **May 27, 2022**, it was reported widely that a compressed air storage solution had been chosen to provide back-up electrical energy supply at Broken Hill, New South Wales, Australia. **Hydrostor** with a proprietary technology – advanced compressed air energy storage (**A-CAES**). The **A-CAES** is a long duration energy storage (**LDES**) system capable of dispatching stored energy to the grid, and to help address the capacity constraints across the grid regionally.
- **HESS happening:** On **May 30, 2022**, it was reported widely that **UK Energy Storage Ltd (UKEn)** intends to develop an **Energy-Hub** located across two sites in **Portland, Dorset, United Kingdom**. As reported, beneath land owned by **Portland Port Limited** there are salt caverns that are ideal for the storage of hydrogen, some reporting suggesting up to **1.2 billion m³** of available capacity for hydrogen storage.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

- **NSTA awards carbon storage licences to BP and Equinor:** On **May 12, 2022**, the **North Sea Transition Authority (NSTA)** [announced](#) in a press release that it had awarded carbon storage (**CS**) licences to **bp Exploration** and **Equinor**.
The award of the licences to **bp** and **Equinor** brings to **six** the **CS** licences that the **NSTA** is now stewarding.
- **Cross-border carbon storage:** On **May 13, 2022**, corygroup.co.uk announced that it (**Cory Group**) had signed a memorandum of understanding (**MOU**) with **Northern Lights** (part of the Norwegian Longship CCS project) to work together to realise a major carbon capture and storage projects between **Norway** and the **UK**.
- **Repurposing of natural gas pipeline:** On **May 18, 2022**, upstreamonline.com reported that **Tallgrass** is to expand the reach of its **Eastern Wyoming Sequestration Hub** to include an **ADM (Archer-Daniels Midland Company)** corn processing complex in **Columbus, Nebraska (ADM facility)** by the repurposing of its **Trailblazer natural gas** pipeline to haul **CO₂** captured at the **ADM facility**.
- **CVX launches CCS project:** On **May 18, 2022**, **Chevron U.S.A. Inc.**, [announced](#) the development of a CCS project at its Kern River Eastridge co-generation plant, Kern County, San Joaquin Valley, California.
- **Bayou Bend in the pink:** On **May 24, 2022**, [talosenergy](http://talosenergy.com) announced that it had executed definitive documentation with **Carbonvert, Inc.** and **Chevron U.S.A Inc.**, to develop, in joint venture, the **Bayou Bend CCS** off-shore bub.
- **Slite CCS Project proceeds:** On **May 30, 2022**, [HeidelbergCement](http://HeidelbergCement.com) announced further progress of its **Slite CCS project**. The [announcement](#) from HeidelbergCement starts with – "We're not just making concrete promises – we are also taking action". The **Slite CCS project** has passed pre-feasibility study, and the carbon capture facilities will be scaled up so as to capture **1.8 million metric tonnes** of **CO₂** annually by 2030.

Carbon Credits and Hydrogen Markets and Trading:

- **LEAF Coalition:** On **May 13, 2022**, the **LEAF Coalition** Window for Proposals from Forest jurisdictions opened. The mobilisation of **USD 1 billion** during 2021 was significant. As significant is the reputation that the **LEAF Coalition** has for "rigorous verification mechanisms" to verify that carbon is in fact sequestered, and remains sequestered.
- **Japan Carbon Credit trading platform:** On **May 13, 2022**, asia.nikkei.com reported that the **Ministry of Economy Trade and Industry (METI)** and **Japan Exchange Group** (owner and operator of the Tokyo Stock Exchange, the Osaka Exchange, and the Tokyo Commodity Exchange) are to establish the first market for carbon credit trading in Japan.
- **World Bank perspective:** During **May 24, 2022**, the **World Bank** published [State and Trends of Carbon Pricing 2022](#). The publication is excellent, and is well-worth a read.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

- **Sunshine state to get Super Hybrid Hydro:** On **May 4, 2022**, the plans of **Sunshine Hydro** were reported widely. As reported, **Sunshine Hydro** intends to develop the "world's first **SuperHybrid** project" using **renewable energy generation capacity**, **energy storage capacity** and **Green Hydrogen production capacity** to supply renewable

electrical energy **24/7, 365**, and Green Hydrogen for use within Queensland. It is understood that **Sunshine Hydro** intends to develop three **SuperHybrid** projects within the **Central Queensland Renewable Energy Zone**.

- **Jolly Green Giant**: On **May 4, 2022**, [pv-magazine-australia](#) reported (under **Plans for giant green hydrogen project in WA revealed**) on the scale of the planned **Murchison Hydrogen Renewables** project: while the **Murchison Hydrogen Renewables** project is not new, formal details as to its scale and scope are – the Green Hydrogen and Green Ammonia production facilities are to be powered by **3.7 GW** of installed photovoltaic solar and wind capacity, a **250 MW to 350 MW / 500 MWh / 700 MWh BESS, 3 GW** of electrolyser capacity, a desalination plant (producing six-gigalitres of demineralised water a year) to allow the production of up to **2,118,880 metric tonnes** of Green Hydrogen a year and up to **200** hydrogen storage vessels (each with a 680 metric tonne capacity) which together will allow the production of up to **2 million metric tonnes** of Green Ammonia a year.
- **ScottishPower and Storegga to transform highland hydrogen**: On **May 5, 2022**, **Storegga** [announced](#) that **ScottishPower** (Scotland-based energy company and subsidiary of Spanish utility firm Iberdrola) and **Storegga** (global leading carbon capture solutions corporation) had agreed to develop, to build and to operate a **series of green hydrogen production facilities** across Scotland, with the first to be located in the **Cromarty Firth** region, north of Inverness, producing 20 metric tonnes of Green Hydrogen a day by 2024, with the Green Hydrogen to satisfy demand from corporations, including whisky distilleries.
- **Storegga's continued progress**: On **May 16, 2022**, it was reported widely that **Storegga** had received backing from **GIC, Macquarie Group, M&G Investments, Mitsui** and **Snam** to continue to develop carbon capture and hydrogen projects in **Norway, the UK and the US**.
- **Winterhall Dea announces BlueHyNow**: On **May 5, 2022**, **Wintershall Dea** [announced](#) plans to develop a **clean / low-carbon** hydrogen production facility facilities (the **BlueHyNow Project**), at **Wilhelmshaven, Germany**. As announced, the **CO₂** arising from the **BlueHyNow Project** is to be transported for injection into sub-sea-bed storage in Denmark and Norway. For these purposes, it is assumed that the a **CO₂** liquefaction facility will need to be developed.
- **HyNetherlands Project recast**: On **May 10, 2022**, it was reported widely the **Engie** intends to recast its **HyNetherlands Project** to produce **Green Methanol**, using **Green Hydrogen** (produced from **Engie's** planned **100 MW** electrolyser, using renewable electrical energy sourced from 200 MW of off-shore wind field capacity) as a feedstock to be synthesised with **CO₂** to produce low-carbon methanol in Eemshaven, the Netherlands.
The **Green Hydrogen** produced by **Engie's HyNetherlands Project** will be synthesised with **biogenic CO₂** captured from the **EEW Energy** waste-to-energy facility located at **Farmsum**, at the **OCI Delfzijl Chemical Park**. The **HyNetherlands Project** will be connected with the **OCI Delfzijl Chemical Park** via the hydrogen network developed by **Gasunie**.
- **Iberdrola Green Hydrogen production facility opens**: On **May 13, 2022**, it was reported widely that the King of Spain opened the **€150 million** Green Hydrogen production facility at **Puertollano, Spain**, owned by **Iberdrola**.
- **Plug Power first 1 GW order**: On **May 17, 2022**, [h2-view.com](#) reported that **H2 Energy Europe** (Swiss-headquartered joint venture between Singapore-based commodity trading firm Trafigura Pte Ltd. and H2 Energy Holding AG) had ordered a **1 GW** electrolyser system from Plug Power.
- **Uniper LoI with HIF**: On **May 19, 2022**, **uniper** [announced](#) that it has signed a Letter of Intent (LoI) with **HIF Chile** and **HIF Global** to provide a framework to negotiate binding off-take agreements for **E-Fuels** to be produced from the production facilities at **Magallanes, Chile**. It is understood that the negotiations will extend to the sale and purchase of up to **2 million metric tonnes** of **E-Methanol** a year.
- **JERA to accelerate NH₃ and coal co-firing**: On **May 31, 2022**, [Inqprime.com](#) reported that **JERA** and **IHI Corporation** intend to accelerate the co-firing of ammonia and coal at Unit 4 of the Hekinan Power Station, co-firing of 20% ammonia to 80% coal from the start of April 1, 2023, and completing the pilot project by the end of March 2024.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

- **Sila next-gen anode giga-factory**: On **May 3, 2022**, **Sila** [announced](#) (at silanano.com) that it had acquired 600,000 ft² at Moses Lake, in Washington State, within which to house its lithium-ion anode manufacturing capacity for the use in electric battery electric vehicles. The manufacturing capacity of the facility will be up to **10 GWh** of cells when used as a full-graphite replacement, and up to **50 GWh** when used as a partial replacement.
- **John Cockerill roosts globally**: On **May 4, 2022**, [rechargenews.com](#) reported that by 2025 **John Cockerill Group (JCG)** intends to increase its annual production of pressurised alkaline electrolysers to **8 GW** with new giga-factories to be developed in Europe (**2 GW**), India (**2 GW**), the Middle East (**1 GW**), and the **PRC (2 GW)**, with the location of the **eighth GW** yet to be confirmed.
- **Sodium-ion manufacturing capacity development**: On **May 10, 2022**, [energy-storage](#) reported on the plans of **Altris** and **Natron Energy** to develop new manufacturing facilities.
 - **Altris** (sodium-based cathode technology corporation, backed by **Northvolt**) has announced an agreement with Sandvik Materials Technology to co-locate its first manufacturing facility at a Sandvick factory in **Sandviken, Sweden**, called the **Ferrum facility**. The **Ferrum facility** will produce **2,000 metric tonnes** of cathode material (Ferric) a year, enabling **1 GWh** of sodium-ion battery production.
 - **Natron Energy** (sodium-ion battery manufacturer) has announced the development of a **sodium-ion battery manufacturing plant** in **Meadowbank, Michigan**. As reported, **Natron Energy** batteries are used primarily for critical power applications (including data centres and telecommunications networks), with the intention to achieve broader application of them, including for EVs and grid-scale **BESS**.
- **Hanwha Q Cells plans US Giga-factory**: On **May 12, 2022**, [pv-magazine.com](#) reported that **Hanwha Q Cells** has announced plans to develop a **1.4 GW photovoltaic** cell panel factory in the US. Also it was reported that **Hanwha Q Cells** intends to expand its photovoltaic cell capacity in the **ROK** to **5.4 GW**.
- **Corfo of Chile contracts for development of industry scale electrolyser production in Chile**: On **May 26, 2022**, [h2-view.com](#) reported that the **Production Development Corporation (Corfo)** of Chile had selected **three**

projects to manufacture electrolysis capacity of 388 MW. **Corfo** signed three agreements, with **GNL Quintero**, **CAP SA**, and **Air Liquide**.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

- **Green Steel in Canada:** On **May 2, 2022**, it was reported widely that **ArcelorMittal SA** had tested successfully the use of Green Hydrogen to reduce iron ore at its facilities in Contrecoeur, Quebec, Canada: as reported, Green Hydrogen was used to displace around 7% of the mass of natural gas ordinarily used.
- **Anglo American – nuGen™:** On **May 6, 2022**, **Anglo American** [introduced](#) its **nuGen™ Solution** – **Anglo American's Zero Emission Haulage Solution** or **ZEHS** for short ("**A solution so ambitious, it didn't exist. So we made it from scratch**".) The **nuGen™ Solution** is part of the Anglo American Our FutureSmart Mining™ programme.

Wind round-up, on-shore and off-shore:

- **Colombia Off-shore Wind Roadmap:** On **May 3, 2022**, the **President of Colombia, Ivan Duque**, and the **Minister of Mining and Energy, Diego Mesa**, presented the Colombian [Offshore Wind Energy Roadmap \(OWER\)](#). The **OWER** outlines the potential for off-shore wind field capacity - **50 GW** of installed capacity over **12,000 km²**, with **27 GW** more suited to **fixed-bottom** installation, and **21 GW** more suited to **floating**.
- **US Bureau of Ocean Energy Management (BOEM) busy:**
 - **All cool:** On **May 6, 2022**, it was reported widely that the **BOEM** had completed its review of potential impacts from the development of **OWFs** in the Humboldt Wind Energy Area (**WEA**), off-shore the US State of California, the **BOEM** reporting a finding of no significant impact (**FONSI**). As reported, the **WEA** has the potential for the installation of up to **1.6 GW** of **OWF** capacity;
 - **All go, go, go:** On **May 11, 2022**, the **BOEM** held a lease auction offering two lease areas located in US Federal Waters off-shore of **North Carolina** and **South Carolina**. The two lease areas (in the Wilmington East Area (**WEA**)) are located in the **Carolina Long Bay** (covering 110,000 acres) with potential to install up to **1.3 GW** of off-shore wind fields capacity across them. The lease areas are **OCS-A 545** and **OCS-A 0546**.
On **May 11, 2022**, it was announced that lease area:
 - **OCS-A 0546** had been awarded to **TotalEnergies Renewables USA**, with a bid of **USD 160** million; and
 - **OCS-A 546** had been awarded to **Duke Energy Renewables Wind** with a bid of **USD 150** million.
- **Norway to achieve 30 by 40:** On **May 11, 2022**, the **Government of Norway** outlined its plans to promote the development of off-shore wind field capacity so as to develop **30 GW** of capacity by **2040 (30 by 40)**.
- **California 3 by 2030, 15 by 2045 and 20 GW by 50:** On **May 11, 2022**, the **California Energy Commission (CEC)** outlined plans to allow the development of floating off-shore wind field capacity **3 GW** by **2030**, **15 GW** by **2045**, and **20** by **2050**.
- **Petrobras and Equinor eye 4 GW development:** On **May 18, 2022**, [offshorewind.biz](#) reported that **Petrobras** and **Equinor** were considering the feasibility of the development of a **4 GW** off-shore wind field. **Petrobras** and **Equinor** have been working together on the **Aracatu OWF** project since signing a memorandum of understanding in 2018.
- **Hollandse Kust West Site bids close:** As the close date of **May 12, 2022** for bids approached, there was considerable coverage of the fact that the criteria for the assessment of bids for **Hollandse Kust (west) VI** and **Hollande Kust (west) VII** were different, in particular for:
 - **Hollandse Kust (west) VI** the criteria are reported as requiring bidders to consider and to address the impact of ecosystems in the North Sea (with a reported 50% weighting in respect of these criteria); and
 - **Hollande Kust (west) VII** the criteria are reported as requiring bidders to consider and to address the integration on the renewable electrical energy generated (and related infrastructure) into the energy system in the Netherlands (again with a reported 50% weighting in respect of these criteria).

At the risk of missing those that bid in the process (and apologies in advance if anyone is missed), from news reports the following bidders have been reported: **BASF** and **Vattenfall** are reported to have bid jointly in respect of **Hollandse Kust (west) VI**, and **Vattenfall** is reported to have bid on **Hollande Kust (west) VII**; **bp** is reported to have bid for both **Hollandse Kust (west) VI** and **Hollande Kust (west) VII**; **Brookfield** and **SSE Renewables** are reported to have bid for **Hollandse Kust (west) VII**; **Eneco** and **Shell** are reported to have bid for both **Hollandse Kust (west) VI** and **Hollande Kust (west) VII**; **Ocean Winds** (the **EPD Renewables** and **Engie** 50:50 joint venture) is reported to have bid for **Hollandse Kust (west) VI**; **Ørsted** and **TotalEnergies** are reported to have bid jointly for both **Hollandse Kust (west) VI** and **Hollande Kust (west) VII**; and **RWE** is reported to have submitted bids for both **Hollandse Kust (west) VI** and **Hollande Kust (west) VII**.

- **Noatun Nord and Noatun Syd:** On **May 20, 2022**, it was reported by [offshorewind.biz](#) that **OX2** and **Ålandsbanken Fondbolag Ab** had agreed to progress to develop multi-giga-watt off-shore wind field projects, **Noatun Nord** and **Syd**, off of the **Åland Islands** in the **Baltic Sea**. Both OWF projects are at early development phase.
- **BlueFloat Energy and Falck Renewables floating off-shore Sardinia:** On **May 20, 2022**, [rechargenews.com](#) reported that **BlueFloat** and **Falck Renewables** planned to develop **975 MW** of off-shore wind capacity, off the northeast coast of **Sardinia, Italy**, the **Tibula Energia**.

Solar and Sustainability (including NZE Waste):

- **Solar Juice and Sungrow position for C&I and residential renewable electrical energy equipment market:** On **May 7, 2022**, as reported in [pv-magazine-australia.com](#), **Solar Juice** and **Sungrow** signed a long-term distribution contract in respect of up to **2 GW** of capacity. The long-term distribution contract reflects the confidence in the continued growth of the C&I and residential market for photovoltaic solar capacity.

- **Westinghouse to house pumped-storage:** On **May 9, 2022**, [energy-storage](#) reported that on **May 5, 2022**, **Westinghouse Electric Company** had signed a memorandum of understanding with **Bulgarian Energy Holding** to develop **two pumped thermal energy storage (PTES)** units.
- **BP stake in Asian Renewable Energy Hub (AREH):** On **May 9, 2022**, it was reported widely that **BP** (leading international energy corporation) intended to invest in **AREH** (see [Editions 2, 18, 20](#) and [37](#) of Low Carbon Pulse).
- **Portugal First Floater:** On **May 10, 2022**, [Reuters reported](#) that on **May 9, 2022**, two tugboats moved an array of **12,000 (5 MW)** photovoltaic solar panels to their mooring on the **Alqueva** reservoir, ahead of the start-up of what will be Europe's largest floating photovoltaic (**FPV**) solar park in July 2022. The floating photovoltaic solar park has been developed by **EDP**.
- **DNV on FPV:** On **May 13, 2021**, [pv-magazine.com](#) reported that **DNV** (Norwegian classification society) is developing recommended practices (**RPs**) for the design, development and operation of **FPV** arrays.
- **Richer at PORA:** On **May 13, 2022**, the **Port of Rotterdam Authority (PORA)** reported the development of the first **e-waste and battery waste recycling plant** in the Netherlands. As noted above, batteries use the metals and minerals cobalt, lithium and nickel, each of which is increasingly valuable.
- **Northvolt recycling voltage:** On **May 15, 2022**, **Northvolt** (Swedish battery developer for electric vehicles) [announced](#) and **Norsk Hydro** [announced](#) that the **Hydrovolt AS** (a joint venture between **Northvolt** and **Norsk Hydro**) recycling plant, located in **Fredrikstad, Norway**, had commenced operation.
The fully automated **Hydrovolt** recycling plant has capacity sufficient to recycle the entire end-of-life battery pack market in Norway, i.e., **12,000 metric tonnes of battery packs** from BEVs annually (around 25,000 battery packs) recovering up to **95%** of the materials comprising each battery pack.
- **ACE Green Recycling plant:** On **May 16, 2022**, [pv-magazine.com](#) reported that **ACE Green Recycling** plans to develop a lithium-ion and lead-acid battery recycling plant in Texas. As reported, the recycling plant will be able to recycle up to **100,000 metric tonnes of lead-acid** batteries, and up to **20,000 metric tonnes of lithium-ion** batteries, annually.
- **Li-cycle Corporation (Li-cycle) third spoke turning:** On **May 17, 2022**, it was reported widely that **Li-cycle** had commenced commercial operation at its recovery and recycling plant in **Gilbert, Arizona (Arizona Spoke Facility)**. The **Arizona Spoke Facility** recovers metals and mineral from full battery packs from **BEVs**, having capacity to recover up to **30,000 metric tonnes** annually.
- **Xlinks progresses:** On **May 20, 2022**, it was reported widely that **Xlinks** plans to proceed to develop the Morocco to UK sub-sea **HVDC** renewable electrical energy project. [Editions 16](#) and [28](#) of Low Carbon Pulse reported on Xlinks.

Land Mobility / Transport:

- **Buses and coaches:**
 - **Bonn / Köln fuel cell fleet:** On **May 3, 2022**, **Dutch Hydrogen Magazine** reported that the region of Bonn / Köln in Germany is to procure a fleet of **108 fuel-cell technology buses**. By the reckoning of the author of Low Carbon Pulse, this is the largest single procurement to date of fuel-cell technology buses.
 - **Volgren and Wrightbus look to Australian market:** On **May 11, 2022**, **Wrightbus** [announced](#) that it was working with **Volgren** to manufacture **two zero-emission** hydrogen single deck **fuel-cell technology** buses for the Australian market. The two fuel-cell technology buses will be powered and propelled by the **Wrightbus' NexGen fuel-cell powertrains**.
 - **Maine Street:** On **May 17, 2022**, [electrek.co](#) reported that the first of four **Proterra ZX5** 35 foot battery electric buses had entered service in **Portland, Maine**. Greater Portland Metro and Biddeford Saco Old Orchard Beach Transit purchased the electric busses using funding support from both Federal and State Governments.
 - **NSW first hydrogen bus:** On **May 25, 2022**, **Transport NSW** announced that the State of New South Wales would commence trials of its **first fuel-cell technology electric bus** on the Central Coast of New South Wales later in 2022.
 - **Wrightbus right for Germany:** On **May 27, 2022**, [h2-view.com](#) reported that **Wrightbus** is to supply **60** zero-emission hydrogen-powered-and-propelled buses to Germany. German bus operator, **Regionalverkehr Köln GmbH (RVK)** is the purchaser.
- **Cars (including taxis and air-taxis):**
 - **Taking the Scenic route - Renault to manufacture BEV and fuel cell family cars:** On **May 19, 2022**, it was reported widely that **Renault** is to manufacture a battery electric vehicle (**BEV**) family car, and a hydrogen powered and propelled family car (using fuel-cell technology) for the European car market.
 - **Great Wall Motor to manufacture fuel cell cars:** On **May 27, 2022** (or thereabouts), it was reported widely that **Great Wall Motors** or **GWM (PRC)** giant vehicle manufacturer) is to manufacture a number of hydrogen powered and propelled family vehicles. **GWM** manufactures **BEV** cars already (the **ORA** and **WEY**).
 - **Western Australian police trialling fuel police cars:** On **May 31, 2022**, it was reported widely that the **Western Australian (WA) Police Force** was to commence trials of a fuel-cell technology vehicle. For these purposes, the **WA Police Force** is using a **Toyota Mirai** fuel-cell technology vehicle.
- **Battery, Fuel Cell and ICE Technology:**
 - **Cummins Inc ICE:** On **May 9, 2022**, **Cummins Inc** [announced](#) the debut of its 15-litre hydrogen engine at ACT Expo in Long Beach, California.
- **Industrial Vehicles and Trucks:**
 - **Hyundai to expand in the US:** On **May 9, 2022**, Hyundai Motor Company [announced](#) plans to increase its participation in the US commercial vehicle market with the introduction of its **XCIENT Fuel Cell** trucks into the US market.

- **Emergency services roll-out:** On **May 11, 2022**, [hydrogen-central](#) reported hydrogen fuel-cell technology pioneer, **ULEMCo**, is working with **Oxfordshire County Council** and its **Fire and Rescue Service** to assess and to determine the basis upon which fuel-cell technology may be used to power and to propel fire engines.
- **Scania expands to match growing interest in biogas trucks:** On **May 12, 2022**, Scania [announced](#) that it is responding to increased customer interest in biogas (more correctly, **biomethane** or **renewable natural gas**) with new specifications and tanks, with ranges of **1,400 km** now possible.
- **Volvo Trucks using Fossil-free Steel:** On **May 24, 2022**, it reported widely that **Volvo AB** is now manufacturing trucks comprising **Fossil-free Steel**.
This marks continued progress in the decarbonisation of steel used in vehicle manufacture, and continued progress of **SSAB** producing **Fossil Free Fuel** from the **HYBRIT** mill, using **HYBRIT** technology. **Edition 25** of Low Carbon Pulse reported that (under **HYBRIT's Clean Steel in the road**) SSAB delivered the "first fossil-free steel in the world" to Volvo Group from the **HYBRIT** mill, using **HYBRIT** technology.
- **Recharging and refuelling infrastructure:**
 - **Green for Greece:** On **May 18, 2022**, it was reported widely that the first hydrogen refuelling station (**HRS**) had commenced operation in Greece. The **HRS** is located in **Athens, Greece**, and will be used to refuel light duty vehicles (bikes and scooters) in the first instance.
 - **HRS opens in Antwerp, Belgium:** On **May 30, 2022**, it was reported that **Colruyt Group** (Belgian family owned retail group) and **DATS 24** (energy and fuel supplier) has opened a new **HRS** on the **A12** in **Wilrijk, Antwerp, Belgium**. As reported, this is the first of five new **HRS** in Belgium.
- **Trains:**
 - **ATCO Group to supply to Canadian Pacific:** On **May 4, 2022**, **ATCO Group** [announced](#) that it had contracted **Canadian Pacific** to develop and to deploy two hydrogen production facilities and hydrogen refuelling infrastructure – the facilities and infrastructure are to be developed at the railyards of Canadian Pacific in **Calgary** and **Edmonton**, in the province of **Alberta, Canada**.
 - **Deutsche Bahn and Siemens Mobility present new hydrogen train and hydrogen storage tank trailer:** On **May 5, 2022**, it was reported widely that **Deutsche Bahn** and **Siemens Mobility** had presented the newly developed **Mireo Plus H** and a newly designed mobile hydrogen storage tanker. The **Mireo Plus H** is intended to replace diesel powered and propelled trains.

Ports Progress and Shipping Forecast:

- **Ferries and other craft:**
 - **ADB (Asian Development Bank) funds E-Smart Ferries Project:** On **April 27, 2022**, **ADB** [announced](#) that it had agreed to provide funding support (from its Clean Technology Fund) to **Energy Absolute Public Company Ltd** to assist in the funding required to develop and to deploy an electric ferry fleet for mass rapid transport in Bangkok, Thailand.
 - **Gladstone – Curtis Island Shuttle:** On **May 9, 2022**, [pv-magazine-australia.com](#) reported that **SeaLink Marine & Tourism** had received a funding support commitment from the **Government of Queensland**, Australia (under its Hydrogen Industry Development Fund) to develop a ferry powered and propelled by **fuel cell technology**.
 - **Workboats afloat:** On **May 11, 2022**, **CMB.TECH** and **Windcat Workboats** [announced](#) that they have developed as the world's first hydrogen-powered (and propelled) crew transfer vessel (**CTV**) – the **Hydrocat 48**. The **Hydrocat 48** uses dual-fuel **MAN Engines**, retrofitted by **CMB.TECH** with a hydrogen injection system, and is to undertake bunkering and sea-trials.
 - **Chase Zero on the water:** On **May 13, 2022**, [hydrogenenergy](#) reported that chase boat, **Chase Zero**, had been tested in Hauraki Gulf, Auckland, New Zealand. The **Chase Zero** is a hydrogen powered and propelled chase boat, and during testing it reached a little over 50 knots (58 mph or 93 km/h), and powered and propelled by **fuel cell technology** developed by **Toyota**.
- **Green Ports (including infrastructure):**
 - **Gasunie and Vopak:** On **May 2, 2022**, **Vopak** [announced](#) that **Gasunie** and **Vopak** had agreed (under a cooperation agreement) to work together jointly to develop **open access** hydrogen import terminal infrastructure at **Dutch** and **German** ports to allow the import of hydrogen and hydrogen-based fuels into **northwest Europe**.
 - **Port of Rotterdam Authority (PORA) continues to lead the way:** On **May 10, 2020**, a number of news items covered the size and shape of what **PORA** and 70 corporations will be able to achieve, represented most consistently by a representation of a hydrogen molecule marked with "**4.6 mega tonnes hydrogen in 2030**" and "**Rotterdam Europe's Hydrogen Hub**".
- **Green Shipping:**
 - **Design for 37,500 m³ liquified hydrogen carrier:** On **May 3, 2022**, it was reported widely that **C-Job Naval Architects** has provided high-level details of its **141 metre, 37,500 m³**, liquid hydrogen (**LH₂**) carrier. Critically, the design of the **LH₂** carrier allows transportation of **LH₂** without the need for ballast, with the containment system at deck-level. Also the containment system will allow a lower level of boil-off than currently.
 - **First truck to ship hydrogen bunkering successful:** On **May 5, 2022**, **Ekinetix** [announced](#) that the **Hydrocat** (a hydrogen-powered vessel used as a support vessel for off-shore wind field developments) had been bunkered with hydrogen using its mobile refueler and bunkering process.
 - **ONE orders 10 13,700 TEU container vessel:** On **May 31, 2022**, [offshore-energy](#) reported that Singapore-based **Ocean Network Express** had order the build of 10 eco-efficient very large container vessels (**VLCS**). As reported, five **VLCS** will be built by **Hyundai Heavy Industries** and five by **Nihon Shipyard**.

Airports and Aviation:

- **SAF continues to find, and to expand, market:**

- On **May 19, 2022**, it was reported widely that **Neste** (leading renewable chemical and fuel supplier) and **United Airlines** had signed a three year sale and purchase agreement under which **Neste** is to sell and **United Airlines** is to purchase up to **160,000 metric tonnes (52.5 million gallons)** of **Neste's MY Sustainable Aviation Fuel**, with the **SAF** to be used to power and to propel United's flights from Schiphol Airport, Amsterdam.
- On **May 27, 2022**, **Neste** [announced](#) that **Neste** and **ITOCHU** were celebrating the **first delivery**, in Japan, of **Neste's MY Sustainable Aviation Fuel** to **Etihad Airways**, with **SAF** being delivered to Etihad Airways at Narita International Airport, Tokyo. Japan is committed to the use of **SAF** to satisfy 10% of total use of aviation fuel by 2030.

Low Carbon Pulse - Edition 40 (long-form)

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to the **Long Form Version** of **Edition 40** of Low Carbon Pulse – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Sunday May 1, 2022** to **Tuesday May 31, 2022**. The **Short Form Version** of **Edition 40** will be published on **Monday June 6, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering October 7, 2021 to March 31, 2022), and click [here](#) for the **Third Compendium of Low Carbon Pulse**.

Headlines:

Burning Platform:

The month of May has been a month of mixed news:

- On **May, 5 2022**, it was reported widely that in **April 2022**, the US **National Oceanic & Atmospheric Administration (NOAA)** observatory at **Mauna Loa, Hawaii** recorded the highest level of **CO₂** in the atmosphere – **420 ppm**. (For more on this news item see **CO₂ at highest levels** under **Climate Change Reported and Explained**.)
- On **May 9, 2022**, the **World Meteorological Organisation (WMO)** released a press-release reporting on the [Global Annual to Decadal Climate Update / State of the Global Climate 2021](#).

The headline from the press-release is as follows:

*"There is a 50:50 [actually expressed as: "about as likely as not (48%)"] chance of the annual average global temperature temporarily reaching **1.5°C** above the pre-industrial level for at least one of the next five years – and the likelihood is increasing with time".*

The source of the headline is the **Global Annual to Decadal Climate Update**, produced by the **Met Office** in the UK (the **Met Office** being the **WMO's** lead advisory organisation for predictions of this kind).

As reported in previous editions of Low Carbon Pulse (and sibling publications), in 2021 the global average temperature was **1.1°C** above the pre-industrial level. (For other key findings, see **Key Findings from [Global Annual to Decadal Climate Update / State of the Global Climate 2021](#)** below under **Climate Change Reported and Explained**.)

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven to those displaced.

Ministers meet:

On **May 12**, and **13, 2022**, a meeting of Ministers from more than 40 countries (convened by the Presidencies of **COP-26** and **COP-27**) took place in **Copenhagen, Denmark (May Ministerial)**.

The **May Ministerial** marked six months since **COP-26** and six months until **COP-27**, and was co-chaired by the President of **COP-26 Mr Alok Sharma**, and the incoming President of **COP-27, Mr Sameh Shoukry**. The [communiqué](#) from the **May Ministerial** is worth a read.

For the author of Low Carbon Pulse, the quote of the month came from **UN Climate Change Executive Secretary, Ms Patricia Espinosa**:

"**COP27 must be the implementation COP.** The first COP where nations must show how they will begin putting the Paris Agreement to work in their home countries".

This quote is consistent with the increasing sentiment that the **EU** and the UK cannot do all the heavy-lifting.

Biodiversity Day 2022:

Sunday May 22, 2022, was **Biodiversity Day 2022**. There was considerable coverage before, on and after [Biodiversity Day 2022](#) about all aspects of the environment, including the need to cease activities giving rise to degradation, and to undertake activities that will remedy degradation that has occurred. The [Blue and Green Carbon and Biodiversity](#) section of this **Edition 40** of Low Carbon Pulse provides some background.

The Month in the rear view mirror:

- **May 2 to 6, 2022:** The **XV World Forestry Congress (Congress)** was held in Seoul, Republic of Korea (**ROK**) under the theme of **Building a Green Healthy and Resilient Future with Forests**.

For the author of Low Carbon Pulse, the progress made at the **Congress** is key, for both forestry and land use. During the first four months of 2022, there has been a clear uptick in interest in the role that land-management and optimal land-use can have on increased absorption of **CO₂**, i.e., its negative **GHG** emission impact.

Outcomes from the **Congress**:

- Participants at the Congress endorsed the [Seoul Forest Declaration](#), identifying areas for action as a priority;
 - Ministerial Call on Sustainable Wood; and
 - Youth Call for Action.
- **May 9 to 20, 2022:** The **15th United Nations Conference to Combat Desertification (UNCCD)** was held in Abidjan, Côte d'Ivoire. **COP-15** of **UNCCD** was accompanied by the second edition of the [Global Land Outlook – Land Restoration for Recovery and Resilience](#) published by the **UNCCD**.

Outcomes from **COP-15 UNCCD**:

- Concluded with a global pledge to boost drought resilience and to invest in land restoration for future prosperity, with agreement to establish an **Intergovernmental Working Group for 2022-2024** to consider solutions; and
- Included the adoption of [38 decisions](#) including on migration and tenure, highlighting the role of land in addressing the degradation that has occurred (with up to 40% of land mass degraded), including as a result of climate change.

The theme that emerged from **XV World Forestry Congress** and **COP-15** of **UNCCD** was how to address deforestation, reforestation, afforestation, and land restoration, and land-management and land-use generally. These matters are covered under [Carbon Accounting, Carbon Capture, Carbon Capture and Use and CDR](#).

30th anniversary of UN Framework Convention on Climate Change:

May 9, 2022 was the **30th anniversary** of the adoption of the [UN Framework Convention on Climate Change](#). Considerable progress has been achieved since **May 9, 1992**, critically the [Paris Agreement](#) and the **Paris Rule Book** that underpins the **Paris Agreement**.

To mark the **30th anniversary**, **UN Climate Change Executive Secretary, Ms Patricia Espinosa** made a statement, and the following three pages convey, in short form, the essence of that statement.



The Month Ahead:

- On **June 2 and 3, 2022**, the **Stockholm+50** conference will be held in Stockholm, Sweden. The **Stockholm+50** conference marks the **50th anniversary** of the **world's first conference on the environment – United Nations Conference on the Human Environment** held in Stockholm, Sweden, June 5 and 6, 1972, which gave rise to the establishment of the **United Nations Environment Programme (UNEP)**.

The agenda for the **Stockholm+50** conference is **Immediate action for people, planet and prosperity will create a better future for all**. **Edition 41** of Low Carbon Pulse will report on **Stockholm+50**; and

- Also in June:
 - On **June 26 to 28**, the **G7 Summit** will be held at Schloss Elmau, Bavaria, Germany;
 - On **June 26 to 30**, the **World Urban Forum** will be held in Katowice, Poland; and
 - On **June 27 to July 1**, the **UN Ocean Conference** will be held in Lisbon, Portugal.

Edition 41 of Low Carbon Pulse will report on the Summit, Forum and Conference.

Balance of the content of this Edition 40:

Clicking on the contents list will take the reader to the section clicked:

LIST OF CONTENTS: EDITION 40 OF LOW CARBON PULSE			
Pages 3 to 7:	Legal, Policy Setting and Regulatory highlights	Pages 28 to 29:	Carbon Credits, Hydrogen Markets and Trading
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Pages 9 to 10:	Middle East including GCC Countries	Page 32 to 33:	Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories
Pages 11 to 13:	Africa, India and Indonesia; Japan & ROK	Page 33:	Green Metals / Minerals, Mining and Difficult to Decarbonise Industries
Pages 14 to 15:	PRC and Russia	Pages 33 to 36:	Wind round-up, on-shore and off-shore
Pages 15 to 19:	Europe and UK; and Americas	Pages 36 to 42:	Solar, Sustainability and NZE Waste:
Pages 20 to 23:	France and Germany; and Australia	Pages 42 to 43:	Land Mobility / Transport
Pages 23 to 24:	Blue and Green Carbon Initiatives and Biodiversity	Pages 43 to 45:	Ports Progress and Shipping Forecast: Airports and Aviation
Pages 24 to 25:	Bioenergy and heat-recovery	Pages 45 to 46:	Reference Materials
Pages 25 to 26:	BESS and HESS (and other energy storage)	Pages 47:	NZE Publications
Page 26 to 28:	Carbon Accounting, Carbon Capture, Carbon Capture and Use and CDR		

Future Fuels article published:

As advertised in Low Carbon Pulse for some time, on **May 18, 2022**, a standalone article on [Future Fuels](#) was published. In September 2022, a standalone article will be published on **NZE Waste: The recycling and reuse of waste arising on the road to NZE**. Along with plastic waste, these are areas of ever-increasing focus.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse in respect of laws and regulation, and broader policy settings, in each case describing substance, progress and impact. Also this section details Helpful Publications that have been read during the month.*

- **REPowerEU detailed plans released:** As reported in **Edition 37** of Low Carbon Pulse, on **March 8, 2022**, the **European Commission (EC)** outlined its **REPowerEU** plan. On **May 18, 2022**, the **EC** presented its detailed **REPowerEU Plan**. The key points **REPowerEU Plan** are as follows:
 - First, the **Recovery and Resilience Facility (RRF)** will continue as the core of the **REPowerEU Plan**, with the **RRF Regulation** to be amended to reflect the **REPowerEU Plan**;
 - Secondly, **Energy savings (improved energy efficiency)** offers the cheapest and quickest means of mitigating the impacts on the energy market in the **EU**, and to reflect this the **EC** will increase the **Energy Efficiency Target** under **Fit-for-55 package** from 9% to 11%. To accompany the **REPowerEU Plan**, on **May 18, 2022**, the **EC** published **EU Save Energy Communication**;
 - **By way of reminder:** The **Fit-for-55 package** was presented in mid-July 2021 (see **Edition 32** of Low Carbon Pulse) to reduced **GHG** emissions by at least **55% by 2030**, compared to 1990 **GHG** emission levels;
 - Thirdly, **Diversifying energy imports (diversified supply)** is a key element to the policy settings in the **EU**, with natural gas and LNG in the near to medium term (as a transition energy source) and hydrogen as the medium to long-term solution, as reflected in the **EU Energy Platform**. In line with editorial comment provided by Low Carbon Pulse (and sibling publications), the **EC** is contemplating that Member States of the **EU** may purchase natural gas and LNG and hydrogen jointly. In the context of the deployment of hydrogen, arrangements of this kind will accelerate the development and deployment of hydrogen capacity. The **EU External Energy Strategy** is consistent entirely with the concept of diversified supply, acceleration the commitment of the **EU** to the **global green and just energy transition**, critically, it addresses key actions necessary to support the reconstruction and repair of energy infrastructure in Ukraine, launching REPowerUkraine; and
 - Fourthly, **Substituting fossil fuels and accelerating clean energy transition (acceleration of renewable energy deployment)** is the core of progress towards **NZE** globally, and the **EC** policy settings, including the following:
 - to increase the deployment of renewable from **40% to 45% by 2030**;
 - the **EU Solar Strategy** is to provide a pathway to **doubling photovoltaic capacity by 2025**, and to deploy **600 GW of photovoltaic capacity by 2030**, with an obligation to install photovoltaic panels on new commercial, public and residential buildings under the **Solar Rooftop** initiative;
 - **Heat pump deployment** is to double, with policy settings to integrate geothermal and solar thermal energy across communal / district heating systems;
 - the **Renewable Energy Directive** is to be amended to allow the development and deployment of renewable projects at a quicker rate, and on a simplified basis;
 - targeting the production of **10 million** metric tonnes of **Renewable Hydrogen** within the **EU** and the import of **10 million** metric tonnes of Renewable Hydrogen into the **EU by 2030**.

- the [Biomethane Action Plan](#) targeting the production of **35 billion cubic metres of biomethane by 2035**. The **Biomethane Action Plan** is covered in more detail below, under [Bioenergy and Heat Recovery](#).

By way of a reminder: Edition 39 of Low Carbon Pulse reported (under **EC considering higher renewable energy target**) that: "During April 2022 there were a number of news items, and from the author's perspective, a number of conversations with folk in Europe, suggesting that the **EC** was assessing whether the **EU** may be able to achieve a higher renewable electrical energy target (45% by 2030), than that currently contemplated (40% by 2030). On April 20, 2022, Reuters reported that the **Deputy Director-General of the Energy Department** of the **EC** had stated: "We are working on it full speed to take, first of the proposal of going from 40% to 45%, but also in the context of higher energy prices".

While the **EC** may be considering the proposal at full speed, the **EU Member States** and the **European Parliament** will have to be aligned if the proposal is to become the new policy setting. There seems to be in alignment.

- **EC publishes technical regulations:** Edition 39 of Low Carbon Pulse reported that on May 18, 2022, the **EC** intends to publish technical regulations that will provide the parameters by which hydrogen will be classified as renewable under the [EU RED II](#).

On May 18, 2022, among other things, the **EC** published two [draft Delegated Acts](#) to clarify **EU** rules applicable to renewable hydrogen under the **2018 Renewable Energy Directive**. The **two Delegated Acts** are: the **Delegated Act** on the production of renewable transport fuels – share of renewable electricity (requirements) and the **Delegated Act** on renewable energy – method for assessing **GHG** emission savings from certain fuels. The **Delegated Acts** work together:

A number of participants in the hydrogen industry (and the broader energy industry) have noted that the requirements for **additionality** and **coupling** may have unintended consequence of slowing the pace of development of Green Hydrogen production capacity. The form of the **two delegated acts** are [open for consultation](#) until **June 17, 2022**, having commenced on **May 20, 2022**. Edition 41 of Low Carbon Pulse will consider each **Delegated Act**.

- **Green Hydrogen Organisation defines Green Hydrogen:** On May 17 2022, the **Green Hydrogen Organisation** or **GHO** (Swiss based not for profit organisation) published [The Green Hydrogen Standard](#): the **GHO** has defined Green Hydrogen as:

"hydrogen produced through the electrolysis of water with 100% or near 100% renewable energy with close to zero greenhouse gas emissions (less than or equal to 1kg of CO₂-e per kg of H₂ taken as an average over a 12 month period".

The **Green Hydrogen Standard** imposes environmental, social and governance obligations on producers of Green Hydrogen, and Green Hydrogen produced must be assessed by **Independent Assurance Providers** to verify compliance. Each assessment and compliance report of **Independent Assurance Provider** will be submitted to the **Accreditation Body** of the **GHO** which will make the final determination as to compliance, and, if compliant, accredit as Green Hydrogen.

- **Clean Air Task Force framework for CCS in Europe:** On May 10, 2022, the **Clean Air Task Force** or **CATF** (an **environmental organization**) published [A European Strategy for Carbon Capture and Storage](#), effectively providing a policy setting framework for carbon capture and storage across Europe.

The policy setting framework proposed by the **CATF** provides a helpful perspective: central to the policy setting framework is the need for a coordinated policy framework that allows first-mover projects to develop to provide European wide CCS capacity. The report is well-worth a read.

- **Unlocking the hydrogen economy:** During May the **European Commission (EC)** and the **European Investment Bank (EIB)** published [Unlocking the hydrogen economy - stimulating investment across the hydrogen value chain](#). The publication highlights the key takeaways from an investor consultation with 46 market participants conducted by the **EIB** Advisory Services Group at the request of the **EC**.

There are six findings and seven recommendations. The publication is well-worth a read, framing as it does the dynamics across the continent with the most developed thinking and the most developed regulatory / statutory framework.

- **McKinsey & Co:** On May 16, 2022, **McKinsey Sustainability** published a collection of analyses – [Decarbonizing the world's industries: A net-zero guide for nine key sectors](#) (Power, Oil and Gas, Automotive, Aviation and shipping, Steel, Cement, Mining, Agriculture and food and Forestry and land use).

As is always the case with McKinsey publications, each analysis provides rich reading: each analysis provides a pithy piece on momentum and acceleration, underpinned by rich factual and statistical information.

- **Global CCS Institute publishes inaugural report:** On May 17, 2022, the **Global CCS Institute** (a CCS "think-tank") published [State of the Art: CCS Technologies 2022](#). The publication is welcome, and very helpful.

- **Council of European Union (CEU) revises Trans-European Networks for Energy (TEN-E) Regulation:** On May 16, 2022, the **CEU** adopted the revised **TEN-E Regulation**. The press release ([consilium.europa.eu](#)) provides background and details on the next steps.

The headline from the revised **TEN-E Regulation** is the introduction of mandatory sustainability criteria for all projects across the **EU**, and the end to support for natural gas and oil projects.

The revised **TEN-E Regulation** prioritises **11 corridors** for the **Trans-European Network**, and **three thematic areas** for development and interconnection. The following info-graphic provides a snap-shot of the thinking.

TEN-E: Europe's energy corridors

The trans-European networks for energy (TEN-E) regulation supports **cross-border projects** to link member states' energy networks and support the **integration of renewables**. It sets corridors across the EU to chart priority areas for investments.

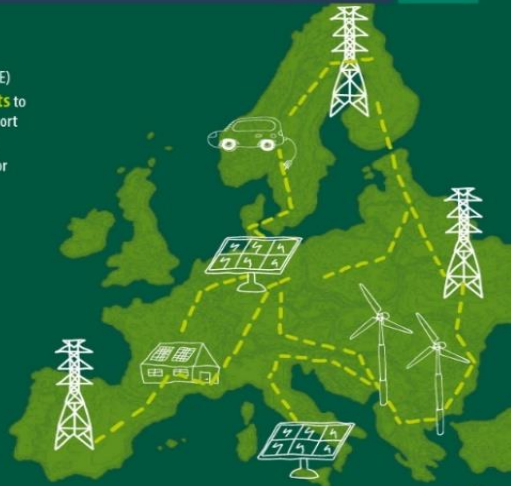
The revised policy identifies 11 **priority corridors** focusing on:

- electricity
- offshore grids
- hydrogen and electrolysers

Three **priority thematic areas** are also defined:

- the deployment of smart electricity grids, improving the efficiency of electricity networks
- a cross-border carbon dioxide network, enabling CO₂ capture and storage
- smart gas grids, focusing on renewable and low-carbon gas sources

The TEN-E objectives are implemented mostly through **projects of common interest** (PCIs) which are financed by the **Connecting Europe Facility** for 2021-2027.



WITH THE NEW LEGISLATION, THE EU WANTS TO:



- align with the **European Green Deal objectives** and climate goals
- support more **renewables**, hydrogen and new clean energy technologies
- build more **interconnected and integrated energy infrastructure**, ensuring a more secure energy supply to isolated regions
- continue ensuring market **competitiveness, security** of supply and **affordability** of energy
- modernise rules by **simplifying procedures** and revising governance structures

THE MAIN INNOVATIONS ARE:



compulsory **sustainability criteria** for all projects



ending support for new **oil and natural gas** infrastructure



a new focus on **offshore electricity** and **hydrogen**



the acceleration of **smart grid** deployment and electrification

- **International Energy Agency (IEA) publications during May:**

- On **May 11, 2022**, the **IEA** published [Renewable Energy Market Update – May 2022 – Outlook for 2022 and 2023](#). The **Update** provides forecasts for new renewable energy capacity installation, and the development in **biofuel** demand, including for transport.
- On **May 17, 2022**, the **IEA** published [Southeast Asia Energy Outlook 2022](#). The publication provides a helpful overview of Southeast Asia generally (including the 10 member countries of the Association of Southeast Asian Nations (**ASEAN**)), and each of the ASEAN member countries, Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

The **Southeast Asia Energy Outlook 2022** is well-worth a read: **Chapter 1**, sets the scene for across **ASEAN**; **Chapter 2**, outlines scenarios in respect of all sources of energy and fuel (including achieving **NZE** by 2050), **Chapter 3**, considers investment in clean energy transition, the power sector, decarbonisation and system flexibility, low-carbon fuels and the supply of, and demand for, metals and minerals required to achieve energy transition. None of these matters are new, each of them is known (and each is consistent with narratives from **IEA** (and **IRENA**) publications), and the scale and scope of what is required is known. What may be required is more detailed engagement by the **IEA** across **ASEAN** to develop workable policy settings (reflecting that no-one size fits all), including provision of funding support.

As with each **IEA** publication since **IEA Roadmap (Net Zero by 2050: A Roadmap for the Global Energy Sector)**, the **Southeast Asia Energy Outlook 2022**, ties back to the **IEA Roadmap**, critically, the policy settings that are required to limit the increase in global average temperatures to **1.5°C** above pre-industrial levels.

- On **May 23, 2022**, the **IEA** published the [Global EV Outlook 2022](#) providing a helpful summary of the **state-of-play** across the electric vehicle market.
- On **May 25, 2022**, the **IEA** published [Enhancing China's ETS for Carbon Neutrality: Focus on the Power Sector](#), which is well-worth a read for those interested in modelling the interface of carbon taxes and ETSs.
- On **May 25, 2022**, the **IEA** published [Renewable Energy Market Update: Key Findings](#).
- **IEA** publications during **April 2022**: [Direct Air Capture – A key technology for net-zero](#), [Sustainable Recovery Tracker – Monitoring Progress towards sustainable recoveries from the Covid-19 crisis](#), [Sustainable Recovery Tracker](#), [Gas Market Report, Q2-Analysis, including Global Gas Review 2021, Belgium 2022 – Energy Policy Review Report](#).

- **International Renewable Energy Agency (IRENA) publications during May:**

- On **May 9, 2022**, **IRENA** published [Global Hydrogen Trade To Meet The 1.5°C Climate Goal – Part II – Technology Review of Hydrogen Carriers](#). The publication focuses on the means, and cost, of transportation of Hydrogen Carriers from the point of production to the point of use. Below are helpful graphs, providing a summary of the current assessments of, and thinking on, costs.

FIGURE 0.1. Most cost-effective hydrogen transport pathway in 2050 as a function of project size and transport distance

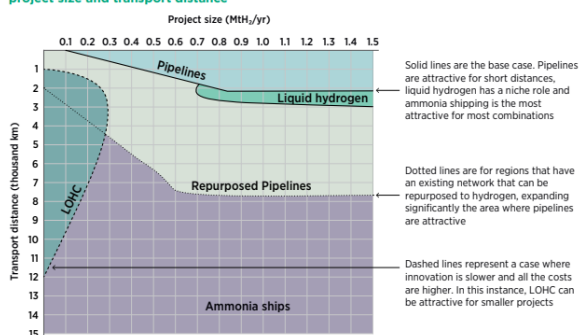
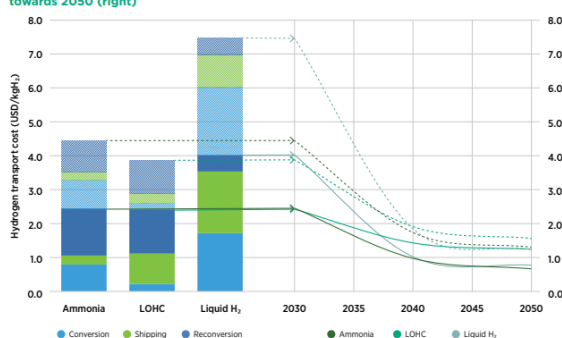


FIGURE 0.2. Transport cost breakdown by carrier and stage for 2030 (left) and evolution towards 2050 (right)



In addition, **IRENA** has published [Global Hydrogen Trade To Meet The 1.5°C Climate Goal – Part I – Trade Outlook for 2050 and way forward](#) and [Global Hydrogen Trade To Meet The 1.5°C Climate Goal – Part III – Green hydrogen supply cost and potential](#). **Part III** should be read with **Part II**. Both **Parts II** and **III** outlined the current the possible evolution of Green Hydrogen towards to 2030 and 2050. These timelines, and the basis of assessment, follow the same path as that of **WETO 2022 (World Energy Transition Outlook 2022)**.

Parts I, Parts II and **III** will be covered in detail in the **May and June Report on Reports**, which will be included in the [Third Compendium of Low Carbon Pulse](#) (which will be available during June).

One of the many narratives that has emerged from the **IRENA** work is that the **PRC** will produce the world's lowest cost hydrogen followed by Chile, Morocco, Colombia and Australia.

- On **April 29, 2022**, **IRENA** published [Critical Materials for Energy Transition: Rare Earth Elements – Technical Paper 2/2022](#). The publication may be regarded as compelling reading, providing an in depth analysis of demand and use and supply and source.

For convenience, see link to [Technical Paper 1/2022](#).

- On **May 19, 2022**, **IRENA** published [Innovation Outlook: Renewable Ammonia](#) (with an accompanying press release [The Role of Renewable Ammonia in the Energy Transition](#)).

The publication is excellent, and is well-worth a read for anyone interested in renewable ammonia technology and supply and demand (including as a **Future Fuel**). The publication will be covered in detail in the **May and June Report on Reports**, which will be included in the [Third Compendium of Low Carbon Pulse](#).

- **IRENA** publications during:

- **April 2022:** [Decarbonising End-Use Sectors: Green Hydrogen Certification \(Certification Paper\)](#), [Renewable Capacity Statistics 2022](#), with a helpful three page summary [Renewable capacity highlights, Grid Codes for Renewable Powered Systems](#) (being an update on the **IRENA** publication from 2016, [Scaling Up Variable Renewable Power: The Role of Grid Codes](#)), and [Renewable Capacity Statistics 2022](#). While the content of the data is not surprising, the data is a helpful reference.
- **March 2022:** [WETO 2022](#), [Decarbonising end-use sectors Green Hydrogen Certification; Green Hydrogen For Industry – A Guide to Policy Making](#) (considered in detail in **Edition 37** of Low Carbon Pulse under **A Guide to Policy Making**), [Collaborative Framework on Critical Materials For The Energy Transition](#), [Collaborative Framework on Critical Materials For The Energy Transition](#), and [Collaborative Framework on Critical Materials For The Energy Transition](#) following like-frameworks from **IRENA** (including on Hydropower, Ocean Energy / Offshore Renewable Energy, Green Hydrogen, Geopolitics of Energy Transformation, Just and Inclusive Energy Transition and Enhancing Dialogues of High Shares of Renewables in Energy Systems), and the [Renewable Energy Market Analysis: Africa and its Regions](#) report.

Climate change reported and explained:

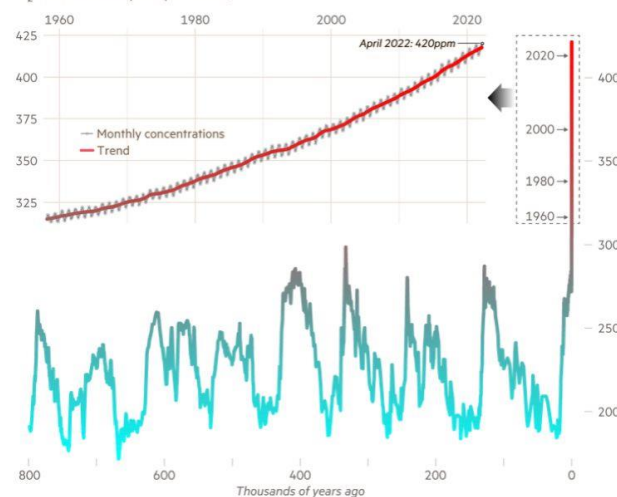
This section considers news items within the news cycle of this **Edition 40** of Low Carbon Pulse relating to climate change and its impact. The intention is to monitor significant and material data points and information, and to explain them.

• CO₂ at highest levels:

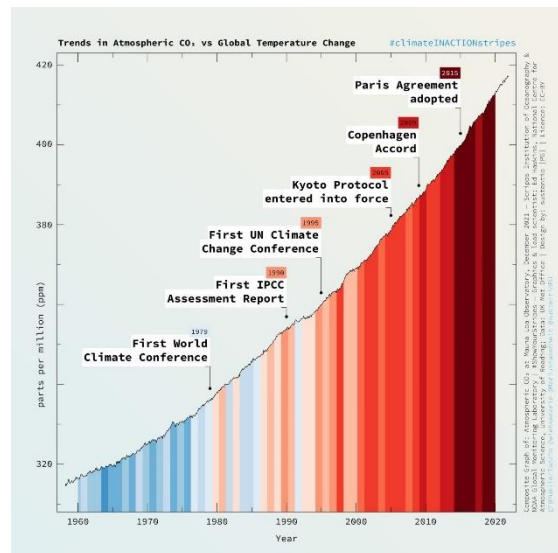
On **May, 5 2022**, it was reported widely that in **April 2022**, the US **National Oceanic & Atmospheric Administration (NOAA)** observatory at **Mauna Loa, Hawaii** recorded the highest level of **CO₂** in the atmosphere – **420 ppm**.

Atmospheric carbon dioxide hits new high in April

CO₂ concentration (parts per million)



Ice-core data before 1958. Mauna Loa data after 1958. Sources: Scripps Institution of Oceanography; NOAA © FT



On **May 14, 2022** it was reported widely that a new daily record of **421.37 ppm** had been recorded by the **Scripps Institution of Oceanography** at the **University of California, San Diego**, with similar record levels confirmed by the **NOAA**.

Many news reports reported on the record level of **CO₂**, accompanied by an alarming headline. It has to be noted that historically the during April and May each year **CO₂** levels tend to peak as a result of increased decomposition of vegetation.

This does not however allow us to ignore the record levels, noting that they are accompanied by record levels of **CH₄**, but it allows them to be place in a better informed context.

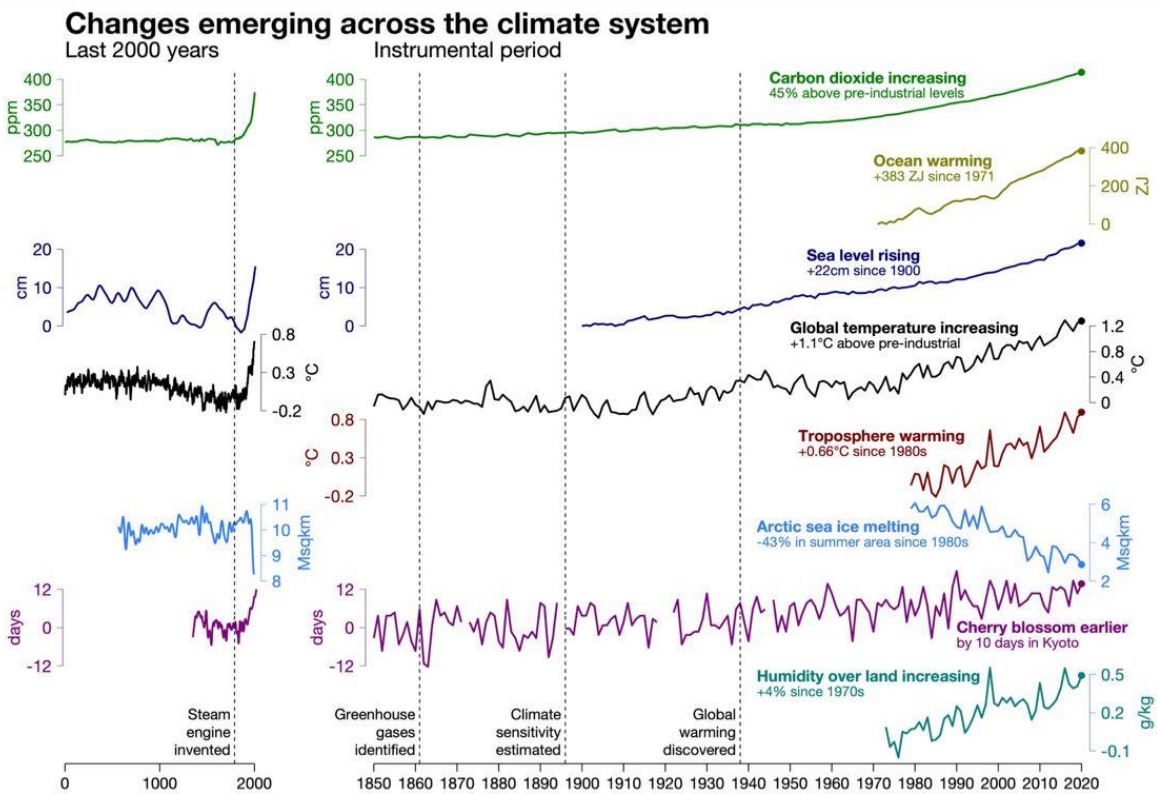
• **Key Findings from Global Annual to Decadal Climate Update:** On **May 9, 2022**, the **Met Office UK** released [Annual to Decadal Climate Update](#), the key finding from which are:

- The annual mean global surface temperature for each year between 2022 and 2026 is predicted to be between **1.1°C** and **1.7°C** higher than pre-industrial levels (being the average over the years 1850-1990);
- The chance of global near-surface temperature exceeding **1.5°C** above pre-industrial levels in at least one year **between 2022 and 2026** is about as likely as not (48%). There is only a small chance (10%) of the five-year mean exceeding this threshold;
- The chance of at least one year **between 2022 and 2026** exceeding the warmest year on record, 2016, is 93%. The chance of the five-year means for **2022-2026** being higher than the last five years (2017-2021) is also 93%;
- The Arctic temperature anomaly, compared to the 1991-2020 average, is predicted to be more than three times as large as the global mean anomaly when averaged over the next five northern hemisphere extended winters;
- Predicted precipitation patterns for 2022 compared to the 1991-2020 average suggest an increased chance of drier conditions over southwestern Europe and southwestern North America [already occurring], and wetter conditions in Northern Europe, the Sahel, north-east Brazil, and Australia;

- Predicted precipitation patterns for the **May to September 2022-2026 average**, compared to the 1991-2020 average, suggest an increased chance of wetter conditions in the Sahel, northern Europe, Alaska and northern Siberia and drier conditions over the Amazon (all of which have been covered in previous editions of Low Carbon Pulse, including their **GHG** emission impact); and
- Predicted precipitation patterns for the **November to March 2022/23-2026/27 average**, compared to the 1991-2020 average, suggest increased precipitation in the sub-tropics, consistent with the patterns expected from climate warming.

To regular readers of Low Carbon Pulse, none of the key findings of the **Met Office** will be of a surprise, each dynamic has been covered in one or more editions of Low Carbon Pulse. The patterns of climate change have emerged, and have been reasonably consistent. While the impact of the patterns of climate change that have emerged remain difficult to predict as to annual extent, it is clear that all patterns will continue, and, absent increased reductions in the mass of **GHG** emissions, will become more pronounced.

- **From then to now:** On **May 13, 2022**, the author of Low Carbon Pulse came across an info-graphic that brings together key measures of climate change. The infographic is at once informative and sobering:



Source: [Martin Gerhardt](#)

- **Key Messages from State of the Global Climate 2021:** On **May 19, 2022**, the **World Meteorological Organisation (WMO)** published [State of the Global Climate 2021](#), with the key messages including:
 - The global mean temperature in 2021 was around **1.11°C** above 1850 to 1900 levels;
 - The global mean sea level reached a new record high in 2021, rising an average of 4.5 mm a year over the period 2013 to 2021;
 - The **Antarctic ozone hole** reach a maximum area of **24.8 million km²** in 2021;
 - **Greenland** experienced an **exceptional mid-August melt**, with the first ever recorded rainfall at Summit Station;
 - Exceptional heatwaves broke records across western North America and the Mediterranean;
 - Many parts of the world were affected by **drought**, including **Afghanistan, Canada, Iran, Pakistan, Turkey, Turkmenistan, and the US.**

In response to the **WMO State of the Global Climate 2021**, **UN Secretary General, Mr Antonio Guterres** said: "*It's time to jump-start the renewable energy transition before it's too late*".

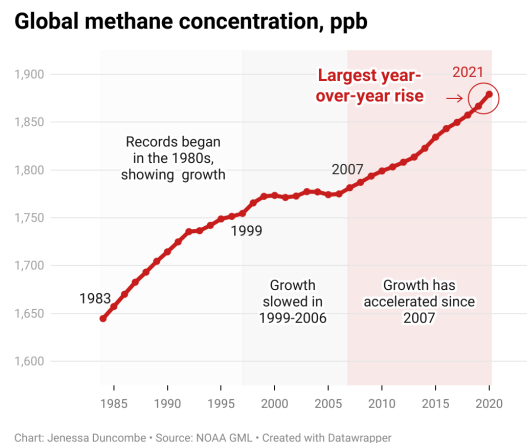
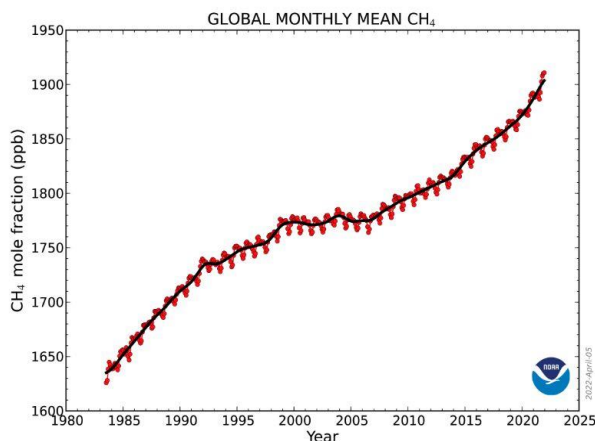
- **Methane Reduction and Carbon Dioxide Removal (CDR):** The author of Low Carbon Pulse notes that there is an ever increasing (and continuing) focus on the reduction in methane emissions to ensure that less methane enters the atmosphere (and is emitted from the bio-sphere) and the removal of carbon dioxide already in the atmosphere, and not to ascribe carbon credits to the carbon dioxide that has been removed from the atmosphere.

This increasing focus was present before the publication of the **IPCC WGIII Report**. The **IPCC WGIII Report** has brought into even sharper focus the need for **CH₄** reduction and **CDR**. This sharper focus is becoming ever more focussed.

The record levels of **CO₂** and their consequences follow the record levels of **CH₄** reported in **Edition 39** of Low Carbon Pulse as follows:

By way of reminder: On **April 7, 2022**, the **NOAA** issued [Increase in atmospheric methane set another record during 2021 – Carbon dioxide levels also record a big jump](#).

The following graph illustrates key dynamics reported by the **NOAA**, critically the (steepening) upward trend.



In April, the record levels of **CH₄** were the subject of an excellent article in [The Washington Post \(Methane emissions jumped by record amount in 2021, NOAA\)](#). In May, the record levels of **CO₂** caught the attention of [The Wall Street Journal](#).

Middle East including GCC Countries:

*This section of Low Carbon Pulse considers news items within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the Gulf Cooperation Council (**GCC**) Countries, being countries that are leading the way in the development of Blue Hydrogen and Green Hydrogen capacity for own use and for export.*

- **EWEC procuring 1.5 GW of photovoltaic solar:** On **May 11, 2022**, it was reported widely that **Emirates Water and Electricity Co. (EWEC)** was accepting expressions of interest to develop a **1.5 GW** photovoltaic solar project in Abu Dhabi (the **AL Ajban PV** project).
- **ADNOC and BP continue cooperation:** On **May 24, 2022**, it was reported widely that **ADNOC** (Abu Dhabi National Oil Company) and **Masdar** (Abu Dhabi Future Energy Company) had agreed to invest in **bp's** Blue Hydrogen and Green Hydrogen projects, **H2Teesside**. **ADNOC** will work with **bp** on the Blue Hydrogen project, and **Masdar** will work with **bp** on the Green Hydrogen project (HyGreen Teesside).

As reported in previous editions of Low Carbon Pulse, **ADNOC**, **bp**, **Masdar**, **Tadweer** (Abu Dhabi Waste Management Centre) and **Etihaad Airways** are to assess the production of **SAF** from hydrogen and the gasification of municipal solid waste.

By way of reminder:

- **Edition 27** of Low Carbon Pulse reported as follows (under **ADNOC Group, bp and Masdar align**):
 "On September 16, 2021, it was reported widely that ADNOC Group (leading national oil company), BP (leading international energy corporation) and Masdar (Abu Dhabi Future Energy Company) entered into framework agreements. It is understood that the framework agreements provide the basis for the development of two clean hydrogen hubs, each of 1 GW, one in the UAE, the other in the UK.
 The framework agreements reflect the clear commitment of ADNOC Group and Masdar to the "Principles of the 50" and the commitment of BP to progress to **NZE** and the achievement of its objectives in respect of the Net-Zero Teesside project (see **Edition 23** of Low Carbon Pulse). The development of the 1 GW Blue Hydrogen facility on Teesside (**H2Teesside**) will be facilitated by the investment of ADNOC Group and Masdar."
- **Edition 37** of Low Carbon Pulse (Long Form Version) reported on projects that had satisfied the eligibility criteria for progress under the UK Government **Cluster Sequencing Phase-2: eligible projects (power, CCUS, hydrogen and ICC)**. The following table identifies the projects that satisfied the eligibility criteria for **Phase-2**, with the **bp H2Teesside** project placed in context.

CO2 CLUSTER	POWER CCS	HYDROGEN	INDUSTRIAL CARBON CAPTURE
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East Coast Cluster:	VPI Humber Zero; Whitetail Clean Energy; Net Zero Teesside Power; Alfanar CCGT Teesside; Keadby 3 CC Power Station and C.Gen Killingholme	N2NorthEast; Uniper Humber Hub Blue Project; bp H2Teesside and Hydrogen to Humber (H2H) Saltend	STV 1,2 and 3 Energy from Waste CC projects; Tees Valley Energy Recovery Facility Project; Alalto Immingham waste to jet fuel project; Lighthouse Green Fuels; Redcar Energy Centre; Humber Zero Refinery; Prax Lindsey Refinery; ZerCal250; Teesside Hydrogen CC; Saint-Gobain Glass CC; Norsesea CC; CF Fertilisers Billingham Ammonia CCS; Teesside Green Energy Park, and North Lincolnshire Green Energy Park
HyNet Northwest	Making Net Zero Possible – Grain	Project Cavendish & HyNet Hydrogen Production Project	Viridor Runcorn Industrial CCS; Protos Biofuels and Energy Recovery; Hanson Padeswood Cement CCS; CF Fertilisers Ince CC Plant; Buxton Lime Net Zero; EssarOil UK CCU; and Emerge CCS
Scottish Cluster	Peterhead Carbon Capture Power Station	Acorn Hydrogen & Fife Hydrogen Hub	CO2 Extraction form St Fergus Gas and SAGE Terminal and Acorn Capture

- **JDA for World Scale Future Fuels project:** Previous editions of Low Carbon Pulse reported that in late 2021, **ACWA Power, Air Products** and **OQ** had signed a memorandum of understanding (**MOU**) in respect of an integrated photovoltaic solar, wind, and **BESS**, Green Hydrogen production facility, and nitrogen separation facility, and a Green Hydrogen and nitrogen synthesis plant (to be located in the Salalah Free Zone, Oman) to produce Green Ammonia. On **May 26, 2022**, it was reported widely that the parties to the **MOU** had progress to the execution of a joint development agreement (**JDA**). It is noted that **ACWA Power** and **Air Products** are working together on the **Neom Green Hydrogen** project in the **KSA**.

By way of reminder: Other Green Hydrogen and Green Ammonia progress in Oman are:

- **Oman Green Energy Hub (OGEH):** On **April 5, 2022**, it was announced that **Worley** had been appointed to undertake a concept feasibility study for the **OGEH**.
Previously, **Edition 18** of Low Carbon Pulse reported that: "On May 22, 2021, plans to develop a USD 30 billion, 25 GW, **Oman Green Energy Hub (OGEH)** were announced. The **OGEH** is to be located close to the Arabian Sea. The development of the **OGEH** is to be spear-headed by **InterContinental Energy**, in partnership with **OQ** (state owned Omani oil and gas company) and **EnerTech Holding Company** (Kuwaiti based investor).
The renewable electrical energy produced from on-shore photovoltaic solar and wind farms, will allow the production of 1.8 million metric tonnes per annum of Green Hydrogen and, as reported, 10 million metric tonnes a year of Green Ammonia. Construction of **OGEH** is to be undertaken in phases, and is scheduled to commence in 2028, with completion of the final phase scheduled for 2038. On full development, the **OGEH** is to be powered by 25 GW of photovoltaic solar and wind."
- **Self-fulfilling dynamics in Oman: Edition 22** of Low Carbon Pulse reported that: "On July 19, 2021, it was reported that Uniper (leading international energy company) has signed a cooperation agreement with the shareholders in **Hyport DUQM** to develop the business case for the off-take of Green Hydrogen through the negotiation of an exclusive off-take agreement for Green Ammonia and to provide related engineering services.
As noted in previous editions of Low Carbon Pulse, there is palpable progress across the **Gulf Cooperation Council (GCC)** countries towards the development of Green Hydrogen and Green Ammonia (and Blue Hydrogen and Ammonia). **Edition 20** of Low Carbon Pulse included a narrative around the highly prospective, world-class resources that exist in the **GCC** countries."
- **Oman building on progress: Edition 25** of Low Carbon Pulse reported that: "Uniper (leading international energy company) had signed a cooperation agreement with the shareholders in **Hyport DUQM** to develop the business case for the off-take of Green Hydrogen through the negotiation of an exclusive off-take agreement for Green Ammonia and to provide related engineering services.
On August 13, 2021, it was announced that the Oman Ministry of Energy had established an alliance (**Hy-Fly**) of thirteen public and private sector organisations (including Oman LNG, OQ, BP, Shell and TotalEnergies) to work together to develop initiatives for the purposes of the production, transportation, use and export of clean hydrogen, and clean hydrogen-based fuels.
- **OQ signs JDA: Edition 29** of Low Carbon Pulse reported that: "On October 17, 2021, OQ (the Omani state-owned energy company) had signed a Joint Development Agreement with Dutco, Linde and Marubeni to undertake feasibility studies to assess the development of a 400 MW Green Hydrogen and Green Ammonia production facility (**SalalahH2 Project**) in Oman's Salalah Free Zone. The **SalalahH2 Project** will make use of OQ's existing ammonia production plant at Salalah".
- **Oman and Siemens mapping a way forward: Edition 30** of Low Carbon Pulse reported that: "On November 11, 2021, the Oman Hydrogen Centre (**OHC**) signed a memorandum of understanding (**MOU**) with Siemens Energy Oman to collaborate on the development and deployment of hydrogen energy projects and on hydrogen initiatives in the Sultanate of Oman".
- **Oman and BP committed to multiple GWs: Edition 33** of Low Carbon Pulse reported that: "On January 17, 2022, the Oman Ministry of Energy and Minerals had signed an agreement with BP (leading international energy corporation) to progress with the development of a combined renewable electrical energy and Green Hydrogen production project by 2030.
In the near term, **BP** will assess the solar and wind resources in a 8,000 km² area of land that would be used to locate photovoltaic solar and wind generation capacity to provide renewable electrical energy for the production of Green Hydrogen".

Africa:

*This section considers news items within the news cycle of this **Edition 40** of Low Carbon Pulse relating to Africa. Africa remains the continent with the most developing countries, the most **Least Developed Countries** and the most countries vulnerable to climate change, and the continent with some of the lowest levels of electrification.*

- **Continued flow of Suez projects:** On **May 11, 2022**, english.ahram.org.eg reported that Egyptian Prime Minister, Mr Mostafa Madbouly attended a signing ceremony for a memorandum of understanding (**MOU**) among the **General Authority for Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**, and a consortium comprising **TotalEren** and **Enara Capital** (a sustainable energy investment platform).

Under the **MOU**, **Total Eren** (reported as TotaEnergies in some news outlets) and **Enara** (a Cairo headquartered investment corporation) will develop facilities to produce Green Hydrogen and Green Ammonia to produce up to **300,000 metric tonnes** of Green Ammonia a year initially, but with the expectation of expansion of up to **1.5 million metric tonnes** a year.

- **And another one!** On **June 1, 2022**, it was reported widely that the **General Authority for Suez Canal Economic Zone (SCZONE)** and **H-2 Industries** (developer of hydrogen storage technology) plan to develop a **USD 4 billion waste-to-hydrogen facility at Port Said**.

As reported, the waste-to-hydrogen facility will process **4 million metric tonnes** of **municipal solid waste** as feedstock, and produce **300,000 metric tonnes** of hydrogen annually.

- **Egyptian Future Fuel Hubbub:**

The waste-to-hydrogen announced on **June 1, 2022**, is another project to be developed in Egypt. The following page or so details the activity during 2022.

- **AMEA Power to produce Green Ammonia in Egypt for export:** On **April 22, 2022**, energy-utilities.com reported that **AMEA Power** had signed a memorandum of understanding (**MOU**) to produce Green Ammonia for export from **Ain Sokhna Industrial Zone**, Egypt. The **MOU** was signed with the **General Authority for Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**. As reported, the **Green Hydrogen** and **Green Ammonia** production facility will produce **400,000 metric tonnes** of **Green Ammonia** a year.

- **EDF Renewables and Zero Waste team-up in Egypt:** On **April 22, 2022**, arabnews.com reported that **EDF Renewables** and **Zero Waste** had signed a memorandum of understanding to develop a carbon-free fuel production project working with the **Ministry of Electricity**, the **General Authority for Suez Canal Economic Zone** and The **Sovereign Fund of Egypt**. The project is to be located within **Suez Canal Economic Zone**.

- **Hassan Allam Utilities and Masdar agree to develop Green Hydrogen production facility:** On **April 25, 2022**, energy-utilities.com reported that **Hassan Allam Utilities** and **Masdar** had signed two memorandums of understanding (**MOUs**) to produce Green Ammonia for export from the **Ain Sokhna Industrial Zone**, Egypt. The **MOUs** were signed with the **Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**. As reported, the **Green Hydrogen** production facilities will be developed to produce up to **100,000 metric tonnes** of **e-methanol a year by 2026** (being methanol using renewable electrical energy in respect of all power required for the purposes of producing the methanol). It is reported that overtime the electrolyser capacity will increase to **4 GW** to allow increased production of e-methanol.

As will be apparent from the following reminder, the **Ain Sokhna Industrial Zone** is going to be home to considerable **Green Hydrogen**, **Green Ammonia** and **Green Methanol** production capacity.

- **By way of reminder Edition 36 of Low Carbon Pulse reported that:**

- On **March 10, 2022**, it was reported widely that **Scatec** (leading Norwegian renewable electrical energy corporation) had signed a memorandum of understanding (**MOU**) with the **Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority**.

It is understood that the **MOU** provides for the development jointly of a **1 million metric tonnes per annum Green Ammonia** production facility (with potential to expand to 3 million metric tonnes annually).

The **Green Hydrogen** and **Green Ammonia** production facility is to be sited in the **Ain Sokhna Industrial Zone** (itself located within the **Suez Canal Economic Zone**). The **New and Renewable Energy Authority** will allocate land proximate to the production facility to allow renewable electrical energy capacity to be installed to generate power for the production facility.

- On **March 28, 2022**, it was reported widely that **A.P. Moller – Maersk** had entered into a memorandum of understanding (**MOU**) signed by Prime Minister of Egypt, [Mr. Mostafa Madbouly](http://www.egypt.gov.eg), under which **A.P. Moller – Maersk** will work with the **Suez Canal Economic Zone**, The **Sovereign Fund of Egypt**, the **Egyptian Electricity Transmission Company**, and the **New and Renewable Energy Authority** to develop green energy and green fuel production capacity.

- **Future Fuel Hubbub snap shot:** On **May 13, 2022**, sczone.eg provided a summary and update of the memorandums of understanding that had been signed in respect of green hydrogen and green hydrogen-based fuel projects within the **Sokhana zone** (which is within the **Suez Canal Economic Zone (SCZONE)**).

The **SCZONE** announcement explains that the intention is to localise green hydrogen and green hydrogen based fuels with both the **Sokhana** zone and **East Port Said**. Further, it is explained that feasibility studies are currently being undertaken in respect of each project the subject of an **MOU**, aligned to the likelihood of firmer announcements at **COP27**.



Source: [Sczone](#)

- African Green Hydrogen Alliance launched:** On **May 20, 2022**, it was reported widely that **Egypt, Kenya, Morocco, Namibia, Mauritania**, and **South Africa** had established the **African Green Hydrogen Alliance (AGHA)**. The **AGHA** is supported by the **African Development Bank**, the **Green Hydrogen Organisation**, and the **UN Climate Change High-Level Champions**, and the **UN Economic Commission for Africa**.
 The **AGHA** is intended to provide a forum to set, and to increase, the pace of the development of Green Hydrogen production capacity across Africa, and as such to accelerate the transition from fossil fuels, opening up access to affordable, and clean, energy supply for all.
- Africa Day: May 25, 2022**, marked **Africa Day 2022**. **Africa Day 2022** marks the **20th anniversary** of the establishment of the **African Union**. The theme for **Africa Day 2022** was nutrition.
 One of the many interesting facts published on May 25, 2022 was that **23%** of the land mass of **Africa** comprises **forests** and **woodlands**, and that the **Congo forests** and the **Miombo-Mopane** woodlands are some of the most pristine wilderness areas in the world.
- First of its kind BESS:** On **May 31, 2022**, [energy-storage](#) reported that **JCM Power** and **InfraCo Africa** had announced that the **20 MW Golomoti Photovoltaic Solar** and **BESS** project in the **Dedza** district of **Malawi** was operational– said to be the first grid-connected utility scale co-located project in sub-Saharan Africa.

India and Indonesia:

*This section considers news items within the news cycle of **Edition 40** of Low Carbon Pulse relating to India and Indonesia, two countries with increasing populations and urbanisation, attendant increased levels of electrification, and being the countries with the third and seventh most **GHG** emissions.*

- **Hindustan Salts seeks bids for 1 GW of solar:** On **May 5, 2022**, [pv-magazine.com](https://www.pv-magazine.com) reported that **Hindustan Salts Ltd** (a Government of India state-owned corporation) had invited bids to develop **1 GW** of photovoltaic solar capacity located on **5,000** acres of disused land in the Indian State of Gujarat. As reported, bidding closed on **May 25, 2022**.
- **1 GW Photovoltaic solar farm at Hengjaya Mine and Industrial Park:** **Ib vogt** (a solar energy engineering company and developer) and **Quantum Power Asia** (an independent power producer) announced the development of a **1 GW photovoltaic solar farm** to provide renewable electrical energy at the **Hengjaya Mine** (nickel and cobalt), contracting with **Nickel Mines Limited** for this purpose, and to provide renewable electrical energy to Morowali Industrial Park.
- **587 GW of renewable energy by 2060:** On **May 23, 2022**, [kaisel.antaranews.com](https://www.kaisel.antaranews.com) reported that Indonesia plans to develop clean energy power plants with capacity of **587 GW** by 2060, including **361 GW** of photovoltaic solar capacity, **83 GW** of hydroelectric power, and **39 GW** of wind capacity. In addition, the plans include the development of **37 GW** of biomass capacity, **35 GW** of nuclear capacity, **18 GW** of geothermal capacity, and **13.4 GW** of ocean current and wave capacity. To complete the clean energy mix, there will be **energy storage capacity of 140 GW** of **BESS**, **52 GW** of **HESS** and **4.2 GW** of **pumped storage**. As reported in previous editions, the decarbonisation of the electrical energy sector will cost an estimated USD 1,177 billion (or USD 1.177 trillion).
- **Giga-factory planned by Exide Industries:** On **May 27, 2022** [Benchmark Mineral Intelligence](https://www.benchmarkmineralintelligence.com) reported that **Exide Industries** is in "advanced stages" of securing land for its first lithium-ion giga-factory. As reported, the giga-factory is to be located in the **state of Karnataka**, with initial production capacity of **six GWh** a year, increasing to **12 GWh** by 2030. It is understood that the giga-factory will be co-developed with **SVOLT** (leading **PRC** battery corporation).
- **Hybrid photovoltaic solar and wind operational:** On **May 28, 2022**, **Adani Green** announced at [adanigreenenergy.com](https://www.adanigreenenergy.com) that it had commissioned the **390 MW hybrid plant** in the **state of Rajasthan**. As reported, this is the first hybrid renewable energy project in India. The **Solar Energy Corporation of India** or **SOCI** (a state-owned corporation) is to off-take the renewable energy from the project with a tariff of **R2.69** per **KWh**.
- **Large scale solar park opens in India:** On **May 30, 2022**, **Statkraft** (Europe's largest renewable energy generator) announced that its **Nellai** photovoltaic solar farm had commenced operation. The **Nellai** solar farm is located in the southern **state of Tamil Nadu**. **Tamil Nadu** has world class solar resources, with an average of **300 days** of sunshine a year.

While the scale of **Nellai** solar farm is not huge, it is a utility-scale solar farm, and it is likely to be the first of a number of solar farms developed by **Statkraft** using the **Indian Group Captive-model** under which customers own a minimum 26% share in the solar farm and off-take renewable electrical energy under long term power purchase agreements.

- **India Hydrogen Alliance – April 2022:** Attached is the link to the November edition of [India H2 Monitor – April 2022](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link rather than repeat the content of the **India H2 Monitor**. (The **India H2 Monitor** tends to be published three to five days after the end of each calendar month, and as such is not published when we publish Low Carbon Pulse – within two days after the end of each calendar month.)

Japan and Republic of Korea (ROK):

*This section considers news items within the news cycle of this **Edition 40** Low Carbon Pulse relating to Japan and ROK, being the countries with the fifth and tenth most **GHG** emissions, and the greatest dependence on imported energy carriers.*

- **Air Liquide and Lotte Chemical aligned strategically:** On **May 2, 2022**, **Air Liquide** (one of the Big Three Industrial Gas Giants), [announced](#) that it had entered into a strategic joint venture with **Lotte Chemical** under which **Air Liquide** (as a 40% participant) and **Lotte Chemical** (as a 60% participant) are to co-invest through joint venture in new generation, large-scale, hydrogen refuelling stations in the industrial basins of **Daesan** (including Seoul and Gyeonggi province) and **Ulsan** (including Busan, Daegu and Ulsan and Gyeongsang province).
- **Japan's plans to issue USD 157 billion of green transition bonds:** On **May 19, 2022**, [reuters](https://www.reuters.com) reported that Japanese **Prime Minister, Mr Fumio Kishida** had outlined plans to issue an estimated **¥ 20 trillion** (USD 157 billion) of green transition bonds to assist Japan in financing the investment required to achieve carbon neutrality. In addition, **Prime Minister Kishida** indicated that the Government intended to create a 10 year road map to promote green investment.
- **Japan and US align further at QUAD:** On **May 23, 2022**, the **White House** released a [Fact Sheet: US – Japan Climate Partnership](#). The Fact Sheet outlines the increasing granularity in alignment between the Japan and the US.
- **SolarEdge opens:** On **May 25, 2022**, [energy-storage](https://www.energy-storage.com) reported that **SolarEdge** has opened its **2 GW** battery cell giga-factory (**Sella 2**).
Sella 2 has been developed by **SolarEdge**, working with **Kokam**, and is located in **Eumseong Innovation City, Chungcheongbuk-do Province, ROK**. As reported, **Sella 2** will produce nickel manganese cobalt (**NMC**) pouch cells.

PRC and Russia:

This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the **PRC** and **Russia**, being countries that give rise to the most and the fourth most **GHG** emissions.

- **Enhancing ETS for PRC:** On **May 25, 2022**, the **IEA** and **Tsinghua University** held an expert discussion in respect of how an enhanced emissions trading system in the **PRC** could assist in providing momentum in progress towards the achievement of **NZE**.

On **May 25, 2022**, the **IEA** published **Enhancing China's ETS for Carbon Neutrality: Focus on the Power Sector**. The publication analyses five policy setting scenarios for the electricity sector for 2020 to 2035, consistent with China's 14 Five-Year Plan (2021-2025), and the Long Range-Range Objectives through the Year 2035.

The **five** policy setting scenarios are as follows: **RPS Scenario**, the **RPS-ETS Scenario**, and **three Enhanced ETS (ETS+) Scenarios**. For those interested in the modelling of ETS and carbon pricing, the publication is excellent.

The table below provides a summary of each policy setting scenario, other than the base case **RPS Scenario**:

Table ES.1 Key outcomes by scenario, 2035

Scenario	Key ETS design features	CO ₂ reduction (from 2020)	Main driver of CO ₂ reductions	Increase in total system costs*	Additional renewables share**	Interaction with RPS
RPS-ETS	Intensity-based; Moderate BM tightening; Free allocation	-20%	CCUS	-/-	-/-	Low
ETS+BM	Intensity-based; Strong BM tightening; Free allocation	-38%	CCUS	5.2%	1%	Low
ETS+Auction	Intensity-based; Moderate BM tightening; Partial auctioning	-38%	Renewables CCUS	1.4%	8%	High
ETS+Cap	Cap-and-Trade; Stringent cap; Free allocation	-38%	Renewables	0%	12%	High

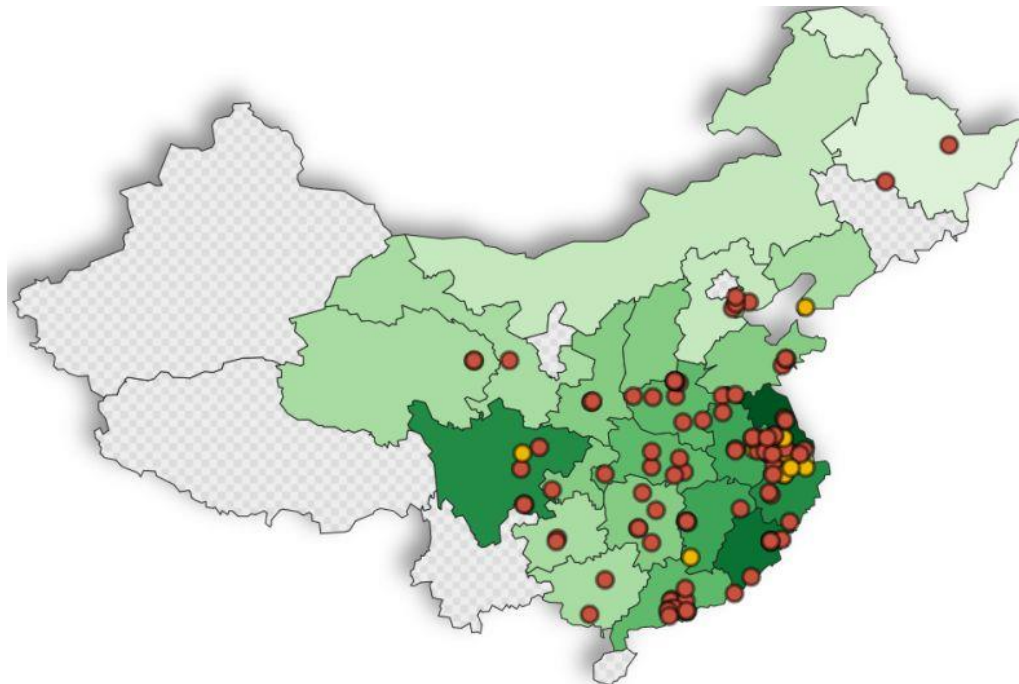
*Increase in total system costs relative to the RPS-ETS Scenario required to achieve given CO₂ reduction level.

**Additional share of non-hydro renewables in electricity generation mix relative to the RPS-ETS Scenario.

Source: [IEA](#)

The **May and June Report on Reports** will consider the publication in detail, and will be published in the **Third Compendium of Low Carbon Pulse**.

- **PRC has 125 giga-factories:** Recent editions of Low Carbon Pulse (including this **Edition 40**) have reported on plans to develop of giga-factories across Europe and North America. The following info-graphic map provides a sense of the giga-factories across the **PRC**.



Source: [China EV map \(uri.sh\)](#)

- **PRC NEA predicts 108 GW of new photovoltaic manufacturing capacity in 2022:** On **May 31, 2022**, [pv-magazine](#) reported that the **National Energy Administration (NEA)** of the **PRC** expects **108 GW** new photovoltaic manufacturing capacity during 2022.

Europe and UK:

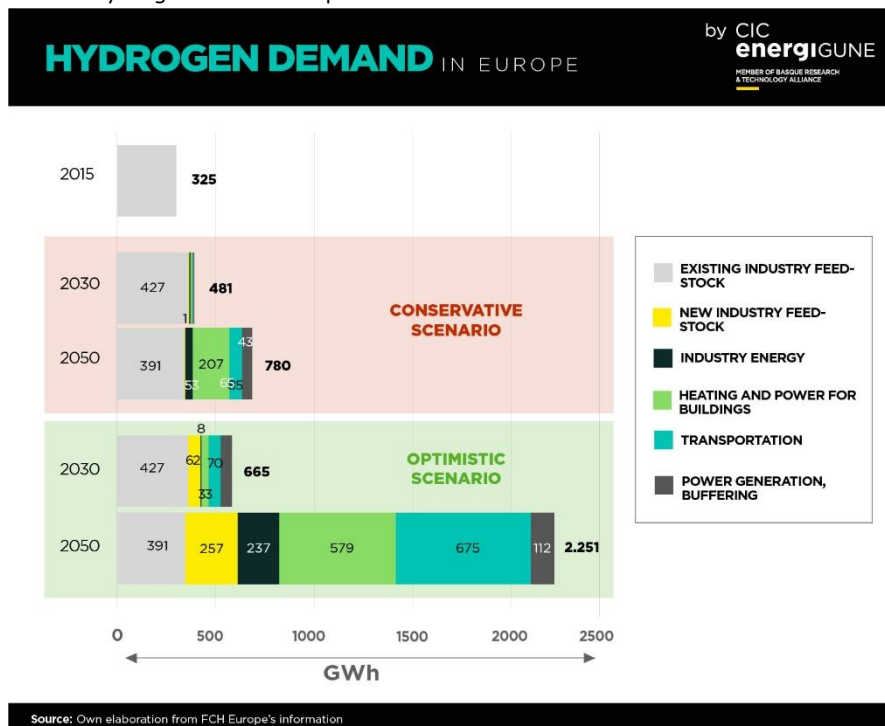
This section considers news items that have arisen within the news cycle of this **Edition 40** of *Low Carbon Pulse* relating to countries within the European Union (**EU**) and the **EU** itself (as an economic bloc) and the UK given geographical proximity, and similar policy settings and progress towards **NZE**. In combination, countries comprising the **EU** give rise to the most **GHG** emissions after the Peoples Republic of China (**PRC**) and the US. The UK is a top-twenty **GHG** emitter, but has been a front-runner in progress towards **NZE**.

- **EU will require hydrogen imports:** In the lead up to the publication of the detailed **REPowerEU** plan (see **REPowerEU detailed plans released** above), on **May 4, 2022**, it was reported widely that **Mr Frans Timmermans** (Executive Vice President of the European Commission for the European Green Deal and European Commissioner for Climate Action) told the **European Parliament** that the **EU** would not be able to produce sufficient hydrogen to satisfy its demand:

"I strongly believe in green hydrogen as the driving force of our energy system of the future ... And I also strongly believe that Europe is never going to be capable to produce its own hydrogen in sufficient quantities".

While there have been a few adverse reactions to this statement (noting however that it is not a policy setting), the statement may be regarded as both sensible and sound, recognising the capacity of the Middle East and North Africa (and other regions with world class renewable resources, in particular solar), to produce and to supply Green Hydrogen to Europe.

To provide context, the good folk at **CIC energigune** have produced the following infographic providing a sense of the possible demand for hydrogen across Europe.

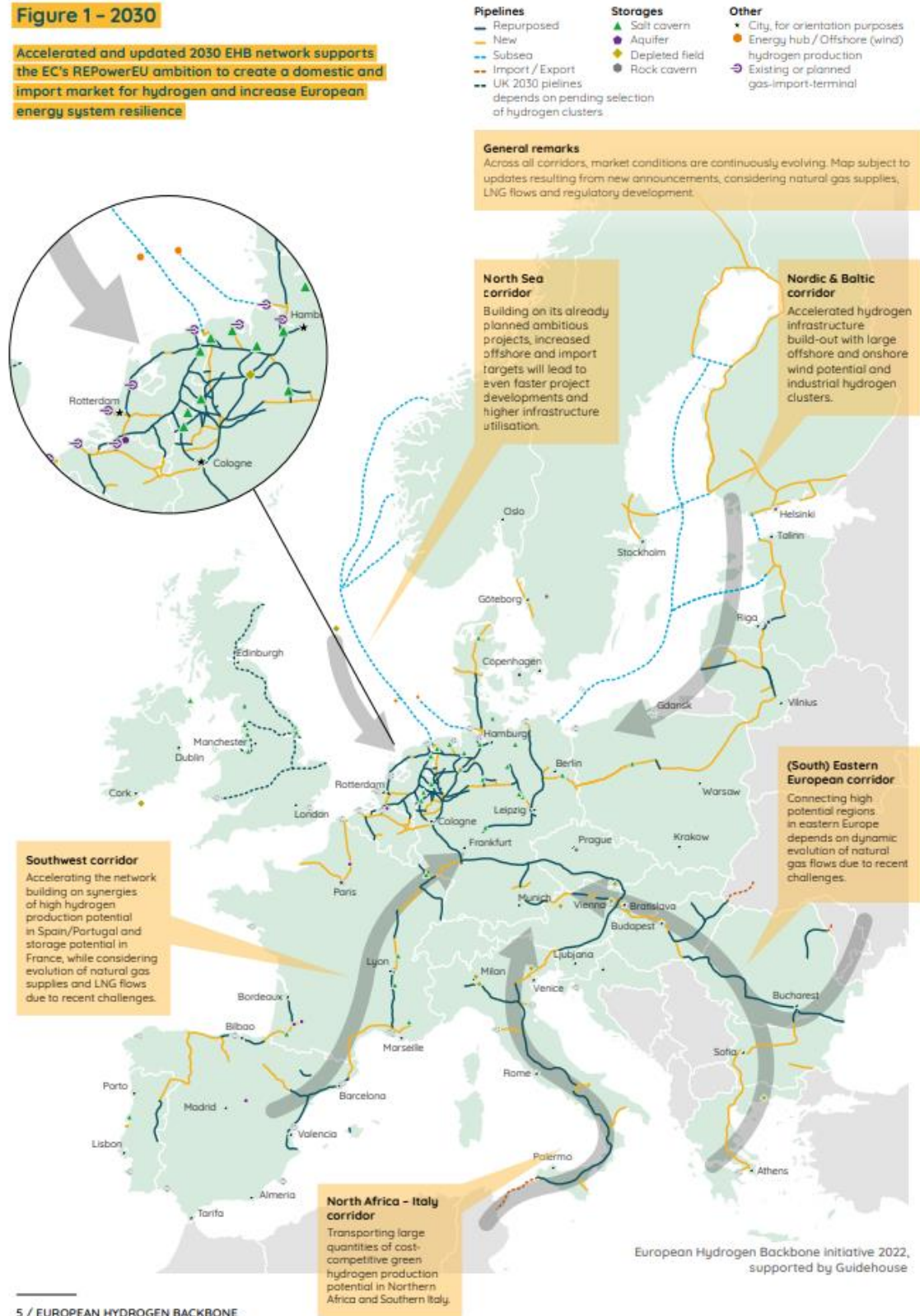


Source: CIC energigune

- **As night follows day...:** On **May 5, 2022**, the **European Commissioner for the Internal Market, Mr Thierry Breton**, met with the European electrolyser manufacturers (under the **European Clean Hydrogen Alliance**), with the result being the signature of a **Joint Declaration** under which the electrolyser manufacturers committed to increase electrolyser capacity **10 fold by 2025** (to **17.5 GW** of electrolyser manufacture a year). Deployment of this level of increased capacity would allow the **EU** to produce **10 million metric tonnes of Green Hydrogen by 2030**, consistent with the **REPowerEU** policy settings announced by the **EC** in March (see **Edition 37** of *Low Carbon Pulse*), and confirmed above.
- **Energy Bill:** On **May 10, 2022**, as part of the Queens Speech (outlining the legislative agenda and program of the current UK Government), the Energy Bill was announced. Please see the [Ashurst insight](#) on the proposed Energy Bill.
- **Updated EHB:** On **May 16, 2022**, the **European Hydrogen Backbone (EHB)** unveiled revised plans to respond to the **REPowerEU**, with the revised plans detailed overpage.

Figure 1 - 2030

Accelerated and updated 2030 EHB network supports the EC's REPowerEU ambition to create a domestic and import market for hydrogen and increase European energy system resilience



Source: [European Hydrogen Backbone](#)

By way of reminder of the EHB: The following picks out from previous editions of Low Carbon Pulse the news items that demonstrate the pace at which thinking has developed around the **EHB**, in turn reflecting the pace of the energy transition.

- On **April 5, 2022**, the **European Hydrogen Backbone (EHB)** published a [paper](#) (entitled **European Hydrogen Backbone – April 2022**) detailing the growth in the network (comprising the backbone necessary to facilitate the use of hydrogen) to meet the **REPowerEU** policy settings. Towards the end of April the **EHB website** launched a map function to detail the pipelines comprising, and to comprise, the **EHB**.

- **Edition 37** of Low Carbon Pulse reported that in the context of the **EHB**, what the **REPowerEU** means as a practical matter is that an additional **15 million metric tonnes** of hydrogen is now contemplated, which when combined with the **5.6 million metric tonnes** projected in **Fit-for-55** means that **20.6 million metric tonnes** of hydrogen is now contemplated **by 2030**, and infrastructure needs to be augmented and expanded and developed to accommodate the fourfold increase.

- **Edition 20** of Low Carbon Pulse (under **Backbone of hydrogen demand**) reported that:

"**Headline:** On June 15, 2021, at the launch of the European Hydrogen Backbone (**EHB**) initiative, a [report](#) was released (**EBR**) providing a perspective on the likely size and shape of hydrogen demand by 2050. The headline is that demand for hydrogen could reach 45% of the levels of natural gas use in 2019, with final total energy consumption (**TEC**) of hydrogen equating to 2,300 TWh a year, book-ended by a low-side estimate of 2,150 TWh **TEC**, and a high-side estimate of 2,750 TWh **TEC**.

Consensus arising: The **EBR** is consistent with "established thinking" that hydrogen has a crucial role to play as an energy carrier for use in the production of cement, chemicals and iron and steel. Across these Difficult to Decarbonise industries it is estimated that 1,200 TWh of energy will be used for high-heat temperature processes, and 200 TWh for medium to high-heat temperature use: hydrogen can be used as a high-heat temperature energy carrier, able to displace fossil, and other carbon intensive, feedstocks and fuels.

In addition to use in these Difficult to Decarbonise industries, hydrogen will be used to power and to propel vehicles (particularly heavy goods vehicles / trucks) using **FCT**. Further, it is stated that hydrogen will be used as a fuel to produce dispatchable electrical energy or, as noted in the next paragraph, Hydrogen Energy Carrier Storage (**HECS**) (up to 600 TWh) and, in some countries, to heat buildings (up to 600 TWh), including through district heating.

Efficiency in hydrogen use and storage: The **EBR** notes that while it would be possible for the **EU** and the **UK** to produce sufficient Green Hydrogen to satisfy this level of projected demand, this will require considerable investment in renewable electrical energy development. While production and supply of Green Hydrogen within the **EU** and the **UK** will fulfil some of the early policy setting thinking around energy security, it is likely to prove more expensive than sourcing Green Hydrogen from countries and regions with renewable energy sources better suited to the production of Green Hydrogen and, as a result, lower cost production.

As noted in previous editions of Low Carbon Pulse, while hydrogen can be used to produce dispatchable energy, it will be interesting to see how this prospective use develops given thinking of policy settings and the thinking of development / policy banks: current trends reflect the view that hydrogen should not be used as a fuel for base load dispatchable energy, rather hydrogen (suited as it is to storage) is best used to provide **HECS**. The **EBR** recognises the use of hydrogen for **HECS** in the context of use of hydrogen to produce dispatchable energy only, not to provide a fuel for base-load dispatchable energy."

- **Honing in on Northern Europe:**

Each part of the **EHB** will have a local backbone. By way of illustration, the **Gasunie Hydrogen Backbone**.



- **North Sea Countries 65 by 2030 and 150 by 2050:** On **May 18, 2022**, at the **North Sea Summit**, **Belgium**, **Denmark**, **Germany** and **the Netherlands**, consolidated their collective thinking around the development of off-shore wind field capacity development and Green Hydrogen production, with thinking around use of the **North Sea** as the **Green Power Plant of Europe** – the thinking includes the development of **65 GW** of **OWF** capacity **by 2030** and **150 GW** of **OWF** capacity **by 2050**.

For these purposes, each of the countries signed the [Esbjerg Declaration](#) (formally, **The Declaration of Energy Ministers on The North Sea as a Green Power Plant for Europe**).

ESBJERG DECLARATION - NORTH SEA OWF TARGETS

Belgium: 8 GW by 2040 | Denmark: 35 GW by 2050 | Germany: 70 by 2050 | The Netherlands: 21 GW by 2030

The positive reaction to the **Esbjerg Declaration** is best expressed by **CEO's**:

- **Mr Mads Nipper (CEO of Ørsted)**: "It's an historic day, and the 150 GW offshore wind target is key to accelerating the transition to renewable energy. Add to that the ambitions of the UK, Norway, and other countries, and the North Sea will end up being THE power plant of Europe. To the benefit of our climate, our communities and our energy independence".
- **Mr Roland Baan (CEO of Topsoe)**: "Witnessed history in the making at Esbjerg today, during the North Sea Summit. Heads of Government from Denmark, Germany, Belgium and the Netherlands took an enormous step toward reaching the EU's climate neutrality goal by co-signing a joint declaration that will make the North Sea a green powerhouse of Europe. Together, the four countries want to harvest at least 150 GW of offshore wind in 2050".

Understandably, the coverage of the **Esbjerg Declaration** has been overwhelmingly positive. As noted above, it is important that in addition to progress being made in Europe towards achieving **NZE**, that progress is made across the world, at an increasing pace.

• **Alliance Investment Management and CIP to assess feasibility of energy island:**

- On **May 19, 2022**, it was reported widely that **Allianz Investment Management (AIM**, global asset management and diversified insurance company based in the US) and **Copenhagen Infrastructure Partners** or **CIP** (global leading renewable energy investor and sponsor) had agreed to conduct a feasibility study to determine how to build an **energy island** in the **German sector** of the North Sea. As with other energy / power islands, offshore wind field turbines will be connected to the energy / power island, with the electrical energy used both to power electrolyzers to produce Green Hydrogen, then piped to northern Europe, and to dispatch electrical energy to northern Europe.
- On **May 20, 2022**, rechargenews.com reported that **CIP** intended to develop **Brintø Island** (or Hydrogen Island) in the **Danish sector** of the North Sea, in the area of **Dogger Bank**, located on an extensive sandbank. As reported **Brintø Island**, would locate Green Hydrogen production facilities, powered by renewable electrical energy from up to **10 GW** of OWF capacity, with production capacity of up to **1 million metric tonnes** of Green Hydrogen a year.

ENERGY / POWER ISLANDS IN THE NORTH SEA

AquaVentus – Helgioland Island – Equinor, RWE and Shell	NorthH2 – Gasunie, Groningen Seaports and Shell	Brintø Island: CIP
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By way of reminder: Previous editions of Low Carbon Pulse have reported that:

CURRENT PLANNED DEVELOPMENT OF OFF-SHORE WIND

North Sea Energy Island – 3 GW – ATP & Partners and Ørsted	Baltic Sea Energy Island – 2 GW – To be awarded	Hesselo (Baltic Sea) – up to 1.2 GW - To be awarded	North Sea Thor – 1 GW
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- **Edition 5** of Low Carbon Pulse (under **Greenlights for New Green Islands**) reported that: "In June 2020, the Danish government announced consideration of the development of green power islands in the Baltic and North Seas. On November 23, 2020, the Danish Ministry of Climate, Energy and Public Utilities confirmed progress of feasibility studies, with a decision to be taken in Q1 of 2021 as to the locations of green islands in the North Sea. "The [green] island will help to increase the amount of renewable energy significantly, and at the same time make it possible to transform green power into fuels for heavy transport ... both on land, at sea and in the air. In other words, the [green] islands will supply the green electricity which is the prerequisite for the climate-neutral Denmark and Europe of the future". (Minister of Climate, Energy and Public Utilities, Dan Jorgensen.)

The Danish Energy Agency and Energinet (grid operator, for electrical energy and natural gas in Denmark) will start detailed studies for each location, with a view to finalising those studies by 2024. It is anticipated that initially the new green islands will add an additional 3 GW of installed capacity of off-shore wind power, increasing to up to 10 GW. A final investment decision is expected in 2021.

As a result of the green power islands, and other projects, the Danish government intends to install 7.2 GW of off-shore wind capacity between 2027 and 2030, including the green islands, the 1 GW Thor Project in the North Sea, and a proposed 1.2 GW project in the Baltic Sea.

The feasibility studies being undertaken have started to firm-up the likely location as 60 kilometres west of Thorsminde, on Denmark's west coast."

- **Editions 5, 8, 9, 27, 32,** and **39** of Low Carbon Pulse have reported on the green energy / power islands to be developed in the Baltic and North Seas.
- **All is well in the Kingdom of Denmark and beyond:**
 - **Topsoe (previously Haldor Topsoe):** On **May 23, 2022**, h2-view.com reported that **Topsoe** (leading electrolyser technology corporation) is to develop an electrolyser giga-factory capable of manufacturing up to 5 GW electrolyser capacity. It is understood that the giga-factory will manufacture solid-oxide electrolyser cells (SOEC) electrolyzers (see **Edition 37** of Low Carbon Pulse and [Reference Materials](#) below for explanation of SOEC electrolyser technology.)

In addition to **Topsoe**, the consortium comprises, **Aalborg Airport, Aarhus Airport, Aarhus Havn** (Port of Aarhus), **AAU Energy, Alfa Laval, A.P. Moller – Maersk, COWI, Crossbridge Energy, DLR, Energy Cluster Denmark, GreenFuelHub, SkyNRG** and **Steeper Energy**.

- **TES-Wilhelmshaven project continues to accelerate:** On **May 25, 2022**, the **TES-Wilhelmshaven project** was given priority project status by the German Federal Government. The priority project status was conferred by the Acceleration Law (reported in **Edition 39** of Low Carbon Pulse).

By way of reminder:

- **Edition 39** of Low Carbon Pulse (under **TES Fast-tracks**) reported that **TES** (a green hydrogen corporation, reported on in **Editions 36** of Low Carbon Pulse) was reported to be "fast-tracking" the development of a **green hydrogen hub** at **Wilhelmshaven** in Northern Germany (the **TES-Wilhelmshaven project**).

"Clean hydrogen will be used as a bridging fuel in the early years. By 2030, there will likely be a 50:50 split between clean and green hydrogen. In the initial phase, 25 [TWh a year] of green methane, from which more than half a million [metric tonnes] of [clean] hydrogen can be produced, will be imported into Wilhelmshaven. That will increase to 250 TWh [a year] and more than 5 million metric tonnes of hydrogen in a final stage. The green hydrogen will be produced using exclusively renewable sources, mainly solar in several cased wind or hydroelectricity [or both]."

- **Edition 37** of Low Carbon Pulse included a map-graphic outlining the plans of **TES** in visual form, for ease of reference a [link](#) to the map-graphic is included. As will be apparent from the map-graphic, clean hydrogen will be sourced from the Middle East, **CO₂** will be captured and shipped to the Middle East, the **CO₂** will be combined with hydrogen to produce green methane, which is then liquified, with the green **LNG** shipped to Germany. As reported, the **TES-Wilhelmshaven project**, on full development, will comprise **six berths**, and **eight on-site storage tanks**, with combined storage capacity of **1,600,000 m³**.

On **April 25, 2022**, **TES** announced that it was running an open-season process to fast-track the import of **LNG** to its **TES-Wilhelmshaven project**. It is understood that under the first phase of open-season process non-binding expressions of interest are sought. The second phase will involve binding commitments, with third phase involving conclusion of the binding commitments.

Americas:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the US, Brazil, Canada, and Mexico, being countries that give rise to the second, sixth, ninth and eleventh most **GHG** emissions.*

- **Load matched by 100% renewable electrical energy:** On **May 2, 2022**, it was reported widely that between **2.45 pm** and **3 pm** on **April 30, 2022**, the electrical energy load of the US State of California was matched by the dispatch of electrical energy sourced from renewable electrical energy sources. This was a first for California: load was **18 GW** and renewables electrical energy was **18.6 GW**.

As reported in previous editions of Low Carbon Pulse, this is not the first time that 100% of a load has been matched by renewable electrical energy, but it is the first time that this has occurred across a grid the size of the Californian grid.

- **Battery funding:** On **May 2, 2022**, the US Department of Energy (**DOE**) announced **USD 3.1 billion** of funding support under the [Battery Materials Processing and Battery Manufacturing](#) initiative and **USD 60 million** of funding support under [Battery Manufacturing and Electric Drive Vehicle Battery Recycling and Second Life Applications](#) initiative.

These initiatives are provided for under the **Infrastructure Investment and Jobs Act (IIAJA)** also known as the Bipartisan Infrastructure Law (**BIL**). In addition to funding for these initiatives, the **BIL** provides for funding support of **USD 7.5 billion** for electrical vehicles charging infrastructure, **USD 5.5 billion** for electric buses, and **USD 5 billion** for clean and electric school buses. The **BIL** funding support is intended to accelerate the development of the supply chain for electrical vehicles in the US.

As noted in previous editions of Low Carbon Pulse, there is **USD 8 billion** to provide support for **at least four hydrogen hubs** that are able to demonstrate that their development and deployment will contribute to production of clean hydrogen and to multiple uses of that clean hydrogen.

- **CCS funding:** On **May 5, 2022**, the US **DOE** announced more than **USD 2.3 billion** of funding support for three initiatives to support the abatement, reduction and storage of **CO₂** emissions.

First, USD 2.25 billion (under the **BIL**) to accelerate carbon storage projects – **BIL: Storage Validation and Testing (Section 40305): Carbon Storage Assurance Facility Enterprise (CarboSAFE) Initiative: Phases II, II.5 and IV;**

Secondly, USD 45 million to increase the number of **CO₂** storage sites – **CarboSAFE: Phase II -Storage Complex Feasibility;** and

Thirdly, USD 46 million to develop technology to remove, capture, convert and store **CO₂** – **Carbon Management.**

- **California joins the hubbub:** On **May 18, 2022**, the **State of California** announced its intention to seek funding support from the **BIL** to establish a renewable hydrogen hub in the State of California.

California joins the States detailed in the following map in seeking Federal funding for a hydrogen hub.



Source: [Fuelcellworks](https://fuelcellworks.com)

By way of reminder: Hubbub among the States:

- **Edition 35** of Low Carbon Pulse reported that the US **DOE** had "gone-live" on the implementation of the **Infrastructure Investment and Jobs Act (IIAJA)** also known as the **Bipartisan Infrastructure Law (BIL)**. Going live involves rolling-out the initiatives in the **IIAJA**. The largest hydrogen program in the **IIAJA** provides the US **DOE** with USD 8 billion to provide support for **at least four hydrogen hubs** that are able to demonstrate that their development and deployment will contribute to production of clean hydrogen (being hydrogen that gives rise to less than 2 kg of **CO₂** for each 1 kg of hydrogen produced) and to multiple uses of that clean hydrogen. The **IIAJA** prescribes that at least one hydrogen hub will use fossil fuel feedstock to produce hydrogen, one will use renewables and one will use nuclear.
- **Edition 36** of Low Carbon Pulse reported (under **Mountain States Hub**) that **Colorado, New Mexico, Utah** and **Wyoming** had signed a memorandum of understanding to develop a regional clean Hydrogen Hub, and in so doing, position more effectively to seek funding from the **Infrastructure Investment and Jobs Act (IIAJA)**.
- **Mississippi States Hub: Arkansas, Louisiana and Oklahoma** are reported to be progressing with a like initiative to create a bipartisan three-state bloc to develop a **regional clean Hydrogen Hub**.
- **West Virginia gets in first:** On **March 22, 2022**, it was reported widely that the State of West Virginia, through the **West Virginia Hydrogen Hub Coalition** had submitted a proposal to the US **DOE** seeking funding to develop a hydrogen hub in the State.
- **Northeast Hydrogen Hub:** On **March 24, 2022**, the Governor of New York State, Ms Kathy Hochul indicated that New York, together with Connecticut, Massachusetts and New Jersey, and 40 hydrogen ecosystem partners, were combining for the purposes of seeking to become one of at least four regional clean hydrogen energy hubs.

For the **Mountain States Hub, Mississippi States Hub, West Virginia Hydrogen Hub** and **Northeast States Hub**, the development of a Hydrogen Hub represents an opportunity to take advantage of their natural advantages.

- **Extension to deadline for Civil Nuclear Credit Program:** While nuclear energy is not a key focus of the Low Carbon Pulse, Low Carbon Pulse does nevertheless covers material and significant development and support programs. On **May 19, 2022**, the US **DOE** announced the extension of the deadline for applications for credit support under the **Civil Nuclear Credit Program** (established under the **BIL**) to **July 5, 2022**: the **Civil Nuclear Credit Program** is intended to allow nuclear reactors, that may otherwise cease operation, to continue to operate.

France and Germany:

*This section considers news items within the news cycle of this **Edition 40** of Low Carbon Pulse relating to France and Germany.*

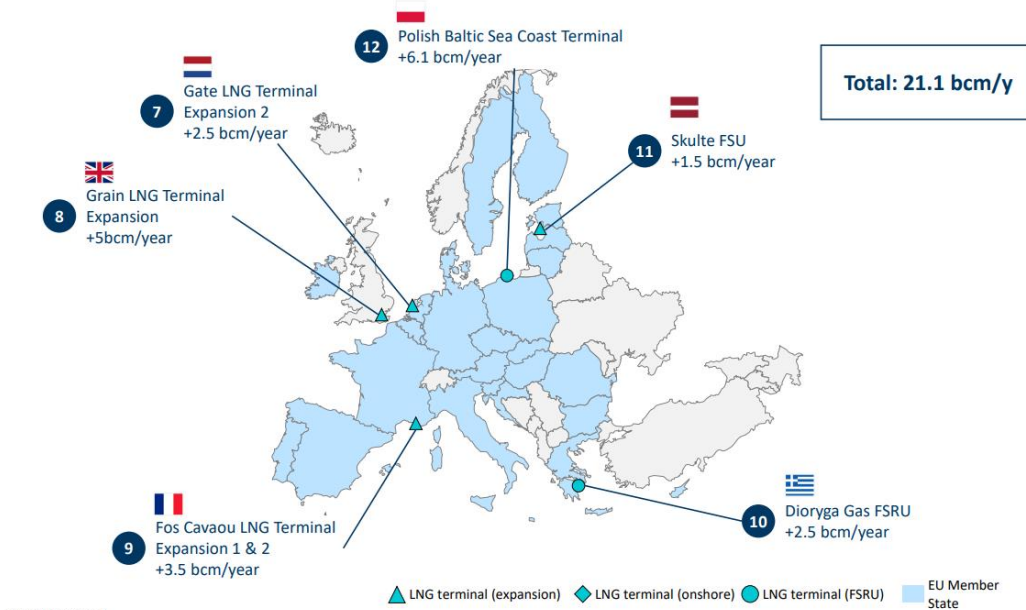
- **A progress check on FSRUs:** **Editions 37** and **39** of Low Carbon Pulse reported on the procurement of floating storage regasification units (**FSRUs**) across Europe so as to address energy security concerns by allowing the import of liquified natural gas (**LNG**). As at the end of **May 2022**, the situation is as follows:
 - **Germany chartering four FSRUs:** On **May 5, 2022**, German Federal Government Economic Minister, Mr Robert Habeck announced that the **German Federal Government** had committed to charter **four FSRUs**, a commitment of **€2.04 billion (USD 3 billion)** to allow the import of sufficient LNG to provide 20% of the demand for natural gas in Germany;
 - **Gasunie chartering FSRUs:** On **May 10, 2022**, it was reported widely that **Gasunie** (energy network operator in the Netherlands and Northern Germany) had agreed to charter an FSRU from **New Fortress Energy** to allow the import of LNG at the **EEM Energy Import Terminal**.
The charterparty with **New Fortress Energy**, follows the charterparty signed with **Exmar** at the end of April 2022.

Both FSRUs are scheduled to arrive at Eemshaven, Groningen, the Netherlands, in August 2022. **Gasunie** subsidiary, **EeemsEnergy Terminal BV** is expanding its **EEM Energy Import Terminal**.

- **Gasrid chartering FSRU:** On **May 20, 2022**, marinelink.com reported that **Gasgrid Finland Oy** (the Finnish state-owned natural gas transmission system operator) had entered into a 10 year charterparty with **Excelerate Energy** (a leading owner of FSRU's) to allow the import of LNG for regasification to provide natural gas to the **Baltic Sea Region**, including **Finland** and **Estonia**. In addition, Estonia plans to develop an on-shore LNG receiving and re-gasification terminal at Paldiski; and
- **Lithuania Klaipeda FSRU:** **Latvenergo** (Latvia's energy corporation) has indicated that hopes to import LNG through the **Klaipeda FSRU**. In addition, Latvia has indicated an intention to develop an on-shore LNG receiving and re-gasification terminal at the Port of Skulte.

By way of background, the following map illustrates the current LNG importation terminals and regasification and send-out facilities across Europe and the UK:

Overview of potential projects – Europe

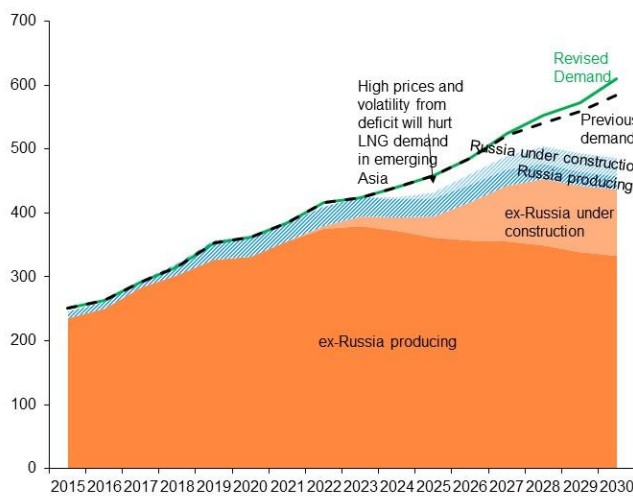


Source: Global LNG Hub

- **LNG demand curve above supply curve:** On **May 9, 2022**, the excellent folk at **Rystad Energy** published an excellent article - [A perfect and unavoidable storm: LNG supply crisis to make landfall in winter 2022](#). The title of the article says it all, but the article is well-worth a read.

Looking past the headline and the winter of 2022, the article includes the following info-graphics in respect of Global LNG supply and demand outlook.

Global LNG supply and demand outlook
Million tonnes

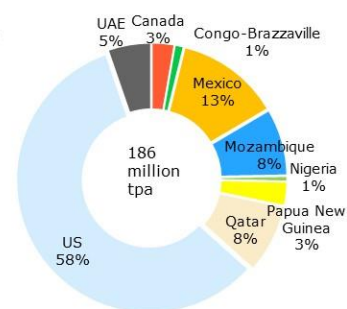


Source: **Rystad Energy GasMarketCube, Rystad Energy research and analysis**



RYSTAD ENERGY

Upcoming liquefaction capacity by country



Note: List not exhaustive

As noted in previous editions of Low Carbon Pulse and sibling publications (see [The Future of LNG and Natural Gas Infrastructure](#)) for some time, natural gas, in the form for LNG, is key to both electrification in many countries, and to energy transition.

The critical point to note is that natural gas is not instead of renewable electrical energy, it is to bridge the gap to energy systems with ever-increasing renewable electrical energy capacity. The policy settings introduced by the German Federal Government in the last three months have demonstrated this duality perfectly.

- **France and Ireland committed to HVDC:** On **May 23, 2022**, the [irishexaminer.com](#) reported that approval had been given for the development of the **Celtic Interconnector** allowing for the exchange of electricity between France and the Republic of Ireland using a **€1 billion 575 km subsea-cable**, from the coast of **Brittany** to the coast of **Cork**.

Australia:

*This section considers news items that have arisen within the news cycle of this **Edition 40** Low Carbon Pulse relating to Australia, a top-twenty **GHG** emitting country, and a developed country with the highest **GHG** emissions per capita. Australia is however progressing to **NZE** at a faster rate than many other developed countries, and, along with the GCC Countries, is one of four countries rich in solar resources (and wind resources) that appear likely to lead in the development of the hydrogen economy over the next five years (and beyond): Australia, Chile, the **PRC** and Spain.*

- **Three consortiums short-listed on Central-West Orana:** On **May 4, 2022**, the **State Government of NSW** announced the short-listed tenderers to develop the **Central-West Orana REZ**.

As announced, the short-listed consortiums are:

1. **ACE Energy**, comprising Acciona, Cobra and Endeavour Energy;
2. **Network REZolution**, comprising APA Group, CPB Contractors, Pacific Partnerships, and UGL; and
3. **NewGen Networks**, comprising Elecnor, Essential Energy, Plenary Group, and Secure Energy.

As stated by the **State Government of NSW**, the next step in the process will involve **Energy Corporation of NSW** inviting the short-listed consortiums to respond to a request for proposal, with contract award during 2023.

By way of reminder: **Editions 30** and **34** of Low Carbon Pulse has reported on the renewable energy zone (**REZ**) initiatives of the State Government of New South Wales, Australia as follows:

- **Edition 30** reported that:

"**Edition 4** of Low Carbon Pulse reported in the plans of the New South Wales Government to promote the development and deployment of renewable electrical energy in the State of New South Wales (**NSW**).

Edition 26 of Low Carbon Pulse reported on the level of interest in **New England Renewable Energy Zone** or **New England REZ**.

"On November 1, 2021, it was reported widely that the NSW Government has invited registrations of interest for its third renewable energy zone (**REZ**) – the **South West REZ**.

There are three more **REZs** to come to market, the **Illawarra REZ** and the **Hunter-Central Coast REZ**. Please click [here](#) to view the NSW Government's electricity roadmap.

NSW REZs – THE STORY SO FAR ...

Central West Orana REZ – interest expressed by the private sector to develop 27 GW of renewable electrical energy capacity

New England REZ – interest expressed by the private sector to develop 34 GW of renewable electrical energy capacity

On November 11, 2021, [pv magazine](#), reported that Australia's first coordinated renewable energy zone is to be built in the central west of NSW, the **Central-West Orana REZ**.

The **Central-West Orana REZ** will deliver up to 3 GW of renewable electrical energy into the grid. The development of the **Central-West Orana REZ** is aligned with the NSW Government policy setting of the development and deployment of 12 GW of renewable electrical energy and 2 GW of BESS by 2030.

It is understood that the **Central-West Orana REZ** was preferred as the first **REZ** to be developed because of the level of investment in renewable electrical energy development already underway in the Central-West region.

It will be interesting to follow the development of the NSW **REZ** initiative as Australia's most populous State progresses to the development and deployment of 12 GW of renewable electrical energy capacity across the State (see **Edition 4** of Low Carbon Pulse)".

- **Edition 34** reported that

South West REZ interest: **Edition 30** of Low Carbon Pulse reported that:

"On February 4, 2022, the NSW Government reported that it had received registrations of interest (ROI) for the **South West REZ** in respect of 34 GW of renewable electrical energy capacity.

The CEO of the Energy Corporation of NSW, Mr James Hay said that the level of ROIs received from industry was "outstanding". Mr Hay said that: "There were 49 registrations totalling over 34 GW from potential generation and storage projects – 13 times the intended capacity for the South-West REZ, which will be no less than 2.5 GW".

Low Carbon Pulse has noted on a number of occasions, that the States and Territories of Australia continue to blaze a trail to **NZE**. This is another instance of this trail blazing, noting always, that the private sector is key to the continued progress to **NZE**.

- **Port of Rotterdam Authority and State of Queensland align:** On **May 20, 2022**, the **Queensland Minister of Energy, Renewables and Hydrogen, Mr Mick de Brenni** signed a memorandum of understanding (**MOU**) with the **Port of Rotterdam Authority (PORA)**. Under the **MOU** the **State of Queensland** and **PORA** agree to work together to develop a hydrogen and hydrogen-based fuels supply chain.

- **New Australian Federal Government:** On **May 21, 2022**, the **Australian Labor Party (ALP)** was elected to form the new **Australian Federal Government**. The **ALP** stood for election on the basis of more detailed and progressive policy settings than that the Liberal and National Party government it replaces, critically a **43% reduction in GHG emissions by 2030**.
- **Monash University article on critical minerals:** On **May 24, 2022**, [monash.edu](https://www.monash.edu) published an article outlining the critical minerals present in abundance in Australia, and that are yet to be mined so to make the most of those resources. The article notes that Australia has the world's largest deposits of **nickel, rutile, tantalum and zircon**, and has top five resources for **antimony, cobalt, copper, lithium, niobium and vanadium**. The thesis of the article is that the private and public sector needs to work more closely to maximise the opportunities for Australia, and globally.
- **Australia and Germany likely to accelerate hydrogen chain development:** On **May 27, 2022**, Reuters (under [Germany looks to speed up green hydrogen development in Australia](#)) reported that Germany wants to speed up the development of the Green Hydrogen value chain between **Australia** and **Germany**. As has been reported in previous editions of Low Carbon Pulse and this **Edition 40**, Germany will not have domestic supply capacity to satisfy its domestic demand for Green Hydrogen.

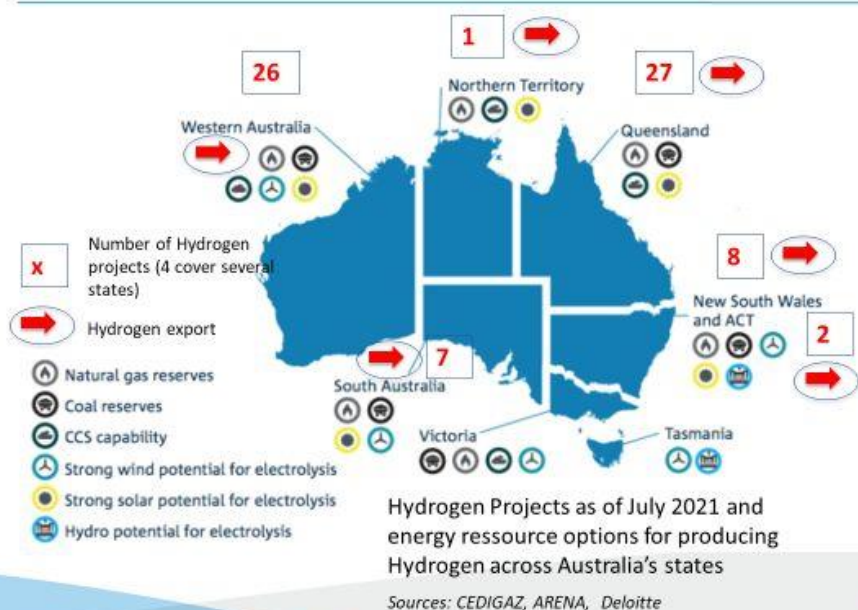
As reported in [innovationaus.com](https://www.innovationaus.com) Dr Christine Falken-Grosser, a German hydrogen delegate, addressed the **National Hydrogen Conference** (in Adelaide, South Australia) on **May 31, 2022**. This may be regarded as the culmination of the visit to Australia of a 35-member delegation to Australia (taking in the states of New South Wales, Queensland, South Australia and Western Australia). The trip by the 35-member delegation is part of the **HySupply** initiative. The delegation was led by the Federal German Government Minister of Education and Research, Ms Bettina Stark-Watzinger.

By way of reminder: In **June 2021**, **Australia** and **Germany** signed a bilateral alliance agreement (**BAA**), a bilateral trade agreement (of sorts), relating to hydrogen production, and trade in hydrogen, and the facilitation of a renewable energy-based hydrogen supply chain between the two countries.

The **BAA** recognises the commitment of Germany to the development of sources of Green Hydrogen supply to match the demand that it is anticipating will develop in response to its policy settings, and the position of Australia as a prospective supplier of Green Hydrogen (see **Edition 20** of Low Carbon Pulse). The initiative has been badged **HySupply**.

The info-map-graphic over the page provides a snap-shot of the scope for hydrogen production in Australia.

Australia has big hydrogen opportunity



- **Microsoft Blue Print for Australia:** During **May 2022**, **Microsoft** published [Accelerating the Journey to Net Zero – A Blue Print for Australia](#). The publication provides a helpful overview of the progress that needs to be made in Australia.

Blue and Green Carbon Initiatives and Biodiversity

*This section considers news items that have arisen within the news cycle of this **Edition 40** Low Carbon Pulse relating to the Blue Carbon and Green Carbon initiatives and Biodiversity.*

- **May 22, 2022**, was **Biodiversity Day**. **Biodiversity Day** is intended to increase awareness of the benefits of **biodiversity** and the importance of preserving **biodiversity**. In the broadest sense, **biodiversity** describes the variety of the fauna and flora globally, and in any particular area. At the highest level, **biodiversity** is important. The preservation of **biodiversity** is therefore a key policy setting. In this context, human activities and the clearing of land to undertake agricultural, forestry or other land use (**AFOLU**) is a key focus of policy settings. Desertification

and deforestation are key concerns (both as a result of **AFOLU**), as is the broader impact of climate change on habitats, critically, the impact on change in temperature on land and in the ocean.

There is a balance in habitats, with eco-systems that have developed overtime, and that continue to develop. The balance of habitats and their eco-systems are impacted by **AFOLU** and climate change. There are many examples, but a consistent example (that many will recognise) is the need to preserve the habitats of bees and other pollinators, and to avoid loss of bees and other pollinators. As a policy setting, the rewilding of habitats is one element of preservation, and, in some cases, restoration of eco-systems. As a broad statement, preserving wilderness areas, and rewilding of areas, and reducing old growth forestry, and afforestation and reforestation, are key to the preservation and restoration of **biodiversity**. These are policy settings over which we have control in the near, medium and long term. In addition, overtime, policy settings may extend to addressing optimal use of land, optimal in the sense of preserving or restoring **biodiversity** while at the same time addressing climate change. As always, what is needed is known. As always, the challenge is acting upon it.

Climate change will impact the effectiveness of these policy settings (in particular coastal habitats, and areas of increased drought and desertification, driven by rising sea-levels and changes in weather patterns, as a result of climate change), but they are policy settings that are necessary and need to be progressed in the near term. In addition, acting to preserve and to restore **biodiversity** is likely to yield benefits, economic and social.

As noted by the **UNEP**:

"Healthy, biodiverse eco-systems sustain life on Earth by providing air, water and other essential elements. From forests to farmlands to oceans, the planet's eco-systems are the basis of resources, services and industries".

Existing impact: It is widely understood that **75%** of the Earth's **land** and **66%** of its **oceans** have been altered by human activity, with associated impact on eco-systems. It is against this background that there is considerable anticipation of **Part 2** of the **15th meeting of the Conference of Parties (COP-15)** to the **Convention on Biological Diversity (CBD)** to be held in Kunming, **PRC**, "tentatively scheduled" for between **August 29** and **September 9, 2022 (Part 1 of COP-15 took place virtually from October 11 to 15, 2021)**.

COP-15 will review the achievement and delivery on the **CBD Strategic Plan for Biodiversity 2011 – 2020**. Also it is anticipated that conclusions will be reached in respect of the **post-2020 global diversity framework**.

Previous editions of Low Carbon Pulse: Editions 32, 33, and 34 of Low Carbon Pulse provide detailed consideration of biodiversity in all its facets.

- **"The best time to plant a tree was 20 years ago. The second best time is now"**: Ahead of Biodiversity Day on **May 22, 2022, UN Biodiversity** shared a number of actions that would assist in the preservation, and contribute to restoration, of biodiversity. These actions are contained in the publication **[22 Actions for Biodiversity](#)**.

Bioenergy and heat-recovery:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to bioenergy, being energy, whether in gaseous, liquid or solid form, derived or produced from biomass. **Bioenergy** includes any energy derived or produced from biomass (organic matter arising from the life-cycle of any living thing, flora or fauna, including from organic waste streams), whether in gaseous, liquid or solid form. In addition, recovered heat and waste heat (derived from any source, including waste water) has been added to this section.*

*From recent activity and reporting, it appears likely that the avoidance of waste heat energy, and the recovery of waste heat energy will become a priority under the first pillar as a part of Energy Efficiency (**IEA**) and Energy conservation and efficiency (**IRENA**). By some estimates, up to 67% of energy arising is wasted. The increased awareness of sourcing heat reflects increased awareness of the energy used to heat buildings, and its source: heating buildings results in around 25% of total final energy demand, with around 75% of the feedstock used to satisfy that energy demand derived from fossil fuels.*

- **Anaergia commissions first of seven:** On **May 3, 2022, Anaergia** (clean energy producer using waste as a resource) announced that it had commissioned its **Easy Energia Ambiente** facility in **Pontinia, Italy**. The **Easy Energia Ambiente** facility will process organic waste to derive biogas, which will then be upgraded (by the removal of **CO₂** and **CO**, and trace compounds) to produce **biomethane** or **renewable natural gas (RNG)**. The **biomethane** will be injected into the gas pipeline network. It is understood that the **Easy Energia Ambiente** facility is the first of seven facilities to be commissioned during 2022.
- **Up to USD 2 billion committed to RNG:** On **May 12, 2022, S&P Global** reported that:
 - **Waste Management** (US' largest waste management corporation) is to invest **USD 825** million to develop and to deploy **RNG** plants at **17** landfills across the US; and
 - **Republic Services** (US solid waste disposal company), with biofuels corporation, **Archaea Energy**, announced a **USD 1.1 billion** joint venture to develop and to deploy **39 RNG** plants across the US.

It is estimated that there are around **2,300** biogas projects across the US, with over **2,000** deriving biogas and firing that **biogas** at site to generate electrical energy. Around **300** biogas project process the **biogas** to upgrade it to **biomethane** or **RNG**.

By way of reminder: Edition 39 of Low Carbon Pulse under (**NREL on top of biogas potential:**) reported that the US **NREL** (the **National Renewable Energy Laboratory** of the US Department of Energy) has published **[Biogas Potential in the United States \(Fact Sheet\), Energy Analysis](#)**. The headline is the **CH₄** that could be derived and produced from waste that would otherwise be landfilled, animal manure, wastewater, and organic waste streams from commercial, industrial and commercial sources is estimated to be sufficient to provide 9% of the natural gas demand of the US. The by-product of the production of biogas is digestate, which is can be used, in processed form, as a fertiliser.

Biogas and **Synthetic Gas** (or **Syngas**): arises as a result of: (a) the decomposition of organic material (in an oxygen free or scarce environment, explained in **Chapters 5** and **6** of the [Ashurst Waste Compendium](#)), consisting of between 60 to 70% **CH₄** and 30 to 40 % **CO₂**, with other compounds and elements in gaseous form, ammonia (**NH₃**), hydrogen sulphide (**H₂S**) and nitrogen (**N₂**), and water vapour; or (b) the thermo-chemical treatment of organic matter to derive **Biogas**.

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "upgrading") so that it can be used as pipeline gas (i.e., complying with the specification for hauling through the applicable natural gas pipeline, including the removal of **CO₂**, and other compounds and elements, such that the gas hauled through the pipeline is **CH₄**). **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel (typically, as a gas that is combusted / oxidised to produce electrical energy or heat energy or both) or as a feedstock. Also either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia**: being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;
- **Bio-butanol**: being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel**: being diesel (i.e. synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol**: being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene**: being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF)**, is a synthetic paraffinic kerosene. Currently most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams (typically using some natural gas). As noted below, typically fatty acids and hydrogenated acids are used to produce synthetic paraffinic kerosene. If the feedstock is sourced from Biomass it is a Bio-kerosene;
- **Bio-LNG**: being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and
- **Bio-methanol**: being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

- **Biomethane Action Plan for the EU**: On **May 18, 2022**, as part of the [REPowerEU Plan](#), the **EU** proposed a [Biomethane Action Plan](#), with the objective of producing **35 billion cubic metres (BCM)** of biomethane by **2030**. The increased derivation and production of **biogas**, and its processing to upgrade it to produce **biomethane** will require the scaling up the value chain to ensure that sufficient **biomass** (of appropriate specification) is collected to allow the derivation and production of **biogas**.
For these purposes, a **Biomethane Industrial Alliance** is proposed by the **EU** as an essential means of steering cooperation between policy makers and investors and participants in the industry. This will promote the development of assured supply and the delivery of that supply via new and repurposed infrastructure. Funding support from the **EU** will be essential, as will long-term policy settings from the **EU**, including [REDIII](#).

BESS and HESS (and energy storage):

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to battery electric storage systems (**BESSs**) and hydrogen energy storage systems (**HESSs**). In addition to **BESSs** and **HESSs**, other forms of energy storage systems are covered, including use of compressed air energy storage (**CAES**) and pumped storage. In this context, long duration energy storage (**LDES**) is considered, being energy technology that is able to allow the off-take electrical energy out of storage for a duration of more than four hours. In the brave new world described in **Edition 13** of Low Carbon Pulse: "**BESS** storage of 10/12/24 hours is being contemplated for business users, and up to 72 hours for telecommunications companies, including to guard against the consequences of land-borne weather events".*

*The **November and December Report on Report** provides a summary of the LDES Council and McKinsey report from November 2021 (see [Second Compendium of Low Carbon Pulse](#)*

- **Maoneng continues roll-out of BESS**: On **May 2, 2022**, it was reported widely that **Maoneng** (renewable energy project developer) proposes to develop the **Merriwa Energy Hub** in the **Hunter Region of New South Wales, Australia** (located 180 kms north-west of Newcastle on the coast of New South Wales).
As reported the **AUD 1.6 billion Merriwa Energy Hub** will comprise a **550 MW** photovoltaic solar farm (1.3 million bifacial solar panels over 780 hectares) and a **400 MW / 1,600 MWh BESS**. Cannily, given the location of the

Merriwa Energy Hub, it appears intended to provide grid integrity and stability, and to be consistent with the policy settings of the state Government of New South Wales.

- **Powin Energy powers on and up:** On **May 4, 2022**, it was reported widely that **Powin Energy** (an energy storage solutions, and systems integration, corporation) is to supply **120 MW / 524 MWh** of **BESS** capacity to **Idaho Power**. **By way of reminder: Edition 39** of Low Carbon Pulse (under **O2 Power and Powin Energy aligned**) reported "that **O2 Power** (renewables corporation, backed by Singapore's **Temasek** and Sweden's **EQT** (a global private equity firm) and **Powin Energy** were to work together to advance the development and deployment of **BESS** across India".
- **The Future of Energy Storage:** In **May, 2022**, the **MIT Energy Initiative** published **The Future of Energy Storage**. As might be expected, the publication is excellent. The publication outlines each of the four basic means of energy storage, electrochemical, mechanical, thermal and chemical. The publication outlines the bases upon which energy storage will develop to store electrical energy generated from variable renewable energy (**VRE**) sources, and it provides modelling of energy storage and outlines the governance and operation of energy systems.
- **Compressed Air Storage preferred for Broken Hill:** On **May 27, 2022**, it was reported widely that a compressed air storage solution had been chosen to provide back-up electrical energy supply at Broken Hill, New South Wales, Australia. **Hydrostor** (a Canadian headquartered corporation) with a proprietary technology – advanced compressed air energy storage (**A-CAES**). The **A-CAES** is a long duration energy storage (**LDES**) system capable of dispatching stored energy to the grid, and to help address the capacity constraints across the grid regionally.

By way of reminder: Editions 20 and 21 of Low Carbon Pulse reported on the storage of energy using compressed air technology, and **Edition 31** reported as follows:

"On November 24, 2021, it was reported widely that **Hydrostor** is contemplating the development of a USD 800 million 400 MW / 3200 MWh LDES CAESS. The **Hydrostor** business model and technology involves the compression of air using off-peak, and surplus electrical, energy from the grid, to derive heat and to compress air (with the compressed air stored at a constant pressure), with compressed air and heat recombined to produce energy to drive a turbine to produce electrical energy for dispatch to the grid.

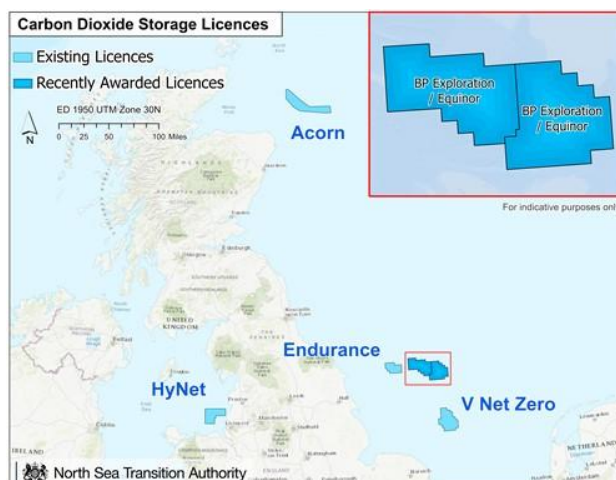
As noted in previous editions of Low Carbon Pulse, the vital statistics of 400 MW / 3,200 MWh mean that the contemplated LDES CAESS will be able to supply 400 MW of electrical energy for up to 8 hours. **Hydrostor** is reported to have applied to the Californian Energy Commission, with the intention to commence commercial operation of the LDEC CAESS by 2026."

- **HESS happening:** On **May 30, 2022**, it was reported widely that **UK Energy Storage Ltd (UKEn)** intends to develop an **Energy-Hub** located across two sites in **Portland, Dorset, United Kingdom**. As reported, beneath land owned by **Portland Port Limited** there are salt caverns that are ideal for the storage of hydrogen, some reporting suggesting up to **1.2 billion m³** of available capacity for hydrogen storage.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to carbon accounting and carbon dioxide removal (**CDR**), including bioenergy carbon capture (**BECCs**), bioenergy carbon capture use and storage (**BECCUS**), carbon capture and storage (**CCS**), carbon capture use and storage (**CCUS**) and direct air capture (**DACS**). Effective accounting for carbon arising and **CDR** go hand-in-hand. By way of background **CDR** is recognised in the 2021 Report as including: afforestation, soil carbon sequestration, bioenergy with carbon capture and storage (**BECCS**), wet land restoration, ocean fertilisation, ocean alkalinisation, enhanced terrestrial weathering and direct air capture and storage (**DACS**) are all means of **CO₂** removal. The **IEA** pathway to **NZE** estimates that in order to achieve **NZE** it will be necessary to capture and to remove up to 7.6 giga-tonnes of **CO₂** each year through **CCS**, **CCUS** and **CDR**. **CCS** and **CCUS** (and **BECCS** and **BECCUS**) involve the capture at the source of **CO₂**, preventing release to the climate system. The following provides a helpful overview of carbon capture as things currently stand.*

- **NSTA awards carbon storage licences to BP and Equinor:** On **May 12, 2022**, the **North Sea Transition Authority (NSTA)** [announced](#) in a press release that it had awarded carbon storage (**CS**) licences to **bp Exploration** and **Equinor**.



The award of the licences to **bp** and **Equinor** brings to **six** the **CS** licences that the **NSTA** is now stewarding. As stated by the **NSTA**, the current project estimates indicate the earliest injection under **CSs** could occur in 2025, given

the progress being made in by HyNet, Northern Endurance's East Coast Cluster and V Net Zero Humber Cluster Projects.

- **Cross-border carbon storage:** On **May 13, 2022**, corygroup.co.uk announced that it (**Cory Group**) had signed a memorandum of understanding (**MOU**) with **Northern Lights** (part of the Norwegian Longship CCS project) to work together to realise a major carbon capture and storage projects between **Norway** and the **UK**.

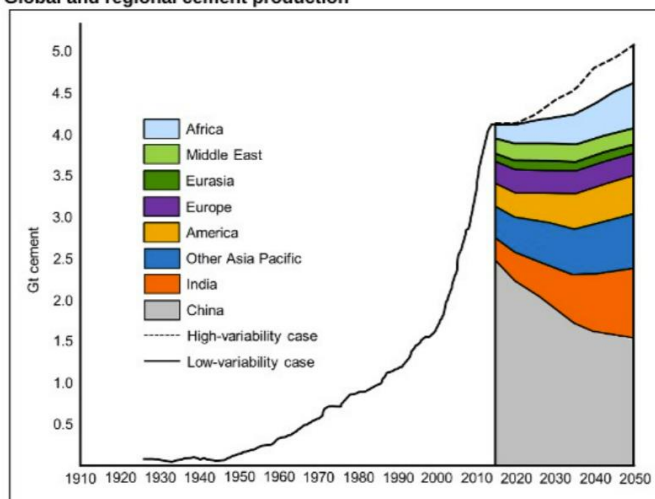
The **MOU** contemplates that **CO₂** captured from the Cory waste-to-energy project on the River Thames, London, will be injected into sub-sea-bed storage comprised in the North Lights Project (see **Editions 11, 20, 26, 31** and **34**) of Low Carbon Pulse).

Marking the significance of the **MOU**, and the need for government-to-government agreement, the signing of the **MOU** was attended by **Norwegian Prime Minister, Mr Jonas Gahr Støre** and the **UK Secretary of State for the Department for Business, Energy and Industrial Strategy** (the oft mentioned, **BEIS**), **Mr Kwasi Kwarteng**.

The Government of Norway website, regjeringen.no, provided a positive narrative: "CO₂ emissions from London's household rubbish will be captured and stored beneath the North Sea in the carbon storage facility of the Norwegian Longship CCS project".

- **Repurposing of natural gas pipeline:** On **May 18, 2022**, upstreamonline.com reported that **Tallgrass** (US Midstream Company) is to expand the reach of its **Eastern Wyoming Sequestration Hub** to include an **ADM (Archer-Daniels Midland Company)** corn processing complex in **Columbus, Nebraska (ADM facility)** by the repurposing of its Trailblazer natural gas pipeline to haul **CO₂** captured at the **ADM facility**. As reported, the repurposed **Trailblazer natural gas pipeline** (which is 400 miles / 640 kms in length) will be able to haul more than **10 million metric tonnes of CO₂** a year (in compressed form).
- **CVX launches CCS project:** On **May 18, 2022**, **Chevron U.S.A. Inc.**, [announced](#) the development of a CCS project at its Kern River Eastridge co-generation plant, Kern County, San Joaquin Valley, California.
- **Bayou Bend in the pink:** On **May 24, 2022**, [talosenergy](http://talosenergy.com) announced that it had executed definitive documentation with **Carbonvert, Inc.** and **Chevron U.S.A. Inc.**, to develop, in joint venture, the **Bayou Bend CCS** off-shore bub.
- **CCUS and decarbonisation of cement industry:** On **May 25, 2022** **The Oxford Institute for Energy Studies (OIES)** published [The role of CCUS in decarbonising the cement industry: A German case study](#). The study is well-worth a read. With one graph, the study illustrates that it is imperative to make progress in the decarbonisation of the cement industry:

Figure 1: Global and regional cement production



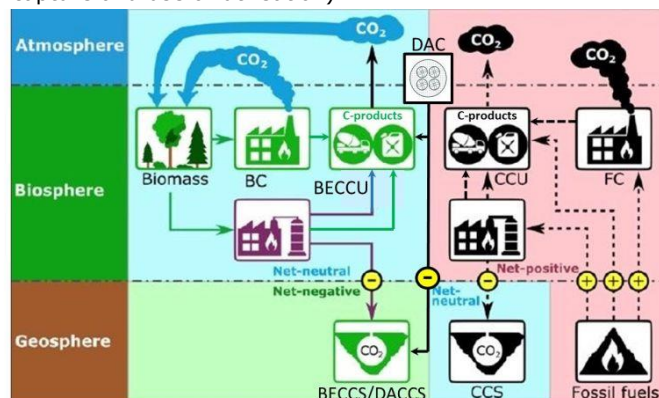
Source: Author's interpretation based on IEA (2018b) and USGS (2017)⁹

- **California carbon capture bills pass Senate:** On **May 27, 2022**, [Clean Air Task Force](http://CleanAirTaskForce.com), reported that three bills passed the state Senate of California. The three bills are:
 1. **SB-905: The Decarbonised Cement and Geologic Carbon Sequestration Demonstration Act;**
 2. **SB-1399: The Carbon Capture Technology Demonstration Project Grant Program;** and
 3. **SB-1101: The Carbon Sequestration: Pore Space Ownership and Carbon Capture, Utilisation and Storage Program.**
- **Carbfix basalt fix:** On **May 30, 2022**, **Carbix** published an atlas (to be found at www.carbix.com/atlas) that provides an open-source database to favourable storage formations around the world.
- **Slite CCS Project proceeds:** On **May 30, 2022**, [HeidelbergCement](http://HeidelbergCement.com) announced further progress of its **Slite CCS project**. The [announcement](#) from HeidelbergCement starts with – "We're not just making concrete promises – we are also taking action". The **Slite CCS project** has passed pre-feasibility study, and the carbon capture facilities will be scaled up so as to capture **1.8 million metric tonnes of CO₂** annually by 2030.

By way of reminder: **Edition 19** of Low Carbon Pulse reported on **Slite** as follows:

"On June 2, 2021, Heidelberg Cement Group (**HCG**) announced the development of the world's first carbon-neutral cement plant: this is reported to involve the augmentation and upgrade of **HCG's** existing cement production facility at Slite, Gotland Island, Sweden. The plant produces 1.8 mtpa of **CO₂**. From 2030 these **CO₂** emissions will be captured and stored. It is understood that the Slite project will benefit from the use of CCS technology by HCG at Brevik, Norway".

- **Definition and diagram:** Mr Reinier Grimbergen has produced the following diagram explaining **CCS** (carbon capture and storage), **CCU** (carbon capture and use or utilization), **BECCS** (bioenergy carbon capture and storage), **BECCUS** (bioenergy carbon capture and use or utilization), **DACCS** (direct air carbon capture and storage), and **DACCUS** (direct air carbon capture and use or utilisation).



- **CCS / CCUS Databases:**

Previous editions of Low Carbon Pulse have included databases, which are included here for reference.

- US **DOE** National Renewable Energy Laboratory (**NREL**) [Carbon Capture and Storage Database](#), which includes information on active, proposed and discontinued CCS projects around the world.
- US **DOE** [Carbon Storage Atlas](#).
- [Atlas of Carbon and Hydrogen Hubs from the Great Plains Institute](#)
- **CO2 Value** launched a [New CCU Project Database](#), provides reference for CCS / CCUS projects across Europe.
- The **Clean Air Task Force** [Carbon Management Tracker](#), maps Middle East and North Africa CCS / CCUS.

Carbon Credits and Hydrogen Markets and Trading:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the creation of carbon credits, the role of carbon credits, and the trading of them. Also this section covers the development of hydrogen markets and trading (bilateral and likely wholesale).*

- **LEAF Coalition:** On **May 13, 2022**, the **LEAF Coalition** Window for Proposals from Forest jurisdictions opened. Regular readers of Low Carbon Pulse will recall that **Edition 15** of Low Carbon Pulse reported as follows:

"LEAF falls in the rain forest:

The US, the UK and Norway, and major corporations, are to co-operate in a public-private initiative to preserve rain forests. The Lowering Emissions by Accelerating Forest Finance (**LEAF**) coalition was announced on April 22, 2021. At a cellular level, **LEAF** is a carbon credit scheme, under which for each tonne of avoided **GHG** emissions, a carbon credit will arise, with that carbon credit capable of being traded to off-set carbon emission reduction commitments or obligations. **LEAF** is reported to have initial funding of USD 1 billion.

It is hoped that **LEAF** will reduce deforestation, while other policy settings reduce **GHG** emissions."

The mobilisation of **USD 1 billion** during 2021 was significant. As significant is the reputation that the **LEAF Coalition** has for "rigorous verification mechanisms" to verify that carbon is in fact sequestered, and remains sequestered. This reputation assists in the development of carbon credits trading in voluntary carbon markets.

Critically, the **LEAF Coalition** recognises that the use of carbon credits is not a substitute for, or an excuse for any delay in, science-aligned **GHG** emission reductions, rather carbon credits are a means to preserve and to increase sequestration capacity to "buy time" as progress is made to achieve decarbonisation and **NZE**.

- **Japan Carbon Credit trading platform:** On **May 13, 2022**, [asia.nikkei.com](#) reported that the **Ministry of Economy Trade and Industry (METI)** and **Japan Exchange Group** (owner and operator of the Tokyo Stock Exchange, the Osaka Exchange, and the Tokyo Commodity Exchange) are to establish the first market for carbon credit trading in Japan.

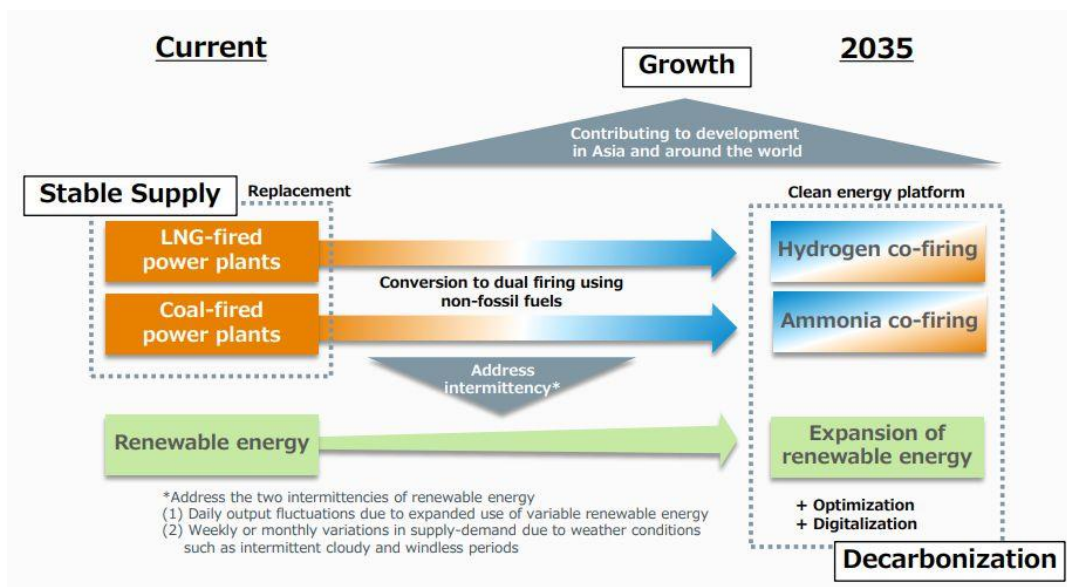
The thinking behind the establishment of the market is to provide transparency in prices and transactions. This informs the reported scheme of the trading platform: corporations wishing to participate in the market will set **GHG** emission reduction targets to be achieved by 2030, with **METI** to authenticate reductions in **GHG** emissions by the issue of carbon credits. Corporations that do not achieve their **GHG** emission reduction targets will be able to acquire carbon credits on the market to acquit their shortfall.

Also Japan has the J-Credit scheme, under which forestry and renewable energy projects are authenticated by the issue of carbon credits. Credit credits issued under the J-Credit scheme will be tradeable on the new trading platform.

It is expected that corporations working with **METI** under the aegis of the existing GX League Basic Concept (around 440 corporations) will set **GHG** emission reduction targets, and participate in the market.

As reported, the **JPX** is to set up the market in the Tokyo Stock Exchange, commencing market demonstration / pilot in September 2022, moving to full market operation at the start of fiscal year April 2023.

On **May 13, 2022**, **JERA Co., Inc.** released its updated corporate vision for 2035, including updated **GHG** reduction emission targets. The following graphic provides an overview of the key elements of the updated corporate vision:



Source: JERA

- **World Bank perspective:** During **May 24, 2022**, the **World Bank** published [State and Trends of Carbon Pricing 2022](#). The publication is excellent, and is well-worth a read.

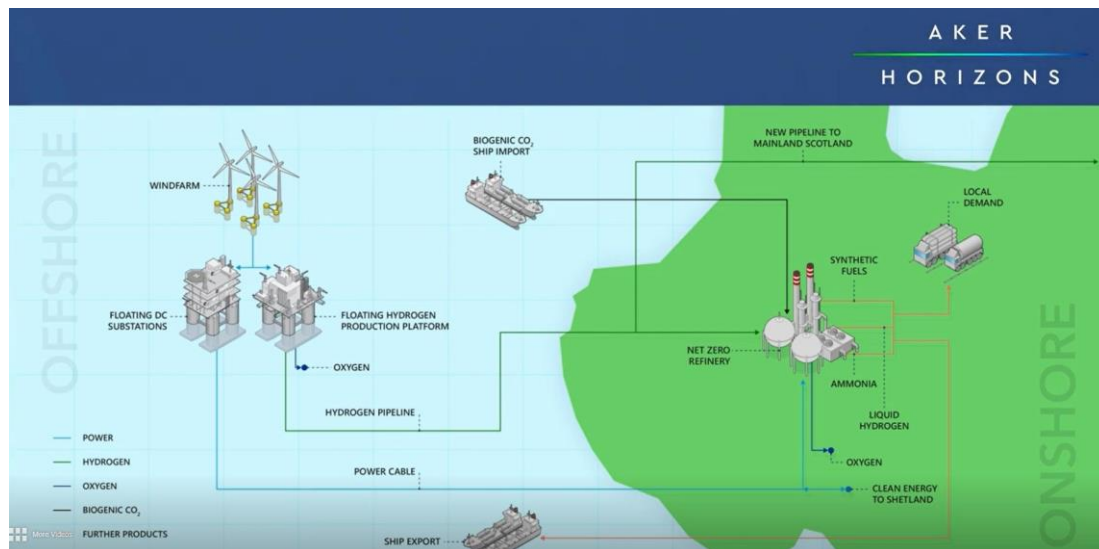
E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

This section considers news items that have arisen within the news cycle of this **Edition 40** of *Low Carbon Pulse* relating to the development of production capacity to derive and to produce **E-fuels** (energy carriers derived or produced using renewable energy) and **Future Fuels** (energy carriers derived and produced that are characterised as clean carbon or low carbon fuels). **E-fuels** include Green Hydrogen and Green Ammonia, and **Future Fuels** include Blue Hydrogen and Blue Ammonia.

- **Sunshine state to get Super Hybrid Hydro:** On **May 4, 2022**, the plans of **Sunshine Hydro** were reported widely. As reported, **Sunshine Hydro** intends to develop the "world's first **SuperHybrid** project" using **renewable energy generation capacity, energy storage capacity and Green Hydrogen production capacity** to supply renewable electrical energy **24/7, 365**, and Green Hydrogen for use within Queensland. It is understood that **Sunshine Hydro** intends to develop three **SuperHybrid** projects within the **Central Queensland Renewable Energy Zone**.
- **Jolly Green Giant:** On **May 4, 2022**, [pv-magazine-australia](#) reported (under **Plans for giant green hydrogen project in WA revealed**) on the scale of the planned **Murchison Hydrogen Renewables** project: while the **Murchison Hydrogen Renewables** project is not new, formal details as to its scale and scope are – the Green Hydrogen and Green Ammonia production facilities are to be powered by **3.7 GW** of installed photovoltaic solar and wind capacity, a **250 MW to 350 MW / 500 MWh / 700 MWh BESS, 3 GW** of electrolyser capacity, a desalination plant (producing six-gigalitres of demineralised water a year) to allow the production of up to **2,118,880 metric tonnes** of Green Hydrogen a year and up to **200** hydrogen storage vessels (each with a 680 metric tonne capacity) which together will allow the production of up to **2 million metric tonnes** of Green Ammonia a year.
- **ScottishPower and Storegga to transform highland hydrogen:** On **May 5, 2022**, **Storegga** [announced](#) that **ScottishPower** (Scotland-based energy company and subsidiary of Spanish utility firm Iberdrola) and **Storegga** (global leading carbon capture solutions corporation) had agreed to develop, to build and to operate a **series of green hydrogen production facilities** across Scotland, with the first to be located in the **Cromarty Firth** region, north of Inverness (see **Edition 25** of *Low Carbon Pulse*), producing 20 metric tonnes of Green Hydrogen a day by 2024, with the Green Hydrogen to satisfy demand from corporations, including whisky distilleries.

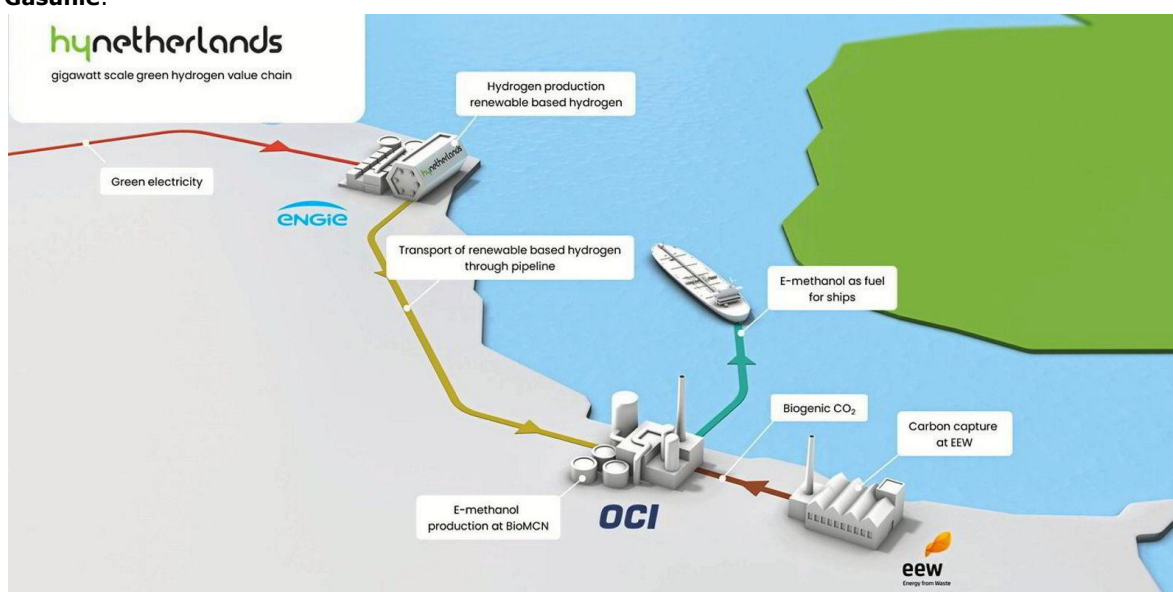
The **ScottishPower / Storegga** projects represent continued progress across Scotland in the development of hydrogen projects, including the **Scot2Ger project** (Scottish and German collaboration to look at potential of exporting green hydrogen from Scotland to Germany), the **Aberdeen Hydrogen Hub** (A BP and Aberdeen City Council joint venture starting with the delivery of a Green Hydrogen production and transport refueling facility powered by a solar farm), the **Acorn Project** (carbon capture and storage project and the development of Scotland's Hydrogen Coast funded by the UK and Scottish Governments and the **EU**), the **Cromarty Hydrogen Hub** (the initial project in the North of Scotland Hydrogen Hub), the **Flotta Hydrogen Hub** (Green Hydrogen production facility on the island of Flotta in Orkney, Scotland developed by joint venture Offshore Wind Power Limited), **Gordonbush H2 project**, the **Net Zero Hub on Stornaway**, and the **Northern Horizons project**.

A graphic from the Northern Horizons project provides an excellent representation of the anatomy of a hydrogen hub project powered by electrical energy sourced from off-shore wind fields.



- **Hydrogen pipeline:** On **May 4, 2022**, it was reported widely that **INEOS** (UK based international conglomerate) and **SGN** (British gas distribution company) intended to use a 29 km decommissioned natural gas pipeline from **Grangemouth** to **Granton** to trial the haulage of compressed hydrogen.
- **Storegga's continued progress:** On **May 16, 2022**, it was reported widely that **Storegga** had received backing from **GIC**, **Macquarie Group**, **M&G Investments**, **Mitsui** and **Snam** to continue to develop carbon capture and hydrogen projects in **Norway**, the **UK** and the **US**.
- **Cromarty Firth as Greenport:** On **May 23, 2022**, it was reported widely that **BlueFloat Energy** and **Falck Renewables** and **Ørsted** had expressed their support for the **Scottish Green Freeport** status to the **Cromarty Firth**. Scottish Green Freeport status, brings with it benefits with a package of tax reliefs, import duties exemption / holiday and other incentives like the opportunity to access seed capital funding of up to £25 million and other trade and investment support.
- **Winterhall Dea announces BlueHyNow:** On **May 5, 2022**, **Wintershall Dea** [announced](#) plans to develop a **clean / low-carbon** hydrogen production facility facilities (the **BlueHyNow Project**), at **Wilhelmshaven, Germany**. As announced, the **CO₂** arising from the **BlueHyNow Project** is to be transported for injection into sub-sea-bed storage in Denmark and Norway. For these purposes, it is assumed that the a **CO₂** liquefaction facility will need to be developed. As regular readers of Low Carbon Pulse will know, **Wilhelmshaven** is a hub for clean / low-carbon production and import, and LNG imports – see **Editions 14, 34, 36** and **37** of Low Carbon Pulse.
- **HyNetherlands Project recast:** On **May 10, 2022**, it was reported widely the **Engie** (global French energy company) intends to recast its **HyNetherlands Project** to produce **Green Methanol**, using **Green Hydrogen** (produced from **Engie's** planned **100 MW** electrolyser, using renewable electrical energy sourced from 200 MW of off-shore wind field capacity) as a feedstock to be synthesised with **CO₂** to produce low-carbon methanol in Eemshaven, the Netherlands.

The **Green Hydrogen** produced by **Engie's HyNetherlands Project** will be synthesised with **biogenic CO₂** captured from the **EEW Energy** waste-to-energy facility located at **Farmsum**, at the **OCI Delfzijl Chemical Park**. The **HyNetherlands Project** will be connected with the **OCI Delfzijl Chemical Park** via the hydrogen network developed by **Gasunie**.



Source: [Engie / OCI / EFW](#)

As reported, **Engie** intends to develop its **HyNetherlands Project** from **100 MW** of electrolyser capacity to **1.85 GW** of electrolyser capacity by 2030, with the Green Hydrogen produced capable of used both as a **Future Fuel** itself and as a feedstock for the production of other **Future Fuels**.

The recast **HyNetherlands Project** is a great example of the role of Green Hydrogen in **Future Fuels** (see sibling publication, **Future Fuels** for background) and of how hydrogen hubs and carbon clusters work.

- **Iberdrola Green Hydrogen production facility opens:** On **May 13, 2022**, it was reported widely that the King of Spain opened the **€150 million** Green Hydrogen production facility at **Puertollano, Spain**, owned by **Iberdrola** (a Spanish multinational electrical energy utility company). As reported in previous editions of Low Carbon Pulse, the Green Hydrogen produced will be used by **Fertiberia Group** (a fertilizer and ammonia and derivatives producer) to displace the natural gas currently used to produce ammonia. The Green Hydrogen production facility (powered by **100 MW** of photovoltaic solar power, and having a **20 MW BESS**) will produce **3,000** metric tonnes of Green Hydrogen a year.
- **Plug Power first 1 GW order:** On **May 17, 2022**, [h2-view.com](https://www.h2-view.com) reported that **H2 Energy Europe** (Swiss-headquartered joint venture between Singapore-based commodity trading firm Trafigura Pte Ltd. and H2 Energy Holding AG) had ordered a **1 GW** electrolyser system from Plug Power. The **1 GW** electrolyser system will be used to produce up to **100,000 metric tonnes** of Green Hydrogen a year to be used across northern Europe's transportation sector.
- **Uniper LoI with HIF:** On **May 19, 2022**, **uniper** (an international energy company) [announced](#) that it has signed a Letter of Intent (LoI) with **HIF Chile** and **HIF Global** to provide a framework to negotiate binding off-take agreements for **E-Fuels** to be produced from the production facilities at **Magallanes, Chile**. It is understood that the negotiations will extend to the sale and purchase of up to **2 million metric tonnes** of **E-Methanol** a year.
By way of reminder: **Edition 32** of Low Carbon Pulse (under **Total Eren swoops to develop H2 Magallanes**) reported that: "Total Eren (a leading renewable energy corporation part owned by TotalEnergies) plans to develop a 10 GW on-shore wind project to supply renewable electrical energy to power Green Hydrogen and Green Ammonia production facilities in the Magallanes region of southern Chile (**H2 Megallanes**): it is reported that **H2 Megallanes** will comprise a desalination facility, 8 GW of electrolyser capacity, and ammonia production facilities. First production is expected by 2027, with the expectation that **H2 Megallanes** will produce 800,000 metric tonnes of Green Hydrogen a year, and 4 million metric tonnes of Green Ammonia".
- **Iberdrola commits €3 billion Green Hydrogen:** On **May 25, 2022**, it was reported widely that at the World Economic Forum in Davos, Switzerland, **Iberdrola Chair, Mr Ignacio Galan** announced that: "*We cannot afford to miss this train and, similarly to the test of green technologies, a stable regulatory framework is required in order to attract investment*". The **EU** may be regarded as well on the way to providing a stable regulatory framework.
- **JERA to accelerate NH3 and coal co-firing:** On **May 31, 2022**, [inqprime.com](https://www.inqprime.com) reported that **JERA** and **IHI Corporation** intend to accelerate the co-firing of ammonia and coal at Unit 4 of the Hekinan Power Station, co-firing of 20% ammonia to 80% coal from the start of April 1 2023, and completing the pilot project by the end of March 2024.

By way of reminder:

- **Edition 18** of Low Carbon Pulse (under **IHI and JERA granted means to commence co-firing**) reported that: "On May 24, 2021, it was announced that **IHI** and **JERA** had received notice of acceptance of their joint grant application to undertake a demonstration project to co-fire ammonia in the generation of thermal power. It is understood that the co-firing project will commence in June 2021, and continue until March 2025, with the plan to progress to commence co-firing at **JERA's** Unit 5, Hekinan Thermal Power Station from August to December 2021. With the rate of co-firing to increase over time, so that by 2024, co-firing will be taking place at a rate of 20% Green Ammonia, 80% coal, at Unit 4, Hekinan Thermal Power Station. As is a recurring theme reflected in Low Carbon Pulse, this is another world first for Japan - the first large scale ammonia and thermal coal co-firing project. The co-firing project is consistent with the policy settings in Japan. (The grant was approved under the New Energy and Industrial Technology Development Organization's "Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation / Research, Development and Demonstration of Technologies for Ammonia Co-Firing Thermal Power Generation" program: an approval process likely shorter than the name of the program under which it was granted!)."
- **Edition 29** of Low Carbon Pulse (under **IHI and JERA co-firing**) reported that: "On October 6, 2021, it was reported widely that **IHI** and **JERA** had commenced co-firing of coal and ammonia at the Hekinan Thermal Power Station. The commencement of co-firing is part of a program (scheduled to complete in March 2025), with the objective of co-firing ammonia (20%) and coal (80%). As noted in **Edition 17** of Low Carbon Pulse, Unit 5 is being used to develop the co-firing burner, with Unit 4 to be used as the co-firing burner is scaled up."
- **Edition 36** of Low Carbon Pulse (under **JERA demand for ammonia**) reported that: "On February 18, 2022, it was reported widely that **JERA** is running a tender to procure hydrogen based ammonia as part of its plans to reduce **GHG** emissions arising from its coal-fired power generation. It is understood that the procurement is for the supply of 500,000 metric tonnes of ammonia from 2027 through to the 2040s, with around 30 prospective suppliers approached for the purposes of the tender." The tender from **JERA** is significant in providing demand that will underpin, or provide demand side support for, the development of supply side. The production of 500,000 metric tonnes of ammonia will require around 88,000 metric tonnes of hydrogen, which is then combined with nitrogen. 500,000 metric tonnes of ammonia equates to 20% of the mass of fuel to fire a 1 GW coal-fired power plant – the mass of fuel required to power Unit 4 at the Hekinan coal-fired power station."

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the development of:

- areas in which: **1. infrastructure** will be developed and deployed to support the development and deployment of hydrogen production capacity and use (**Hydrogen Hubs**), the capture of carbon dioxide, and the consolidation of captured carbon dioxide for storage or use or both (**Carbon Clusters**); and **2. technologies** facilitating energy transition will be concentrated and supported (**Hydrogen Corridors and Valleys**); and
- **giga-factories** that fabricate and manufacture photovoltaic solar panels (and associated equipment), wind-turbine blades and towers (and associated equipment), electrolyzers (and associated equipment), electric batteries and hydrogen fuel cells, and transmission cabling (including HVDC transmission cabling).

Also the section considers developments in cities to decarbonise (including using waste heat), and to cool, cities. The development of infrastructure at ports and installation and support vessels for off-shore wind developments are considered in the **Ports Progress and Shipping Forecast** section of each edition.

- **Panasonic Corporation progresses: Edition 18** of Low Carbon Pulse reported as follows:

"Panasonic announces global circuit developer: On May 24, 2021, Panasonic Corporation announced the development of the world's first **"RE100" (Renewable Energy 100%)** factory to be located at Kusatsu, Shiga Prefecture.

The **Panasonic RE 100** factory will be powered using hydrogen fuel cells and photovoltaic solar panels, and **BESS**, to provide 100% renewable energy at all times from within an "in-house" renewable electrical energy system to allow all activities at the factory to be undertaken without the use of any non-renewable energy source".

On **May 3, 2022**, fuelcellsworks.com reported that **Panasonic** had commenced operation of the factory located at Kusatsu, Shiga Prefecture, with the power system combining a hydrogen production facility and fuel-cell technology, photovoltaic solar, lithium-ion batteries.

- **Sila next-gen anode giga-factory:** On **May 3, 2022**, **Sila** [announced](http://silanano.com) (at silanano.com) that it had acquired 600,000 ft² at Moses Lake, in Washington State, within which to house its lithium-ion anode manufacturing capacity for the use in electric battery electric vehicles. The manufacturing capacity of the facility will be up to **10 GWh** of cells when used as a full-graphite replacement, and up to **50 GWh** when used as a partial replacement.

- **John Cockerill roosts globally: Edition 39** of Low Carbon Pulse reported that: "The **John Cockerill Group** (leading electrolyser technology corporation) was to develop a **2 GW** electrolyser giga-factory in India in conjunction with a subsidiary of **Greenko Group** (a leading renewable energy corporation). The **John Cockerill Group** manufactures pressurised alkaline electrolyzers."

On **May 4, 2022**, rechargenews.com reported that by 2025 **John Cockerill Group (JCG)** intends to increase its annual production of pressurised alkaline electrolyzers to **8 GW** with new giga-factories to be developed in Europe (**2 GW**), India (**2 GW**), the Middle East (**1 GW**), and the **PRC (2 GW)**, with the location of the **eighth GW** yet to be confirmed. **JCG** and **Nel ASA** both have significant plans to expand manufacturing capacity.

- **Sodium-ion manufacturing capacity development:** On **May 10, 2022**, energy-storage reported on the plans of **Altris** and **Natron Energy** to develop new manufacturing facilities.

- **Altris** (sodium-based cathode technology corporation, backed by **Northvolt**) has announced an agreement with Sandvik Materials Technology to co-locate its first manufacturing facility at a Sandvik factory in **Sandviken, Sweden**, called the **Ferrum facility**. The **Ferrum facility** will produce **2,000 metric tonnes** of cathode material (Ferric) a year, enabling **1 GWh** of sodium-ion battery production.

- **Natron Energy** (sodium-ion battery manufacturer) has announced the development of a **sodium-ion battery manufacturing plant** in **Meadowbank, Michigan**. As reported, **Natron Energy** batteries are used primarily for critical power applications (including data centres and telecommunications networks), with the intention to achieve broader application of them, including for EVs and grid-scale **BESS**. A number of commentators are suggesting that there will be lithium and cobalt and nickel gaps, and the sodium-ion batteries are regarded one of the most promising options.

Consistent with other publications referenced in this **Edition 40** of Low Carbon Pulse, the following table provides an indication of the metal and mineral content of different batteries.

HOW BATTERY CHEMISTRIES DIFFER, BY MINERAL CONTENT FOR A 60KWH LITHIUM-ION BATTERY

The name of the battery chemistry typically indicates the composition of the cathode.

	NMC811 Nickel (80%) Manganese (10%) Cobalt (10%)	NMC523 Nickel (50%) Manganese (20%) Cobalt (30%)	NMC622 Nickel (60%) Manganese (20%) Cobalt (20%)	NCA+ Nickel Cobalt Aluminum Oxide	LFP Lithium iron phosphate
LITHIUM	5KG	7KG	6KG	6KG	6KG
COBALT	5KG	11KG	11KG	2KG	0KG
NICKEL	39KG	28KG	32KG	43KG	0KG
MANGANESE	5KG	16KG	10KG	0KG	0KG
GRAPHITE	45KG	53KG	50KG	44KG	66KG
ALUMINUM	30KG	35KG	33KG	30KG	44KG
COPPER	20KG	20KG	19KG	17KG	26KG
STEEL	20KG	20KG	19KG	17KG	26KG
IRON	0KG	0KG	0KG	0KG	41KG

ELEMENTS

Source: Elements

- **Hanwha Q Cells plans US Giga-factory:** On **May 12, 2022**, [pv-magazine.com](https://www.pv-magazine.com) reported that **Hanwha Q Cells** has announced plans to develop a **1.4 GW photovoltaic** cell panel factory in the US. Also it was reported that **Hanwha Q Cells** intends to expand its photovoltaic cell capacity in the **ROK** to **5.4 GW**.
- **Corfo of Chile contracts for development of industry scale electrolyser production in Chile:** On **May 26, 2022**, h2-view.com reported that the **Production Development Corporation (Corfo)** of Chile had selected **three projects** to manufacture electrolysis capacity of 388 MW. **Corfo** signed three agreements, with **GNL Quintero, CAP SA**, and **Air Liquide**.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the extraction of metals and minerals necessary for the decarbonisation of activities to progress towards achievement of **NZE**, the use of **E-fuels** and **Future Fuels** to power and to propel vehicles used to extract and to transport metals and minerals, and the use of E-fuels and Future Fuels to process and to treat those metals and minerals. Also this section considers the Difficult to Decarbonise industries, including the iron and steel sector.*

- **Green Steel in Canada:** On **May 2, 2022**, it was reported widely that **ArcelorMittal SA** had tested successfully the use of Green Hydrogen to reduce iron ore at its facilities in Contrecoeur, Quebec, Canada: as reported, Green Hydrogen was used to displace around 7% of the mass of natural gas ordinarily used.

By way of reminder: The **iron and steel industry** is **carbon intensive** (responsible for between 7 and 10% of direct **GHG** emissions globally). Article 2 in the Shift to Hydrogen (**S2H2**): Elemental Change series (sibling publication to Low Carbon Pulse) noted that: "The production of steel may be regarded as giving rise to between 7 and 10% of global **GHG** emission or between 3,500 and 5,000 mmt (or 3.5 to 5 billion tonnes) of **GHG** emissions a year [Note: This does not include the **GHG** emissions arising to extract, transport to iron ore to mill, and from mill to point of use]. Global crude steel production is around 1,900 mmt (1.9 billion tonnes) a year. The best estimate is that between 1.9 and 2.1 tonnes of CO₂ emissions arise in respect of each tonne of steel produced ... On metrics discernible consistently, it is estimated that a little over 3,500 mmt (3.5 billion tonnes) of CO₂ emissions arise each year from steel production. The **EU** has this higher at close to 4,000 mmt (4 billion tonnes)."

Blast furnace technology using metallurgical coal (coking coal) "to melt" iron ore (producing "pig iron") and to remove oxygen. As might be expected, **CO₂** emissions arise as a result. **Direct-reduced iron** technology uses natural gas to remove oxygen and to produce sponge iron (in the form of iron ore pellets), then melted in an electric arc furnace (**EAF**).

The use of Green Hydrogen for these purposes has been championed and led by **LKAB, SSAB** and **Vattenfall** using **HyBRIT (Hydrogen Breakthrough Ironing Making Technology)** developed jointly by them: **Edition 10** of Low Carbon Pulse reported that: "On June 21, 2021 it was announced that **HYBRIT** had completed the first production test of sponge iron (or direct reduction iron (DRI) using hydrogen instead of coking coal to remove oxygen thereby avoiding the **CO₂** arising". **Edition 25** of Low Carbon Pulse reported that (under **HYBRIT's Clean Steel on the road**) delivered the "first fossil-free steel in the world" to Volvo Group from the **HYBRIT** mill, using **HYBRIT** technology. And that on September 1, 2021, **SSAB** announced that it is to partner with Daimler's Mercedes-Benz to introduce fossil-free steel to the production of vehicles.

As reported in previous editions of Low Carbon Pulse, **ArcelorMittal SA** has announced plans to invest around USD 6.5 billion in four **Direct-reduced iron** plants (in Belgium, Canada, France and Spain).

By way of a further reminder: **Edition 37** of Low Carbon Pulse reported that the **Green Steel Tracker** had been released. The **Green Steel Tracker** has been developed by the Stockholm Environment Institute and the Leadit Secretariat. A link to the internet site with the **Green Steel Tracker** is included [here](#). The **Green Steel Tracker** is a helpful tool for those wishing to follow green iron and steel projects globally.

- **Anglo American – nuGen™:** On **May 6, 2022**, **Anglo American** (global mining giant) [introduced](#) its **nuGen™ Solution – Anglo American's Zero Emission Haulage Solution** or **ZEHS** for short ("**A solution so ambitious, it didn't exist. So we made it from scratch**".) The **nuGen™ Solution** is part of the Anglo American Our FutureSmart Mining™ programme.

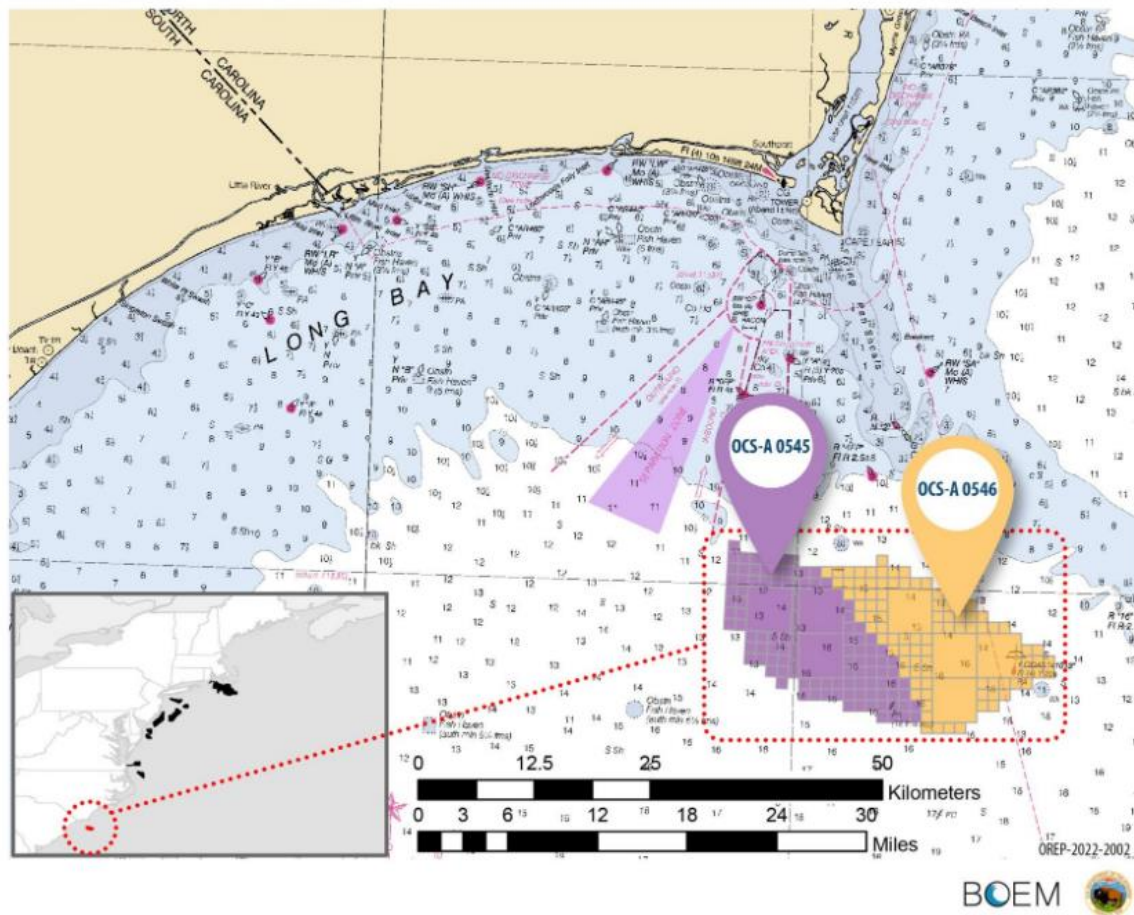
The pilot for the **nuGen™ Zero Emission Haulage Solution** is a hydrogen powered and propelled ultra-class mine haul truck: the truck is 220 tonnes, with a load capacity of 290 tonnes (with a total laden weight of 510 tonnes). The truck will be converted to hybrid power and propulsion using fuel cell and battery electric technology. The hydrogen will be produced at mine-site.

Wind round-up, on-shore and off-shore:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the development of wind power generation capacity, on-shore and off-shore (fixed bottom and floating).*

- **Colombia Off-shore Wind Roadmap:** On **May 3, 2022**, the **President of Colombia, Ivan Duque**, and the **Minister of Mining and Energy, Diego Mesa**, presented the Colombian [Offshore Wind Energy Roadmap \(OWER\)](#). The **OWER** outlines the potential for off-shore wind field capacity - **50 GW** of installed capacity over **12,000 km²**, with **27 GW** more suited to **fixed-bottom** installation, and **21 GW** more suited to **floating**.
- **Update on ROK offshore wind field (OWF) development:** On **May 3, 2022**, a map was published by epj-co-kr.cdn providing a helpful snapshot of the current contemplated development of OWF. This link will give a sense of the level of activity in and around the **ROK**.
- **US Bureau of Ocean Energy Management (BOEM) busy:**
 - **All cool:** On **May 6, 2022**, it was reported widely that the **BOEM** had completed its review of potential impacts from the development of **OWFs** in the Humboldt Wind Energy Area (**WEA**), off-shore the US State of California, the **BOEM** reporting a finding of no significant impact (**FONSI**). As reported, the **WEA** has the potential for the installation of up to **1.6 GW** of **OWF** capacity. The **WEA** is off-shore of Eureka and Arcata, locations near and dear to the heart of the author (who is writing a novel based on Eureka and its surrounds);

- **All go, go, go:** On **May 11, 2022**, the **BOEM** held a lease auction offering two lease areas located in US Federal Waters off-shore of **North Carolina** and **South Carolina**.
The two lease areas (in the Wilmington East Area (**WEA**)) are located in the **Carolina Long Bay** (covering 110,000 acres) with potential to install up to **1.3 GW** of off-shore wind fields capacity across them. The lease areas are **OCS-A 545** and **OCS-A 0546**.



Source: Bureau of Ocean Energy Management

PRE-QUALIFIED BIDDERS			
547 Energy	Arevia Power	Avangrid Renewables	BP US Offshore Wind Energy
Carolina Offshore Wind	Duke Energy Renewables Wind	EDF Renewables Development	Invenergy Long Bay Offshore
Jera Renewables NA	Masdar Offshore Wind Americas	MRP Offshore Wind Farm	Ørsted North America
Ocean Winds NA Ventures	RWE Offshore Wind Holidays	Shell New Energies	TotalEnergies Renewables USA

On **May 11, 2022**, it was announced that lease area:

- **OCS-A 0545** had been awarded to **TotalEnergies Renewables USA**, with a bid of **USD 160** million; and
- **OCS-A 0546** had been awarded to **Duke Energy Renewables Wind** with a bid of **USD 150** million.

The auction process for **Carolina Long Bay** included a 20% credit mechanism for bidders that committed to initiatives and programs supporting capacity development in the off-shore wind industry, i.e., for training and for supply chain development.

The lease auction was the second of 2022, the first being the New York Bight auction process (see **Editions 29, 33** and **36** of Low Carbon Pulse). As was expected, the bids for **OCS-A 545** and **OCS-A 0546** did not reach the levels for the New York Bight auction process.

- **Norway to achieve 30 by 40:** On **May 11, 2022**, the **Government of Norway** outlined its plans to promote the development of off-shore wind field capacity so as to develop **30 GW** of capacity by **2040 (30 by 40)**. The scale of the development is best illustrated by reference to the number of wind turbines currently installed and to be installed as noted by **Norwegian Prime Minister, Mr Jonas Gahr Støre**:

"With this ambition we go from the two off-shore wind turbines that are in operation today to about 1,500 off-shore wind turbines".

Previous editions of Low Carbon Pulse have reported in earlier planned development and mapping of possible off-shore areas suitable for fixed-bottom and floating wind-turbine installations (see **Editions 18, 20** and **35** of Low Carbon Pulse).

- **California 3 by 2030, 15 by 2045 and 20 GW by 50:** On **May 11, 2022**, the **California Energy Commission (CEC)** outlined plans to allow the development of floating off-shore wind field capacity **3 GW by 2030, 15 GW by 2045, and 20 by 2050**.
- **Thor hammering along:** On **May 11, 2022**, it was reported widely the **Danish Energy Agency (DEA)** issued a feasibility study permit allowing progress of the **Thor Project**.

By way of reminder:

- **Edition 32** of Low Carbon Pulse (under **Luck of the Thor**) reported that: "On December 1, 2021, the successful tenderer would be determined by the drawing of lots, with the successful tenderer to develop the 1 GW Thor off-shore wind field. On December 1, 2021, the Danish Ministry of Climate, Energy and Utilities and the Danish Energy Agency announced that Thor Wind Farm I/S (owned by RWE AG, RWE Renewables GmbH, and RWE Renewables Management UK Limited) was the successful tenderer. On December 8, 2021, [S&P Global Platts](#) provided a perspective of the competitive nature of some off-shore wind field projects".
- **Edition 34** of Low Carbon Pulse (**Thor'sday on a Tuesday**) reported that: "**RWE**, announced that it had signed the concession agreement with the Danish Government for the Thor off-shore wind field (**TOSW**) project awarded to **RWE** on the drawing of lots on December 1, 2022".
- **Petrobras and Equinor eye 4 GW development:** On **May 18, 2022**, [offshorewind.biz](#) reported that **Petrobras** (the national oil company of Brazil) and **Equinor** (leading international renewable energy corporation) were considering the feasibility of the development of a **4 GW** off-shore wind field. **Petrobras** and **Equinor** have been working together on the **Aracatu OWF** project since signing a memorandum of understanding in 2018.
- **Hollandse Kust West Site bids close:** **Edition 37** of Low Carbon Pulse reported as follows:

"Regulations issued: On **March 10, 2022**, [offshorewind.biz](#) reported that the Ministry of Economic Affairs and Climate Policy had issued regulations detailing rules for the upcoming licensing of Hollandse Kust (west) Wind Farm Zone, which comprises Hollandse Kust (west) VI and Hollandse Kust (west) VII in the Dutch sector of the North Sea. The licence areas are located 53 kms off the west coast of the Netherlands.

The auction for the two licenses open on April 12, 2022 and will close on May 12, 2022."

As the close date for the auction approached, there was considerable coverage of the fact that the criteria for the assessment of bids for Hollandse Kust (west) VI and Hollandse Kust (west) VII were different, in particular for:

- Hollandse Kust (west) VI the criteria are reported as requiring bidders to consider and to address the impact of ecosystems in the North Sea (with a reported 50% weighting in respect of these criteria); and
- Hollandse Kust (west) VII the criteria are reported as requiring bidders to consider and to address the integration on the renewable electrical energy generated (and related infrastructure) into the energy system in the Netherlands (again with a reported 50% weighting in respect of these criteria).

At the risk of missing those that bid in the process (and apologies in advance if anyone is missed), from news reports the following bidders have been reported: **BASF** and **Vattenfall** are reported to have bid jointly in respect of Hollandse Kust (west) VI, and **Vattenfall** is reported to have bid on Hollandse Kust (west) VII; **bp** is reported to have bid for both Hollandse Kust (west) VI and Hollandse Kust (west) VII; **Brookfield** and **SSE Renewables** are reported to have bid for Hollandse Kust (west) VII; **Eneco** and **Shell** are reported to have bid for both Hollandse Kust (west) VI and Hollandse Kust (west) VII; **Ocean Winds** (the **EPD Renewables** and **Engie** 50:50 joint venture) is reported to have bid for Hollandse Kust (west) VI; **Ørsted** and **TotalEnergies** are reported to have bid jointly for both Hollandse Kust (west) VI and Hollandse Kust (west) VII; and **RWE** is reported to have submitted bids for both Hollandse Kust (west) VI and Hollandse Kust (west) VII.

- **Noatun Nord and Noatun Syd:** On **May 20, 2022**, it was reported by [offshorewind.biz](#) that **OX2** (leading off-shore wind field developer) and **Ålandsbanken Fondbolag Ab** (an investment management firm) had agreed to progress to develop multi-giga-watt off-shore wind field projects, **Noatun Nord** and **Syd**, off of the **Åland Islands** in the **Baltic Sea**. Both OWF projects are at early development phase.

By way of reminder:

- **Edition 36** of Low Carbon Pulse (under **OX2 given legs offshore shore**) reported that: "OX2 had applied for a Natura 2000 permit to develop the 1.8 GW Triton off-shore wind field, located within the economic zone off the coast of Skåne, Sweden, and that OX2 had been granted exploration permits for two off-shore wind fields in the Gulf of Bothnia Exclusive Economic Zone (EEZ): the permits were granted at a plenary session of the Finnish Government, and are in respect the Halla project (approximately 35 km off-shore the city of Raahel) and Laine project (approximately 30 km off-shore of the adjacent cities of Kokkola and Pietarsaari)".
- **Edition 37** of Low Carbon Pulse (under **Continued activity for OX2 in the Baltic Sea**) reported that: "OX2 had applied for a Natura 2000 permit to develop the 5.5 GW Aurora off-shore wind field, located 20 kilometres south of Gotland and 30 kilometres east of Öland, within the Swedish Baltic Sea Exclusive Economic Zone. The application by OX2 marks its continued progress, with three major off-shore wind field developments at various stages of development / progress".
- **BlueFloat Energy and Falck Renewables floating off-shore Sardinia:** On **May 20, 2022**, [rechargenews.com](#) reported that **BlueFloat** (leading off-shore wind developer) and **Falck Renewables** (leading Italian renewable energy developer) planned to develop **975 MW** of off-shore wind capacity, off the northeast coast of **Sardinia, Italy**, the **Tibula Energia**.

As reported an application for a maritime concession was made on May 6, 2022, with approval sought for up to 62 floating wind turbines with an annual generation capacity of up to **3.4 TWh**. For the projects to proceed, among other things, a maritime concessions must be granted by the Ministero delle Infrastrutture.

(Editions [28](#), [29](#), [30](#) and [31](#) of Low Carbon Pulse have tracked progress to date in the development of off-shore wind field projects in Italian waters.)

By way of reminder:

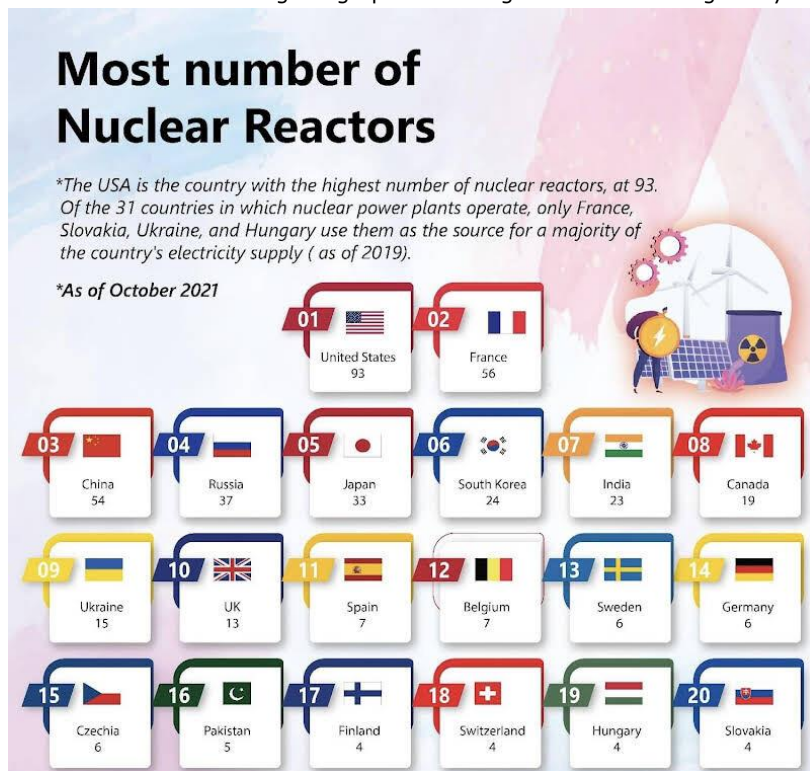
BlueFloat and **Falck Renewables** have been working together in the OWF sector offshore Italy for coming up to 12 months:

- **Edition 28** reported that **BlueFloat Energy** and **Falck Renewables** had announced that they have entered into a 50:50 joint venture for the purposes of developing off-shore wind field (**OWF**) projects off the coast of Italy
- **Edition 37** reported that **BlueFloat Energy** and **Falck Renewables** had been granted a 40 year maritime concession to allow the development of the **1.35 GW Orda Energia** floating off-shore wind field project (**Orda Energia OWP**). The **Orda Energia OWP** is to comprise 90 turbines located in waters with depths of 100 to 200 metres.
- **Current projects progressing:** By the reckoning of the author, **BlueFloat** and **Falck Renewables** are progressing four other OWF projects : the **675 MW Minervia Energia** project in the **Gulf of Squillace**, **1.4 GW Nora Energia 1** and **2** wind fields in **Gulf of Cagliari** and **1.2 GW Kailia Energia** off Brindisi.

Solar and Sustainability (including NZE Waste):

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the development of solar power generation capacity, on-shore (photovoltaic and concentrated) and floating. Also this section covers news items relating to the development of facilities and technologies to process and to recycle **NZE Waste**. Also this section considers the treatment of residual **NZE Waste**.*

- **Superstores can match half load with roof-top solar:** On **May 2, 2022**, a report (entitled [Solar on Superstores: Big roofs, big potential for renewable energy](#)) from Environment America Research & Policy Center and Frontier Group came to the attention of the author of Low Carbon Pulse. The report estimates that retail superstores across the US had sufficient area of useable roof space to install photovoltaic solar arrays to generate **50% of their electrical energy load**. The report is based on data compiled by the **National Renewable Energy Laboratory (NREL)**. **NREL** estimates that around **2/3rds** of the roof space on large buildings across the US is suitable for the installation of photovoltaic solar arrays.
- **Nuclear reactors:** There is increased activity in the development and proposed development of nuclear reactors, both to replace aging reactors and to decarbonise the generation of electrical energy. On **May 3, 2022**, the author of Low Carbon Pulse came across the following infographic detailing nuclear reactors globally.



Source: Power System Operation's LinkedIn

In passing, it is noted that Germany, Spain and Switzerland have announced that they intend to phase-out the use of nuclear reactors.

On **April 29, 2022**, [nei.org](#) published ([Nuclear Needs Small Amounts of Land to Deliver Big Amounts of Electricity](#)). The facts and stats (which in broad terms align with the understanding of the author of Low Carbon Pulse) are that for an equivalent amount of electrical energy, nuclear power plants take 31 times less land than photovoltaic solar, and 173 times less than on-shore wind farms. In addition, nuclear plants can be located anywhere, whereas photovoltaic solar and on-shore wind farms have to be located in areas of renewable resources. While these facts and stats are not an argument of nuclear power, they are worth understanding.

- **Solar Juice and Sungrow position for C&I and residential renewable electrical energy equipment market:** On **May 7, 2022**, as reported in pv-magazine-australia.com, **Solar Juice** (Australian wholesale solar distributor) and **Sungrow** (Chinese power inverter manufacturer) signed a long-term distribution contract in respect of up to **2 GW** of capacity. The long-term distribution contract reflects the confidence in the continued growth of the C&I and residential market for photovoltaic solar capacity.

- **Increasing focus on waste as a resource:** On **May 8, 2022**, the **BBC** published an [article](#) entitled **Mine e-waste, not the Earth, say scientists**. The article is worth a read. In the context of the progress that needs to be made to reduce **GHG** emissions to progress to **NZE**, it is critical that all sources of resources are "mined".

In addition to the elements identified in previous editions of Low Carbon Pulse (including aluminium, cobalt, copper and gold, lithium, manganese, and nickel, the price of each commodity having reached record levels in recent times), **e-waste** contains elements, some of which are in increasingly short supply, including arsenic, gallium, indium, tantalum and yttrium.

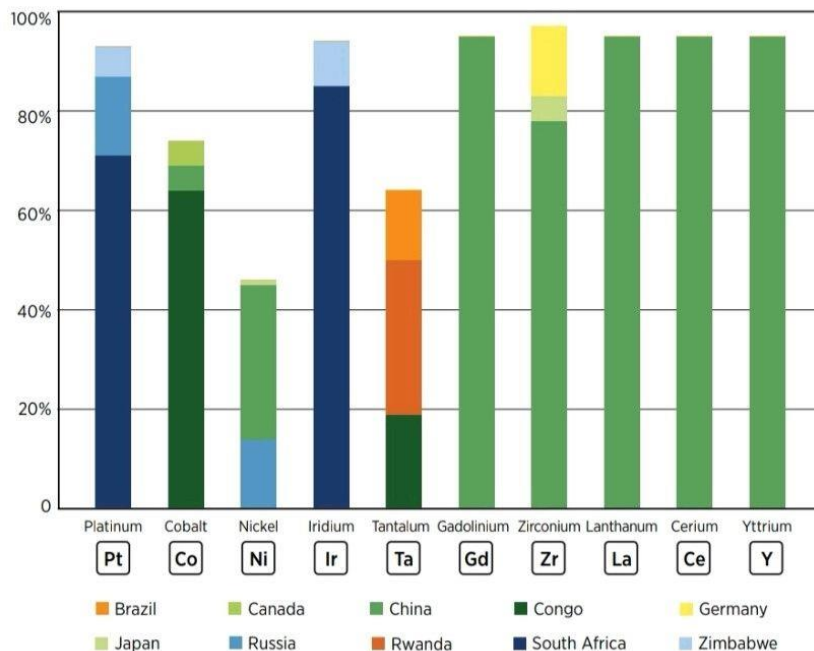
This will be the subject of a standalone article from the author of Low Carbon Pulse in coming months (title **NZE Waste and Recovery**). In the interim, it is clear that policy settings are needed to allow collection and consolidation of **e-waste** to allow the elements within in to be recovered and recycled. The role of government is central, including because overtime electrical goods from which **e-waste** arises will be manufactured in more sustainable ways, and the mass of **e-waste** may decline.

By way of reminder: There are **17 rare earth elements (REE)**, sometimes referred to a **rare earth metals** or **rare earth oxides**, including the following **REE** which are key for the purposes of energy transition: cerium, dysprosium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, scandium, terbium, and yttrium.

In passing, the value of recycling of metals and minerals appears to gathering momentum: on **May, 11, 2022**, it was reported widely that **Glencore AG** (global metals and minerals giant) had agreed to provide **USD 200** million of funding to **Li-Cycle** (leading Canadian battery recycling corporation), under which **Glencore** will have access to the lithium recovered by **Li-Cycle**, and **Glencore** will provide reagents used in the recovery of metals and minerals. More of **L-Cycle** shortly.

LANTHANIDE REES								
Light REE	cerium	Europium	gadolinium	lanthanum	neodymium	praseodymium	promethium	samarium
Heavy REE	dysprosium	Erbium	holmium	lutetium	terbium	thulium	ytterbium	
NON – LANTHANIDE REES								
Scandium					Yttrium			

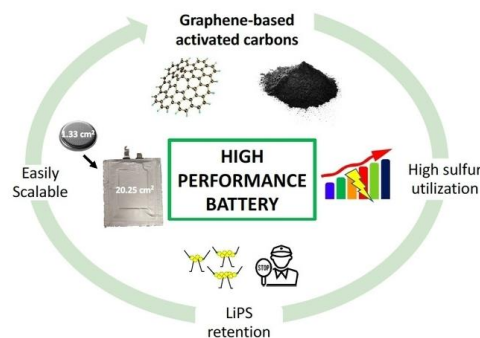
The **International Energy Agency (IEA)** has been highlighting the need for sufficient supply of metals and minerals necessary for progress towards to **NZE (critical minerals)** in the lingua franca of the **IEA**, and in **March 2022** the **IEA** determined to deepen its work on **critical minerals**. The **IEA** has released the following bar chart indicating the scale of price increases across some **critical minerals**.



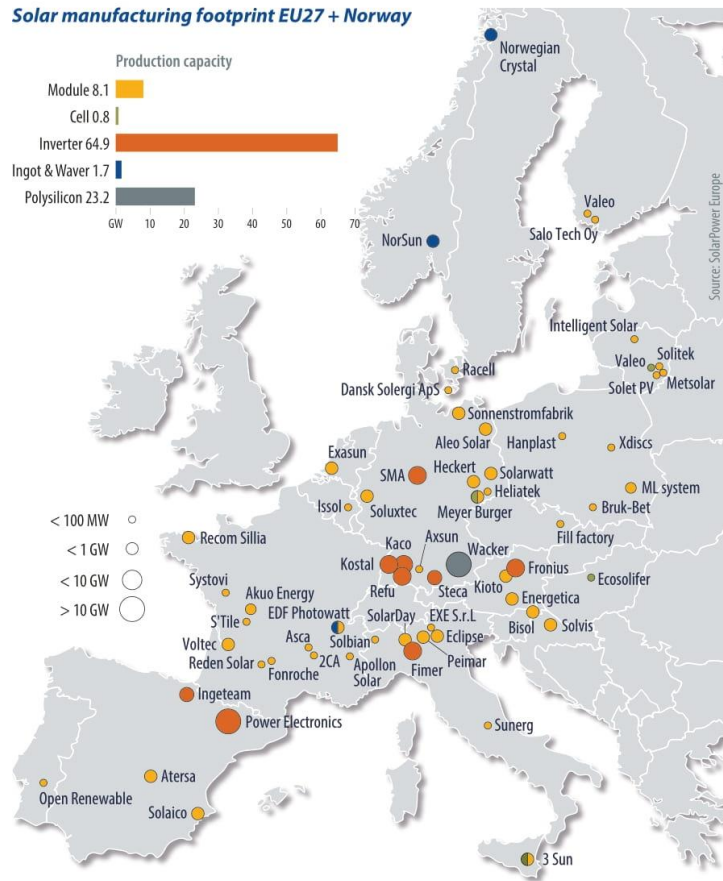
Source: International Renewable Energy Agency (IRENA)

The standalone article, **NZE Waste and Recovery**, will cover the mass of **NZE Waste** arising globally, and the recovery of inorganic materials from it, critically, **critical minerals** and **REES**.

- **Westinghouse to house pumped-storage:** On **May 9, 2022**, [energy-storage](#) reported that on **May 5, 2022**, **Westinghouse Electric Company** (US head-quartered power corporation) had signed a memorandum of understanding with **Bulgarian Energy Holding** to develop **two pumped thermal energy storage (PTES)** units. It is understood that the Westinghouse **PTES** technology allows dispatch over 10 hours (or more), and has a design-life of 50 years. The **PTES** units provide Long-Duration Energy Storage (**LDDES**), which will assist in providing grid system integrity and stability in Bulgaria. As reported, **Westinghouse** has partnered with **Echogen Power Systems** (a waste-heat recovery and electro-thermal energy storage technology corporation).
- **BP stake in Asian Renewable Energy Hub (AREH):** On **May 9, 2022**, it was reported widely that **BP** (leading international energy corporation) intended to invest in **AREH** (see [Editions 2, 18, 20 and 37](#) of Low Carbon Pulse). This may be regarded as providing a clear pathway for Green Hydrogen and Green Ammonia projects, with an international energy corporation providing a cornerstone investment, and the ability to contract for off-take.
- **Portugal First Floater:** On **May 10, 2022**, [Reuters reported](#) that on **May 9, 2022**, two tugboats moved an array of **12,000 (5 MW)** photovoltaic solar panels to their mooring on the **Alqueva** reservoir, ahead of the start-up of what will be Europe's largest floating photovoltaic (**FPV**) solar park in July 2022. The floating photovoltaic solar park has been developed by **EDP**. While the floating photovoltaic solar park may be regarded as having relatively low electrical energy generation capacity, the cost and ease of development is likely to mean that it will form a model of increased use of floating photovoltaic solar.
- **DNV on FPV:** On **May 13, 2021**, [pv-magazine.com](#) reported that **DNV** (Norwegian classification society) is developing recommended practices (**RPs**) for the design, development and operation of **FPV** arrays.
- **Richer at PORA:** On **May 13, 2022**, the **Port of Rotterdam Authority (PORA)** reported the development of the first **e-waste and battery waste recycling plant** in the Netherlands. As noted above, batteries use the metals and minerals cobalt, lithium and nickel, each of which is increasingly valuable. The **PORA** is in the vanguard, indeed is the frontrunner, of ports globally, in embracing all facets of progress required to decarbonise activities to reduce **GHG** emissions to achieve progress towards achievement of **NZE**. The **NZE Waste** recycling plant is being developed by **TES** (Singapore based e-waste recycling company).
- **Northvolt recycling voltage:** On **May 15, 2022**, **Northvolt** (Swedish battery developer for electric vehicles) [announced](#) and **Norsk Hydro** [announced](#) that the **Hydrovolt AS** (a joint venture between **Northvolt** and **Norsk Hydro**) recycling plant, located in **Fredrikstad, Norway**, had commenced operation. The fully automated **Hydrovolt** recycling plant has capacity sufficient to recycle the entire end-of-life battery pack market in Norway, i.e., **12,000 metric tonnes of battery packs** from BEVs annually (around 25,000 battery packs) recovering up to **95%** of the materials comprising each battery pack. It is to be expected that **Hydrovolt** will expand to recycle end-of-life battery packs across Europe.
- **ACE Green Recycling plant:** On **May 16, 2022**, [pv-magazine.com](#) reported that **ACE Green Recycling** (US based recycling technology company) plans to develop a lithium-ion and lead-acid battery recycling plant in Texas. As reported, the recycling plant will be able to recycle up to **100,000 metric tonnes of lead-acid** batteries, and up to **20,000 metric tonnes of lithium-ion** batteries, annually.
- **Li-cycle Corporation (Li-cycle) third spoke turning:** On **May 17, 2022**, it was reported widely that **Li-cycle** (leading lithium-ion battery recovery and recycling corporation) had commenced commercial operation at its recovery and recycling plant in **Gilbert, Arizona (Arizona Spoke Facility)**. The **Arizona Spoke Facility** recovers metals and mineral from full battery packs from **BEVs**, having capacity to recover up to **30,000 metric tonnes** annually. **Li-cycle** anticipates that it will have capacity to recycle up to **65,000 metric tonnes** of battery packs in Europe and North America by the end of 2023.
- **Second life and recycling: Edition 39** of Low Carbon Pulse reported on the **CIC energiGUNE** map-graphic (entitled [Second Life and Recycling – Companies in Europe](#)) providing a snap shot of the battery recycling plants across Europe and the UK. The recycling of all forms of **NZE Waste** is critical: in a future standalone article dedicated to **NZE Waste**, the author of Low Carbon Pulse will provide an in depth analysis of each form of **NZE Waste** arising currently, and as estimated. As a forerunner of the article on **NZE Waste**, it is worth reflecting that **by 2050** it is estimated that from **lithium-ion** batteries up to **2.5 million metric tonnes of NZE Waste** may arise a year, from **wind-turbines** up to **45 million metric tonnes of NZE Waste**, and from **photovoltaic solar panels** up to **80 million metric tonnes**.
- **Xlinks progresses:** On **May 20, 2022**, it was reported widely that **Xlinks** plans to proceed to develop the Morocco to UK sub-sea **HVDC** renewable electrical energy project. [Editions 16 and 28](#) of Low Carbon Pulse reported on Xlinks.
- **CIC energiGUNE paper on Graphene-based Activated Carbon Composites for High Performance:** On **May 31, 2022**, the good folk at **CIC energiGUNE** published an excellent [article](#) on graphene based activated carbon composites. The following graphic provides an overview of the key messages from the article.

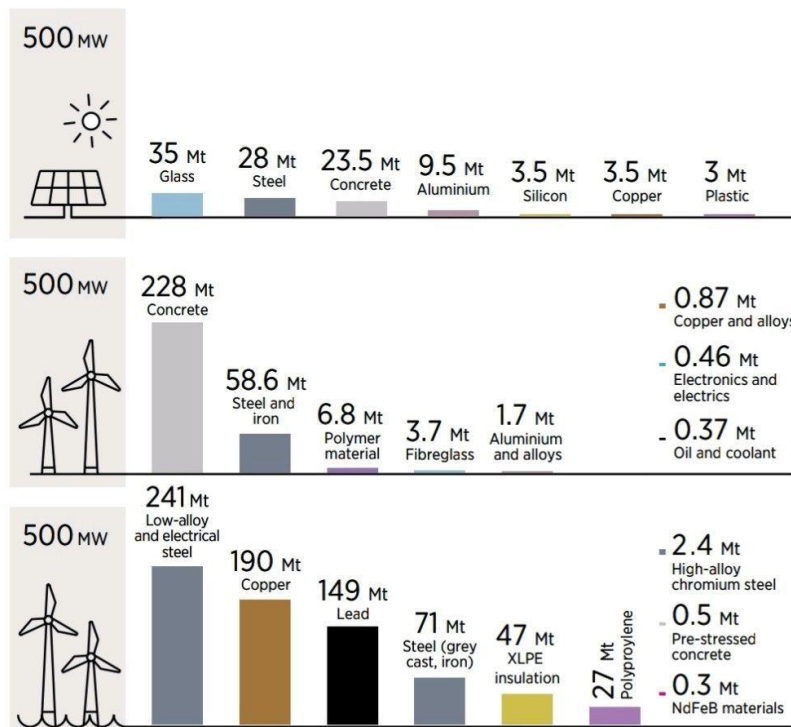


- **European photovoltaic solar manufacturing capacity:** On **May 25, 2022**, the following info-graphic-map from [pv-magazine](#) provided a snap-shot of the current photovoltaic solar manufacturing capacity across Europe.



Source: SolarPower Europe

- **Insight to what is in sight:** The following infographic provides a sense of the materials required to manufacture photovoltaic solar and wind renewable power generation capacity. For those in the recycling industry, and for all, the need for recycling capacity is upon us. As noted above, a future standalone article from the author of Low Carbon Pulse will consider all aspects of the recycling industry.



- **MENA Climate Week: Edition 37** of Low Carbon Pulse reported that: "From **March 28** to **March 31**, 2022, the first-ever Middle East and North Africa Climate Week (**MENACW**) conference took place in Dubai, United Arab Emirates, under the auspices of the UNFCCC.

On **March 31, 2022**, the UN released the following [press release](#) (titled [MENACW Galvanises Regional Momentum for COP-27](#)). At the half way point between **COP-26** and **COP-27**, **MENACW** is reported to have built on one (held in Glasgow, Scotland), and prepared for the next (to be held in Sharm El Sheikh, South Sinai, Egypt).

In the context of **COP-27**, the Foreign Minister of Egypt, and incoming **COP-27** President, Mr Sameh Shoukry said:

"Holding the Climate Week for the first time in the Arab region has been clear evidence of the priority that the countries in the region give to international climate action and ways to combat the negative effects of a phenomenon that has seen its repercussions and impacts extend to multiple aspects of life in our countries. Egypt seeks to make the twenty-seventh session of the United Nations Framework Convention on Climate Change a milestone in the field of international climate action, in which pledges and promises are transformed into actual implementation on the ground".

The press release provides the facts and stats around the number of participants, meetings and sessions.

Edition 30 of Low Carbon Pulse reported on the **UN High Level Climate Action Champions** initiative, and in Dubai the **COP-26** Champion, Mr Nigel Topping, and the **COP-27** champion, Mr Mahmoud Mohieldin, announced their [vision](#). Previous editions of Low Carbon Pulse have noted that as the **MENACW 2022** outcomes are published, Low Carbon Pulse would report on them. Three key areas of focus are reported to have emerged as follows:

- The need to integrate ambitious actions across key sectors of each country;
- The need to adapt to climate risks through the development of resilience as part and parcel of actions across key sectors; and
- The need to promote and to accelerate the development of breakthrough solutions, innovation and technology, so as to be able to apply incremental and transformational innovations, solutions and technologies to guard against and to overcome the impacts of climate change.

MENACW 2022 encouraged participation in UN initiatives, [Race to Resilience](#) and [Race to Zero](#).

• **Solar and Wind Power By Country:**

By way of a reminder, the following infographic provides a helpful summary of the installed solar and wind power capacity by country.



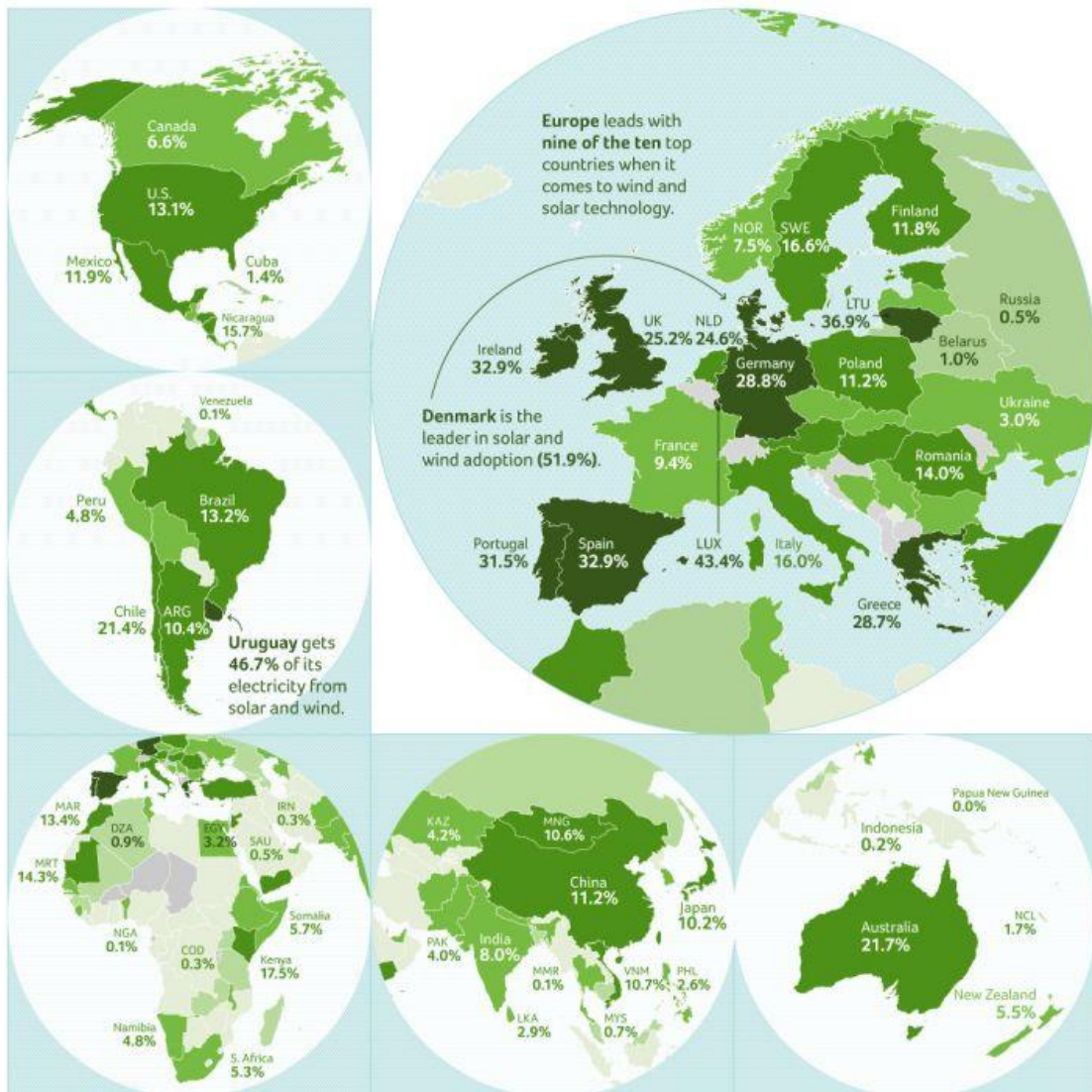
Solar and Wind Power

BY COUNTRY

Wind and solar generated over a tenth of global electricity in 2021.

Taken together, they are now the **fourth-largest source of electricity**, behind coal, gas and hydro.

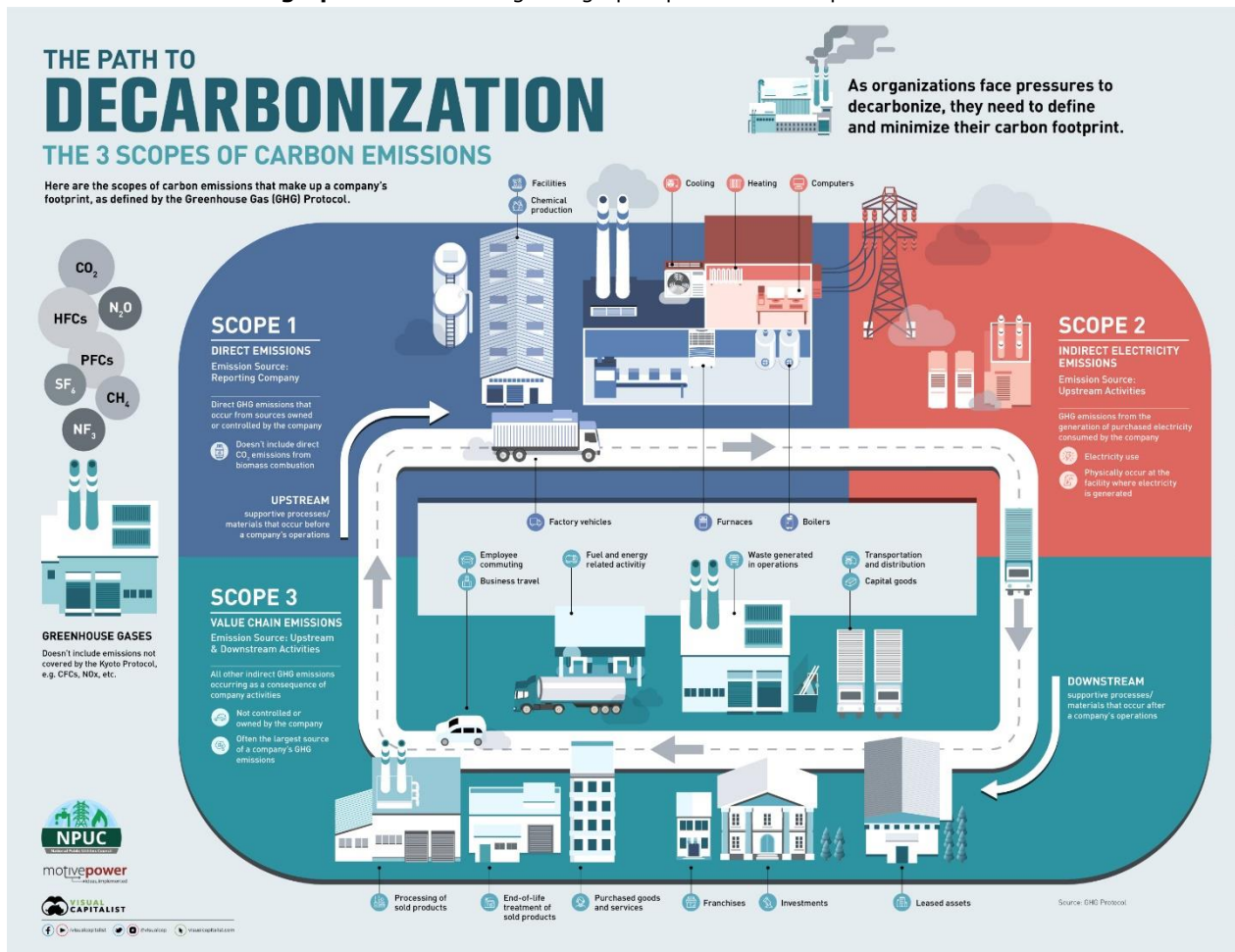
WIND AND SOLAR SHARE OF ELECTRICITY GENERATION



The Middle East and Africa have the fewest countries reaching a landmark (10%) of wind and solar.

Source: Ember's Global Electricity Review 2022. IEA Net Zero by 2050 report. 2021 data used where available, else 2020

- **Decarbonisation infographic:** The following info-graphic places each scope of decarbonisation in context.



Source: [Visual Capitalist](#)

Land Mobility / Transport:

This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the development and deployment of land vehicles, buses and coaches, cars, industrial vehicles and trucks, and trains.

- **Buses and coaches:**
 - **Bonn / Köln fuel cell fleet:** On **May 3, 2022**, **Dutch Hydrogen Magazine** reported that the region of Bonn / Köln in Germany is to procure a fleet of **108 fuel-cell technology buses**. By the reckoning of the author of Low Carbon Pulse, this is the largest single procurement to date of fuel-cell technology buses.
 - **Volgren and Wrightbus look to Australian market:** On **May 11, 2022**, **Wrightbus** (global leading fuel-cell technology bus manufacturer) [announced](#) that it was working with **Volgren** (leading bus body manufacturer) to manufacture **two zero-emission** hydrogen single deck **fuel-cell technology** buses for the Australian market. The two fuel-cell technology buses will be powered and propelled by the Wrightbus' **NexGen fuel-cell powertrains**.
 - **Maine Street:** On **May 17, 2022**, [electrek.co](#) reported that the first of four **Proterra ZX5** 35 foot battery electric buses had entered service in **Portland, Maine**. Greater Portland Metro and Biddeford Saco Old Orchard Beach Transit purchased the electric busses using funding support from both Federal and State Governments.
 - **NSW first hydrogen bus:** On **May 25, 2022**, **Transport NSW** announced that the State of New South Wales would commence trials of its **first fuel-cell technology electric bus** on the Central Coast of New South Wales later in 2022. The thinking is that fuel-cell technology electric buses are likely to be better suited to use in regional and outer metropolitan areas.
 - **Wrightbus right for Germany:** On **May 27, 2022**, [h2-view.com](#) reported that **Wrightbus** is to supply **60** zero-emission hydrogen-powered-and-propelled buses to Germany. German bus operator, **Regionalverkehr Köln GmbH (RVK)** is the purchaser. As reported, this is the first order for left-hand drive versions of Wrightbus' Kite Hydroliner.
- **Cars (including taxis and air-taxis):**
 - **Taking the Scenic route - Renault to manufacture BEV and fuel cell family cars:** On **May 19, 2022**, it was reported widely that **Renault** is to manufacture a battery electric vehicle (**BEV**) family car, and a hydrogen powered and propelled family car (using fuel-cell technology) for the European car market. **Renault** is reported as intending to use its **Scenic** model vehicle, manufacturing a **BEV** family car in **2024**, and a **fuel-cell technology** family car by **2030**.

- **Great Wall Motor to manufacture fuel cell cars:** On **May 27, 2022** (or thereabouts), it was reported widely that **Great Wall Motors** or **GWM** (**PRC** giant vehicle manufacturer) is to manufacture a number of hydrogen powered and propelled family vehicles. **GWM** manufactures **BEV** cars already (the **ORA** and **WEY**).
- **Western Australian police trialling fuel police cars:** On **May 31, 2022**, it was reported widely that the **Western Australian (WA) Police Force** was to commence trials of a fuel-cell technology vehicle. For these purposes, the **WA Police Force** is using a **Toyota Mirai** fuel-cell technology vehicle.
- **Battery, Fuel Cell and ICE Technology:**
 - **Cummins Inc ICE:** On **May 9, 2022**, **Cummins Inc** (global technology leader) [announced](#) the debut of its 15-litre hydrogen engine at ACT Expo in Long Beach, California. As stated: "The engine is built on Cummins' new fuel-agnostic platform, where below the head gasket each fuel type's engine has largely similar components, above the head gasket, each has different components for different fuel types".
It is understood that Cummins intends to manufacture engines with 15 litre and 6.7 litre capacity.
- **Industrial Vehicles and Trucks:**
 - **Hyundai to expand in the US:** On **May 9, 2022**, Hyundai Motor Company [announced](#) plans to increase its participation in the US commercial vehicle market with the introduction of its **XCIENT Fuel Cell** trucks into the US market.
 - **Emergency services roll-out: Edition 30** of Low Carbon Pulse reported on the use of **fuel-cell technology** to power and to propel ambulances. On **May 11, 2022**, [hydrogen-central](#) reported hydrogen fuel-cell technology pioneer, **ULEMCo**, is working with **Oxfordshire County Council** and its **Fire and Rescue Service** to assess and to determine the basis upon which fuel-cell technology may be used to power and to propel fire engines.
 - **Scania expands to match growing interest in biogas trucks:** On **May 12, 2022**, **Scania** [announced](#) that it is responding to increased customer interest in biogas (more correctly, **biomethane** or **renewable natural gas**) with new specifications and tanks, with ranges of **1,400 km** now possible.
 - **Volvo Trucks using Fossil-free Steel:** On **May 24, 2022**, it reported widely that **Volvo AB** is now manufacturing trucks comprising **Fossil-free Steel**.
This marks continued progress in the decarbonisation of steel used in vehicle manufacture, and continued progress of **SSAB** producing **Fossil Free Fuel** from the **HYBRIT** mill, using **HYBRIT** technology.
Edition 25 of Low Carbon Pulse reported that (under **HYBRIT's Clean Steel in the road**) **SSAB** delivered the "first fossil-free steel in the world" to Volvo Group from the **HYBRIT** mill, using **HYBRIT** technology.
Edition 25 of Low Carbon Pulse reported that on September 1, 2021, **SSAB** announced that it is to partner with Daimler's Mercedes-Benz to introduce fossil-free steel to the production of vehicles. As a reminder, **HYBRIT** is a shortening of Hydrogen Breakthrough Ironing Making Technology, developed jointly by **LKAB**, **SSAB** and **Vattenfall**.
- **Recharging and refuelling infrastructure:**
 - **Green for Greece:** On **May 18, 2022**, it was reported widely that the first hydrogen refuelling station (**HRS**) had commenced operation in Greece. The **HRS** is located in **Athens, Greece**, and will be used to refuel light duty vehicles (bikes and scooters) in the first instance. The technology deployed at the **HRS** is noteworthy: hydrogen is produced using a hydrogen compression system (derived from metal hydrides) being noise-free and using water as the means for both cooling and heating.
 - **HRS opens in Antwerp, Belgium:** On **May 30, 2022**, it was reported that **Colruyt Group** (Belgian family owned retail group) and **DATS 24** (energy and fuel supplier) has opened a new **HRS** on the **A12** in **Wilrijk, Antwerp, Belgium**. As reported, this is the first of five new **HRS** in Belgium (the other four stations to be located in **Erpe-Mere**, **Hassrode**, **Herve** and **Ollignies**). **DATS 24** is a first mover, having opened the first **HRS** in Belgium in 2018, located in **Halle, Belgium**.
- **Trains:**
 - **ATCO Group to supply to Canadian Pacific:** On **May 4, 2022**, **ATCO Group** [announced](#) that it had contracted **Canadian Pacific** to develop and to deploy two hydrogen production facilities and hydrogen refuelling infrastructure – the facilities and infrastructure are to be developed at the railyards of Canadian Pacific in **Calgary** and **Edmonton**, in the province of **Alberta, Canada**. The development of the facilities and infrastructure is key to Canadian Pacific continuing implementation of its Hydrogen Locomotive Programme.
 - **Deutsche Bahn and Siemens Mobility present new hydrogen train and hydrogen storage tank trailer:** On **May 5, 2022**, it was reported widely that **Deutsche Bahn** and **Siemens Mobility** had presented the newly developed **Mireo Plus H** and a newly designed mobile hydrogen storage tanker. The **Mireo Plus H** is intended to replace diesel powered and propelled trains.

Ports Progress and Shipping Forecast:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the development and deployment of production and storage capacity, and infrastructure, at ports for **E-Fuels / Future Fuels** (including **Hydrogen Hubs**) and to capture and to store or to use carbon, or both (including **Carbon Clusters**), and the connection of port infrastructure to the hinterland.*

Also this section considers news items that relate to the development of infrastructure at ports, including to allow the development of off-shore wind fields.

- **Ferries and other craft:**
 - **ADB (Asian Development Bank) funds E-Smart Ferries Project:** On **April 27, 2022**, **ADB** [announced](#) that it had agreed to provide funding support (from its Clean Technology Fund) to **Energy Absolute Public Company Ltd** to assist in the funding required to develop and to deploy an electric ferry fleet for mass rapid transport in Bangkok, Thailand. This initiative is part of the E-Smart Bangkok Mass Rapid Transit Electric Ferries Project, which contemplates the deployment of up to 27 E-Ferries along the Chao Phraya River, that runs through Bangkok, each ferry having capacity for up to 250 passengers.

- **Gladstone – Curtis Island Shuttle:** On **May 9, 2022**, [pv-magazine-australia.com](https://www.pv-magazine-australia.com) reported that **SeaLink Marine & Tourism** had received a funding support commitment from the **Government of Queensland**, Australia (under its Hydrogen Industry Development Fund) to develop a ferry powered and propelled by **fuel cell technology**. The ferry will provide shuttle services between **Gladstone** and **Curtis Island** (the location of world scale LNG facilities), having capacity for up to 200 passengers, and having a range between refuelling of 50 nautical miles.
- **Workboats afloat:** On **May 11, 2022**, **CMB.TECH** (technology corporation) and **Windcat Workboats** (the Netherlands based operator of offshore crew transfer vessels, in the European offshore wind sector) [announced](#) that they have developed as the world's first hydrogen-powered (and propelled) crew transfer vessel (**CTV**) – the **Hydrocat 48**. The **Hydrocat 48** uses dual-fuel **MAN Engines**, retrofitted by **CMB.TECH** with a hydrogen injection system, and is to undertake bunkering and sea-trials. As a **CTV**, the **Hydrocat 48** will be used by the marine and off-shore wind industries.
- **Chase Zero on the water:** On **May 13, 2022**, [hydrogenenergy](https://www.hydrogenenergy.com) reported that chase boat, **Chase Zero**, had been tested in Hauraki Gulf, Auckland, New Zealand. The **Chase Zero** is a hydrogen powered and propelled chase boat, and during testing it reached a little over 50 knots (58 mph or 93 km/h). The **Chase Zero** is a foiling boat, developed by the Emirates Team New Zealand for use in the America's Cup, and powered and propelled by **fuel cell technology** developed by **Toyota**.
- **Green Ports (including infrastructure):**
 - **Gasunie and Vopak:** On **May 2, 2022**, **Vopak** [announced](#) that **Gasunie** (European energy-infrastructure corporation) and **Vopak** (global leading energy infrastructure corporation) had agreed (under a cooperation agreement) to work together jointly to develop **open access** hydrogen import terminal infrastructure at **Dutch** and **German** ports to allow the import of hydrogen and hydrogen-based fuels into **northwest Europe**.
As announced, the cooperation agreement includes import terminal projects for green ammonia, liquid hydrogen and liquid organic hydrogen carriers (for further details of these energy carriers, see [Future Fuels](#) a sibling publication of Low Carbon Pulse).
Gasunie and **Vopak** are used to working together to develop major import terminal infrastructure they have been working together on the **Gate LNG regasification terminal** at the Port of Rotterdam since 2011. More recently, as reported in [Edition 39](#) of Low Carbon Pulse, Gasunie and Vopak are working with HES International to develop the ACE Terminal in the Port of Rotterdam. **By way of a reminder:** "The **ACE Terminal**, being developed by **Gasunie**, **HES International B.V.** and **Vopak**, is the Green Ammonia import terminal being developed in the Port of Rotterdam. The **ACE Terminal** is planned to be operational from 2026."
 - **Port of Rotterdam Authority (PORA) continues to lead the way:** On **May 10, 2020**, a number of news items covered the size and shape of what **PORA** and 70 corporations will be able to achieve, represented most consistently by a representation of a hydrogen molecule marked with "**4.6 mega tonnes hydrogen in 2030**" and "**Rotterdam Europe's Hydrogen Hub**". The news items and the photo-opportunities arose ahead of the presentation of **REPowerEU** on **May 18, 2022**. While the news items and the photo-opportunities were jolly, the underlying message is clear – for the **EU** to achieve the objectives of **REPowerEU** production and import capacity has to be increased at ports (has hydrogen hubs), across Europe.
- **Green Shipping:**
 - **Design for 37,500 m³ liquified hydrogen carrier:** On **May 3, 2022**, it was reported widely that **C-Job Naval Architects** has provided high-level details of its **141 metre, 37,500 m³**, liquid hydrogen (**LH₂**) carrier.



Source: [C-Job Naval Architects' website](#)

Critically, the design of the **LH₂** carrier allows transportation of **LH₂** without the need for ballast, with the containment system at deck-level. Also the containment system will allow a lower level of boil-off than currently. The news item has drawn considerable comment, much of it enthusiastic. Of particular interest has been comment around the use of the **LH₂** carrier to facilitate the trade in **LH₂** between Scotland and Germany, delivering 100 metric tonnes (scaling up to 300 metric tonnes) of **LH₂** a day, on a "milk-run". The intention is that **LH₂** carrier will be commissioned at least six months before the first scheduled loading of **LH₂** in 2027.

- **First truck to ship hydrogen bunkering successful:** On **May 5, 2022**, **Ekinetix** [announced](#) that the **Hydrocat** (a hydrogen-powered vessel used as a support vessel for off-shore wind field developments) had been bunkered with hydrogen using its mobile refueler and bunkering process.
- **ONE orders 10 13,700 TEU container vessel:** On **May 31, 2022**, [offshore-energy](#) reported that Singapore-based **Ocean Network Express (ONE)** had order the build of 10 eco-efficient very large container vessels (**VLCS**). As reported, five **VLCS** will be built by **Hyundai Heavy Industries** and five by **Nihon Shipyard**. The new **VLCS** are planned for **Ready Notation** or **Approval in Principal** to use **ammonia** and **methanol** as fuel, and to deploy **carbon capture** and **storage**.
- **Carbon price on shipping emerging:**
 - **Japan supports carbon tax in the shipping sector:** On **May 3, 2022**, **The Financial Times** reported that Japan had informed the International Maritime Organisation (**IMO**) that it would support a carbon tax to raise more than **USD 50 billion** a year. As proposed, the shipping industry would have to pay **USD 56** per metric tonne of **CO₂** from **2025** to **2030**, increasing to **USD 135** per metric tonne of **CO₂** from **2030**. The money raised would be made available to fund the decarbonisation of the shipping industry, both the world shipping fleet and the infrastructure and fuels that it uses.
The shipping industry gives rise to at least 3% (around one billion metric tonnes of **CO₂-e**) of **GHG** emissions arising globally each year.
As regular readers of Low Carbon Pulse will know, there continues to be a debate as to how best to decarbonise the shipping industry. From a policy setting perspective, decarbonisation is best undertaken on a global basis, rather than on a jurisdiction-by-jurisdiction basis or economic bloc basis.
 - **International Maritime Organisation (IMO) consensus:** On **May 23, 2022**, [climatechangenews](#) reported that the **IMO** (the agency of the United Nations responsible for regulating shipping) had reached consensus that a carbon price was required to decarbonise the shipping industry: the meeting of the **IMO** took place during the week beginning May 16, 2022, and the conclusion was that "as part of a basket of mid-term measures", with support to adopt a "well-to-wake" approach – providing a carbon price for production of fuel for shipping, and for use of fuel by shipping.
The **IMO** consensus arose as the **EU** approved the **Fit-for-55 package**, including shipping in the **EU ETS** (see [Editions 22, 27](#) and [32](#) of Low Carbon Pulse for background).

Airports and Aviation:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse relating to the development and deployment of technology at airports and in the aviation sector to decarbonise the airports and the aviation industry.*

- **SAF continues to find, and to expand, market:**
 - On **May 19, 2022**, it was reported widely that **Neste** (leading renewable chemical and fuel supplier) and **United Airlines** had signed a three year sale and purchase agreement under which **Neste** is to sell and **United Airlines** is to purchase up to **160,000 metric tonnes (52.5 million gallons or 198.7 million litres)** of **Neste's MY Sustainable Aviation Fuel**, with the SAF to be used to power and to propel United's flights from Schiphol Airport, Amsterdam.
 - On **May 27, 2022**, **Neste** [announced](#) that **Neste** and **ITOCHU** were celebrating the **first delivery**, in Japan, of **Neste's MY Sustainable Aviation Fuel** to **Etihad Airways**, with **SAF** being delivered to Etihad Airways at Narita International Airport, Tokyo. Japan is committed to the use of **SAF** to satisfy 10% of total use of aviation fuel by 2030.

Reference Materials:

The purposes of this Reference Material section is keep live, reference material that readers may find most useful on an ongoing basis without the need to search for that material:

- **Background on electrolyzers:**

At the moment around 61% of electrolyzers use **AE** technology and around 30% use **PEM** technology.

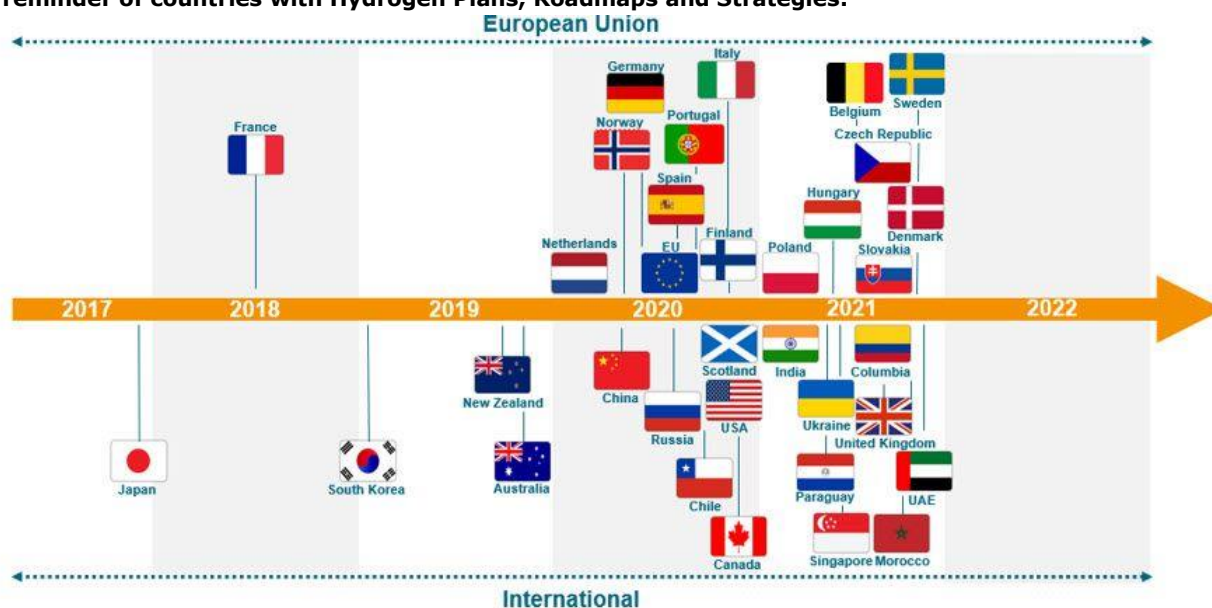
ANATOMY OF AN ELECTROLYSER	
Alkaline electrolyzers (AE) produce H ₂ using a liquid electrolyte, using nickel electrodes and stainless steel for the stack.	AEs and PEMs have similar electrical energy efficiency, with the consumption of electrical energy being almost the same. PEM 's operate at a higher electrical current, and as such are more productive per unit of stack mass.
Polymer Electrolyte Membrane or Proton-Exchange Membrane (PEM) electrolyzers operate in an acidic environment, using iridium coated anodes and platinum coated cathodes, both the anode and cathode are made from titanium.	

In addition to **AE** and **PEM** electrolyser technologies, there are what may be regarded as emerging technologies of anion exchange membranes (**AEM**) and solid oxide electrolysis cells (**SOEC**). It is fair to say that **SOEC** electrolyzers are emerging more quickly, and more developed, than **AEM**.

SOLID OXIDE ELECTROLYSER CELLS (SOECS)
SOECs operate at high temperatures and with high electrical efficiencies of 79-84% (LHV), and require a heat source to produce steam. Therefore if SOEC hydrogen were used to produce synthetic hydrocarbons (power to liquid and power to gas) it would be possible to recover waste heat from the synthesis processes to produce steam for further SOEC electrolysis. Nuclear power, solar thermal and geothermal heat systems, as well as industrial waste heat, could provide heat sources for SOECs .

SOEC electrolyzers can be operated in reverse mode as fuel cells, to convert hydrogen back into electrical energy (again, distinct from **AE** and **PEM**.) Combined with hydrogen energy storage systems (**HES**), **SOECs** can provide balancing services to grids, increasing the overall use of the **SOEC**. **SOEC** can be used for co-electrolysis of steam and **CO₂** so as to create a synthetic gas mix comprising **CO** and **H₂** for conversion into synthetic fuel.

• **A reminder of countries with Hydrogen Plans, Roadmaps and Strategies:**



• **S&P Global Platts – Atlas of Energy Transition:** On **February 22, 2022**, S&P Global Platts published its **Hydrogen Price Wall**, mapping hydrogen prices across means of production and regions of use. The **Hydrogen Price Wall** is to be found in the updated **Atlas of Energy Transition**.

While Low Carbon Pulse does not report on the cost or price of hydrogen, the S&P Global Platts **Hydrogen Price Wall** (as part of the **Atlas of Energy Transition**) provides a helpful point of reference.

Click [here](#) and [here](#) for the sibling publications of Low Carbon Pulse, the **Shift to Hydrogen (S2H2): Elemental Change** series and [here](#) for the first feature in the **Hydrogen for Industry (H24I)** features.

• **A reminder:** On **March 26, 2022**, the author of Low Carbon Pulse came across the following simple reminder of the nomenclature of carbon neutrality and net zero:

Net-zero WHAT?

Net-zero carbon (CO₂)

Net-zero carbon emissions = **only CO₂**

Carbon neutrality

Balancing the emissions and removals of CO₂

Net-zero GHG

Net-zero GHG emissions = **all greenhouse gases**

Climate neutrality

Balancing the emissions and removals of all GHGs

GHG – greenhouse gas



Low Carbon Pulse - Edition 41 – June 2022 (short-form)

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to the **Short Form Version** of **Edition 41** of Low Carbon Pulse – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Wednesday June 1, 2022** to **Thursday June 30, 2022**. The **Long Form Version** of **Edition 41** was published on **Monday July 4, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering October 7, 2021 to March 31, 2022), and click [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39** and **40** of Low Carbon Pulse, covering **April** and **May 2022**).

Change in publishing cycle of Low Carbon Pulse:

Having sought feedback from readers of Low Carbon Pulse delivered in PDF, there was overwhelming support for a switch to publication of Low Carbon Pulse on a weekly basis. While the level of engagement with Low Carbon Pulse continues to increase, feedback suggests that its length in monthly form can be daunting. At the end of each month, the editions of Low Carbon Pulse published during that month will be consolidated into a monthly digest.

Continued emphasis on the Burning Platform:

The month of June has been a month in which there has been continued focus on the increased levels of **GHG** emissions in the climate system, and their impact, with both **CO₂** (carbon dioxide) and **CH₄** (methane) levels subject to increasing focus (and, it has to be said, concern), and increasingly **N₂O** (nitrous oxide) – the three well-mixed greenhouse gases.

- The **Bonn Climate Change Conference (BCCC)** took place between **June 6** and **June 16, 2022**, the first meeting of the [United Nations Intergovernmental Panel on Climate Change \(UN IPCC\)](#) since **COP-26**.

While progress was made on some matters, progress was not made on increased commitments to reduce **GHG** emissions (in the context of the global stocktake of commitments to reduce **GHG** emissions), funding commitments to developing countries to allow them to address the impacts of climate change, and compensation for loss and damage suffered by developing countries as a result of climate change.

UN Climate Change Executive Secretary, Ms Patricia Espinosa stated: "*Clearly, [implementation is needed] as rapidly as possible, and we need much more ambitious climate action. The global stocktake is a critical part of achieving both*".

Hopes were high before the **BCCC** (an intersessional conference) bridging **COP-26** in Glasgow, Scotland (in November 2021) and **COP-27** in Sharm el-Sheikh, South Sinai, Egypt (in November 2022). The good thing is that there is a clear sense of the work that needs to be done in preparation for, and at **COP-27**, including as part of the global stocktake and to progress funding for adaptation and compensation for loss and damage.

As reported, at the end of the **BCCC** **Ms Patricia Espinosa** was presented with a t-shirt sporting the slogan:

"**Science does not negotiate.**"

Reaching a little further back: "The time abides for, tarries for no man, stays no man, tide nor time tarry for no man", or as we have it now: "**Time and tide wait for no one**".

- **Stockholm+50:** On **June 2 and 3, 2022**, the **Stockholm+50** conference was held in **Stockholm, Sweden**, co-hosted by **Kenya and Sweden**. The **Stockholm+50** conference marked the **50th anniversary** of the **world's first conference** on the environment – **United Nations Conference on the Human Environment** held in Stockholm, Sweden, June 5 and 6, 1972, which gave rise to the establishment of the **United Nations Environment Programme (UNEP)**. The agenda for the **Stockholm+50** conference was **Immediate action for people, planet and prosperity will create a better future for all**. The agenda reflecting the perspective of a **triple planetary crisis: climate, nature and pollution**. On **June 8, 2022**, the **Government Offices of Sweden** published [Stockholm agenda shows way forward following Stockholm+50](#).
- **IPCC Bonn intersessional conference:** From **June 6 and June 16, 2022**, the **BCCC** reviewed progress and prepared for **COP-27**, including the global stocktake in respect of **GHG** emissions: the global stocktake provides of the exchange of information among countries and stakeholders in the context of achieving the goals of the **Paris Agreement**. The global stocktake allows each country to take stock on its nationally determined contribution (**NDC**). (For context, the **BCCC** was the 56th session of the Subsidiary Body for Scientific and Technological Advice (part of the **UNFCCC**.) The ever-excellent [carbonbrief.org](#) (under [Bonn climate talks: Key outcomes from June 2022 UN climate conference](#)), provides a more detailed summary of the outcomes from the **BCCC**.
- **Nairobi Conference – Fourth meeting of the open-ended group on the Post-2020 Global Biodiversity Framework:** From **June 21 to June 26, 2022**, a group of experts met in **Nairobi, Kenya**, to prepare a series of **six science briefs** to provide scientific support for the negotiations of the **Post-2020 Global Biodiversity Framework**. The work done at the Nairobi Conference will inform **Part 2** of the **15th Conference of Parties to the UN Convention on Biological Diversity**.
- The **48th G7 Summit** took place between **June 26 and June 28, 2022** in **Schloss Elmau, Krün, Bavaria, Germany**. Attached is a link to the [communiqué](#) from **G7 Summit**.
Among other things, the communiqué covers the endorsement of an open and cooperative **Climate Club** ([G7 statement on Climate Club](#)), and working towards its establishment by the end of 2022. In this context, the **G7** commits to drive urgent, ambitious and inclusive action to align with **1.5°C** pathways and to accelerate implementation of the **Paris Agreement**, with a commitment to a "highly decarbonised" road transport sector by 2030, and a "fully or predominantly decarbonised" power sector by 2035. In addition, through the **G7 Partnership for Global Infrastructure**, the **G7** commits to mobilise **USD 600 billion** over the coming five years to narrow the global investment gap, stepping-up cooperation globally, including through working for **Just Energy Transition Partnerships** with **India, Indonesia, Senegal and Vietnam**, and building on the existing Partnership with **South Africa**.
- The **World Urban Forum** was held in **Katowice, Poland** from **June 26 to 30, 2022**. The [World Urban Forum](#) is held every two years under the auspices of, and convened by, the **UN Human Settlements Programme**. The **World Urban Forum** supports the implementation of **SDG 11** – making cities and human settlements inclusive, safe, resilient and sustainable. Attached is a link to the [communiqué](#) from **World Urban Forum**.
- **UN Ocean Conference 2022** took place between **June 27 to July 1**, in **Lisbon, Portugal**, co-hosted by **Kenya and Portugal**. The **UN Ocean Conference** is the second **UN Conference to Support the Implementation of SDG 14**. Attached is a link to the [communiqué](#) from **UN Ocean Conference**.

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

- **European Parliament on CBAM:** On **June 22, 2022**, the **European Parliament** adopted its position on the regulation to establish **CBAM**. The position of the **European Parliament** is that additional products should be added to products proposed the **European Commission** in July 2021 (as part of the **Fit-for-55** package), the original products being aluminium, cement, fertilisers, iron and steel, and electrical energy production. The **additional products** that the **European Parliament** wants **CBAM** to cover are **ammonia, hydrogen, organic chemicals and plastics**. In addition, the **European Parliament** wants **CBAM** to include **indirect emissions** arising from the production of products, i.e., emissions arising from electrical and heat energy used to manufacture those products.
For a full description of the position of the **European Parliament** click on the following link [europarl.europa.eu](#) under [CBAM: Parliament pushes for higher ambition in new carbon leakage instrument](#).
- **European Parliament locks-in ban on sale of new diesel and motor spirit cars from 2035:** Early on the morning of **June 28, 2022**, **Environment and Climate Change Ministers** from the European Union's 27-Member States "agreed to introduce a 100% **CO₂** emissions reduction target by 2035 for new cars and vans", accommodating the position of Germany to allow the use of "**CO₂** neutral fuels". This agreed position must be considered by the **European Parliament**.
- **European Parliament locks in shipping and aviation into the EU ETS:** In addition, to progress on **CBAM** and **motor-cars and vans**, the **European Parliament** voted to extend the application of the **European Union Emissions Trading Scheme (EU ETS)** to all ships having a gross tonnage above 400 metric tonnes and all off-shore vessels. What this means is that each metric tonne of **CO₂**, **CH₄** and **N₂O** emissions arising from those ships will have to be matched by the requisite number of permits under the **EU ETS**. The **European Community Shipowners' Association** is reported to have welcomed the vote of the European Parliament in respect of the package.
- **DNV Hydrogen Forecast:** On **June 14, 2022**, **DNV** published [Hydrogen Forecast to 2050 – Energy Transition Outlook 2022](#). The **DNV** publication is excellent, and, for those interested in the interface between policy settings and the development of hydrogen production capacity, compulsory reading. The **DNV** publication provides a practical and realistic assessment of the progress towards the development of hydrogen production capacity, and its use, at levels consistent with the goals of the **Paris Agreement**.
- **REN21 report:** On **June 15, 2022**, the **Renewable Energy Policy Network for the 21st century** or **REN21** (comprising Governments, Industry Associations, Inter-governmental organisations, NGOs and Science) published [Renewables 2022 Global Status Report \(GSR\)](#), with the titled by-line: "Record growth in renewables, but world

missed historic chance for a clean energy recovery". While the entirety of the **GSR** well-worth a read, the author commends folk to find the time to read the [Key Messages for Decision Makers](#).

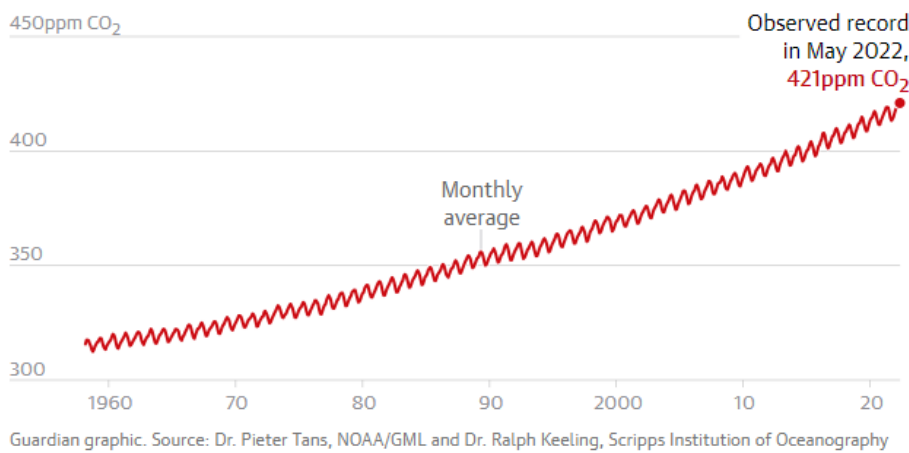
- **Council and European Parliament reach provisional agreement:** On **June 21, 2022**, the **European Council** and the **European Parliament** reached a provision political agreement on the **corporate sustainability reporting directive (CSRD)**, which is covered fully under [New Rules on corporate sustainability reporting: provisional political agreement between the Council and European Parliament](#). This political agreement looks to **amend the 2014 non-financial reporting directive**. As proposed, more detailed reporting requirements will be required, and ensures that larger corporations are required to report on sustainability issues.
- **European Commission proposes legislation to address degradation:** On **June 21, 2022**, the **European Commission (EC)** outlined its proposal for a **Nature Restoration Law** (fully titled [Proposal for a Regulation of the European Parliament and of the Council on nature restoration](#)).
- **New Ember report published:** On **June 22, 2022**, **Ember** published [New Generation – Building a clean European electricity system by 2035](#). As always from **Ember**, the publication is well-worth a read, both for those active in the European market, and those active in markets globally.
- **BP publishes Statistical Review of World Energy:** On **June 28, 2022**, **bp** (leading international energy corporation) published the [bp Statistical Review 2022](#), which is accompanied by a [seven page summary](#) of interesting facts and stats.

Climate change reported and explained:

- **CO₂ at highest levels since well-before first hominids first walked:** During the first week of June, a number of news outlets reported that the level of **CO₂** in the atmosphere is at its highest level since the first hominids first walked, and 50% higher than at the start of the pre-industrial era.
Stated another way: the current levels of **CO₂** in the atmosphere are at the highest they have been for between 4 and 4.5 million years (in an epoch named the Pliocene).
Stated another way still: in the words of **NOAA** Administrator, **Mr Rick Spinrad**, "The science is irrefutable: humans are altering our climate [system] in ways that our economy and our infrastructure must adapt [in response] to".
- **Another month, another graph:** As reported in previous editions of Low Carbon Pulse, the US **National Oceanic and Atmospheric Administration (NOAA)**, among other things, tracks the level of **CO₂** in the atmosphere. The graph below was published by the **NOAA** at the start of June.

Record levels of CO₂ observed at Mauna Loa Observatory

NOAA's measurements at the mountaintop observatory on Hawaii's Big Island were 1.8ppm higher than 2021



Source: [The Guardian](#)

- **Global Methane Pledge Energy Pathway:** On **June 17, 2022**, the **EU** and the **US** released a [media note](#). The media note stated that on **June 17, 2022**, the **EU** and the **US**, and **10** other countries launched the **Global Methane Pledge Energy Pathway** to catalyse **CH₄** emissions in the oil and gas sector, advancing both climate progress and energy security. The **Global Methane Pledge Energy Pathway** represents progress to give effect to the **Global Methane Pledge**. The Pathway aims to encourage all countries: **1.** To capture the maximum potential of cost-effective methane mitigation in the oil and gas sector, and **2.** To eliminate routine flaring as soon as possible, and not later than 2030.
The first movers committing to the **Global Methane Pledge Energy Pathway** are: **Argentina, Canada, Denmark, Egypt, Germany, Italy, Japan, Mexico, Nigeria and Oman**, along with the **EU** and the **US**.
The national oil company of Malaysia **Petroleum Nasional Berhad (Petronas)** is stated to support the **Global Methane Pledge Energy Pathway**.

Middle East including GCC Countries:

- **Consortium to develop Green Hydrogen Facility at KIZAD:** On **June 10, 2022**, it was reported widely that **Korea Electric Power Corporation (KEPCO)**, **Korea Western Power**, **Samsung C&T**, and **UAE** corporation,

- Petrolyn Chemie** had signed a memorandum of understanding (MOU) to provide a framework of the development of a **USD 1 billion** Green Hydrogen production facility in the **Khalifa Industrial Zone Abu Dhabi (KIZAD)**.
- **Saudi Arabian Mining Company to buy steam:** On **June 2, 2022**, it was reported that the **Saudi Arabian Mining Company** is to purchase steam from **GlassPoint**, the steam produced using electrical energy sourced from **1.5 GW** of photovoltaic solar installed capacity.
 - **Masdar commits to Azerbaijan:** On **June 5, 2022**, **Masdar** announced that it had signed an agreement to develop **4 GW** of clean and renewable energy projects (**Mega-Projects**) with the **Republic of Azerbaijan**, with the right to develop an additional **6 GW** as a second phase. For the purposes of the **4 GW** first phase, **Masdar** signed two implementation agreements, one in respect of **1 GW** of on-shore wind farms and **1 GW** of photovoltaic solar farms, the second in respect of the integrated development of a **2 GW** off-shore wind field.
 - **Saudi Aramco to invest in 12 GW of renewables by 2030:** On **June 16, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Saudi Aramco** is to invest in the development and deployment of **12 GW** of photovoltaic solar and wind capacity by **2030**.
 - **IRENA partners with Masdar and Abu Dhabi Fund for Development:** On **June 16, 2022**, **IRENA** [announced](https://www.irena.org) that it had strengthened its partnerships with **Masdar** and the **Abu Dhabi Fund for Development (ADFD)**, by signing documents with both. The **Letter of Intent** with **Masdar** provides a framework for **Masdar** to invest equity and to provide technical advice in respect of renewable energy projects. The agreement with **ADFD** formalises the anchor investment of the **ADFD (USD 400 million)** in the **IRENA Energy Transition Financing (ETAF)** initiative.
 - **UAE to invest further USD 50 billion:** On **June 18, 2022**, [khaleejtimes.com](https://www.khaleejtimes.com) reported that the **President of the UAE, His Highness Sheikh Mohamed bin Zayed Al Nahyan**, had announced on **June 17, 2022**, that the **UAE** plans to invest an additional **USD 50 billion** to scale up climate action within the **UAE** and overseas.
 - **Aramco publishes inaugural sustainability report:** On **June 20, 2022**, **Aramco** [published](https://www.aramco.com) its inaugural sustainability report **Energy security in a sustainable world**. The title of the report speaks to the prevailing mindset globally. The author commends the report to readers of **Low Carbon Pulse**.
 - **Abu Dhabi developing hydrogen policy package:** On **June 20, 2022**, [thenationalnews.com](https://www.thenationalnews.com) reported that the **Abu Dhabi Department of Energy (DoE)** is developing a **hydrogen strategy** and **hydrogen policy settings**, together with a licensing regime, and regulations and standards, to allow the development of the hydrogen industry in **Abu Dhabi**. Future editions of **Low Carbon Pulse** will cover the **hydrogen strategy** and **hydrogen policy settings**.
 - **Oman and the Netherlands meet to progress hydrogen value chain:** On **June 23, 2022**, [hydrogen-central.com](https://www.hydrogen-central.com) reported that **Oman** and the **Netherlands** are progressing discussions to formalise cooperation in Green Hydrogen production and transportation, logistics and port infrastructure development, including establishing joint ventures for these purposes.
 - **OPAZ signs lease for the ACME and Scatec project:** On **June 24, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that the **Oman Public Authority for Special Economic Zones and Free Zones (OPAZ)** had signed a land lease with **Green Hydrogen and Chemicals Company** (a joint venture vehicle of **ACME** and **Scatec**) to develop the first phase of the **USD 2 billion** Green Hydrogen and Ammonia facilities.
 - **UAE and Germany continue high level engagement:** On **June 27, 2022**, it was reported widely that Government teams from the **UAE** and the **German Federal Government** were holding further meetings during the week beginning **June 27, 2022**, this time Germany. **Editions 37** or **39** of **Low Carbon Pulse** reported on earlier meetings.
 - **Alpha knows better:** On **June 27, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Alpha Dhabi Holding** subsidiary, **W Solar Investment**, and the **General Electricity Company of Libya (Gecol)** had signed a memorandum of understanding under which **W Solar Investment** is to develop a **2 GW photovoltaic solar facility in Libya**.

Africa:

- **Angola and German Green Hydrogen and Ammonia:** On **June 15, 2022**, [Reuters](https://www.reuters.com) reported that Angola was set to be the first supplier of Green Hydrogen to Germany. In context, on **June 15, 2022**, **Sonangol** signed a letter of intent with two German corporations for the production and export of 280,00 metric tonnes a year of Green Ammonia by 2024.
- **Egypt and EU Partnership centred around clean energy transition:** On **June 16, 2022**, **Egypt** and the **EU** released a [joint statement](https://www.europa.eu) marking the meeting in Cairo, Egypt, between **Egyptian President, Mr El Sisi**, and **EU Commission President, Ms Ursula von der Leyen**. The joint statement addresses climate, energy and green transition, which reflects that the **EU** and **Egypt** are to work together to implement the **Paris Agreement**.
- **African Energy Outlook:** As noted above, on **June 20, 2022**, the **IEA** published [Africa Energy Outlook 2022 – World Energy Outlook Special Report \(AEO\)](https://www.iea.org). The **AEO** provides an excellent overview of the energy resources of Africa, noting the vast natural gas resources, and the potential for Africa to develop bioenergy, hydro-electric power, photovoltaic solar, and the importance of the role of Africa as a source of critical metals and minerals.
- **Electrification in Africa:** Previous editions of **Low Carbon Pulse** have covered the levels of electrification in Africa. The **AEO** provides the most recent analysis – **600 million** people in Africa do not have access to electricity, and over **1 billion** people do not have clean-cooking facilities. **USD 25 billion** a year of investment is required to progress towards 100% electrification and clean-cooking facilities by 2030.
- **ACWA Power to develop 1.1 GW on-shore wind project in Egypt:** On **June 22, 2022**, it was reported widely that a consortium, comprising **ACWA Power** and **Hassan Allam**, had agreed with the **Egyptian Electricity Holding Company** to develop a **1.1 GW** on-shore wind project in Egypt.

India and Indonesia:

- **India's first Green Hydrogen refuelling station:** On **June 13, 2022**, [outlookindia.com](https://www.outlookindia.com) reported that **NTPC Limited** had contracted with **Amara Raja Power Systems** to develop and to deploy **India's first Green Hydrogen refuelling station** in Leh, in the Ladakh union territory. As reported, **NTPC** is to deploy five buses, using fuel-cell technology using Green Hydrogen to power and to propel those buses.

- **Assam on the tee:** On **June 13, 2020**, **The Economic Times** reported **NLC** is to develop and to deploy a **1 GW** photovoltaic solar farm in the state of **Assam** in joint venture with the state **Government of Assam**. The state **Government of Assam** will host the **1 GW** photovoltaic solar farm on approximately 1,250 hectares of state land.
- **Adani and TotalEnergies to create Green Hydrogen giant:** On **June 14, 2022**, **TotalEnergies** [announced](#) that **Adani Enterprises Limited (AEL)** and it had entered into an agreement under which **TotalEnergies** would acquire a 25% interest in **Adani New Industries Limited (ANIL)**. **ANIL** is to target the production of **1 million metric tonnes** of Green Hydrogen a year **by 2030**, requiring the development of up to **30 GW** of renewable electrical energy generation capacity.
- **Azure Powers to giga-factory development:** On **June 15, 2022**, [pv.magazine.com](#) reported that **Azure Power** had agreed with **Premier Energies** to invest in the development of a **1.2 GW** mono PERC cell and module production facility in the **state of Telangana**.
- **Floating solar in state of Kerala:** On **June 24 and 25, 2022**, it was reported widely that **NTPC Limited's 92 MW** floating photovoltaic solar facility at **Kayamkulam** is operating. The photovoltaic solar arrays comprising the **Kayamkulam** facility have been deployed on reservoirs that are owned by **NTPC Limited's** Rajiv Gandhi gas-fired power station.
- **India Hydrogen Alliance (IHA) presents 25/25 National Green Hydrogen Hub Development Plan (25/25 Plan):** On **June 30, 2022**, [h2-view.com](#) reported that the **IHA** had presented its **25/25 Plan** to the **Ministry of New Renewable Energy** and **NITI Aayog**. As the title suggests, the **25/25 Plan** outlines a plan to develop **25 National Green Hydrogen Projects**, and five **National Hydrogen Hubs, by 2025**. As presented, the **National Hydrogen Hubs** are to be developed in the states of **Andhra Pradesh, Gujarat, Karnataka, Kerala** and **Maharashtra**.
- **India Hydrogen Alliance – May 2022:** Attached is the link to the May edition of [India H2 Monitor – May 2022](#). The link to the June edition will be attached in the next edition of Low Carbon Pulse when available. As noted in previous editions of Low Carbon Pulse, we intend to include the link rather than repeat the content of the **India H2 Monitor**. (The **India H2 Monitor** tends to be published three to five days after the end of each calendar month, and as such is not published when we publish Low Carbon Pulse – within two days after the end of each calendar month.)

Japan and Republic of Korea (ROK):

- **ROK tendering 2 GW of photovoltaic solar:** On **June 14, 2022**, [pv-magazine-australia.com](#) reported that the **ROK Energy Agency** had launched the first of two tenders for photovoltaic solar capacity that it intends to run during 2022. As reported, the **Energy Agency** intends to allocate **2 GW** across four categories of project: less than 100 kW; 100 kW to 500 kW, 500 kW to 3 MW, and over 3 MW. The projects that are successful in the tender will be awarded **20 year contracts** under **ROK's renewable energy certificate (REC)** scheme.
- **Air Liquide Korea, Lotte Chemical and SK Gas signed strategically:** Over the weekend of **June 18 and 19, 2022**, it was reported widely that **SK Gas, Lotte Chemical** and **Air Liquide Korea** had agree on **June 16, 2022**, to establish a joint venture for power generation using by-product hydrogen and hydrogen-powered transportation.
- **Covestro, Neste and SK geo centric coalesce:** On **June 20, 2022**, [Neste](#) announced that it was working with **Covestro** and **SK geo centric** to produce a feedstock to produce polyurethane from "raw material based on renewable raw materials via mass balance".
- **LG Chem create CO₂ "circulation system":** On **June 20, 2022**, [h2-view.com](#) reported that **LG Chemical** had announced the development of a plant to produce **50,000 metric tonnes** of hydrogen a year, at **Daesan, South Korea**.
- **ROK and US cooperate on hydrogen safety:** On **June 23, 2022**, [fuelcellworks.com](#) reported that the **ROK**, Korean Gas Safety Corporation, and the **US**, American Academy of Chemical Engineers' Center for Hydrogen Safety, had signed a memorandum of understanding under which each organisation is to exchange information with the other about hydrogen safety, including accidents and best practices, with each to educate and to promote hydrogen safety.
- **Japan to increase rate of off-shore wind field installation:** On **June 24, 2022**, [asia.nikkei.com](#) reported that draft rules were released on **June 23, 2022** intended to increase wider competition for the development of off-shore wind fields, and to limit the ability of a single bidder "to win multiple projects in one fell swoop".

PRC and Russia:

- **PRC pumping:** On **June 14, 2022**, **The Straits Times** [reported](#) (under [China's massive hydro energy storage goals may be getting bigger](#)) that the largest dam builder in the **PRC** is seeking to develop hydro-energy storage or pumped storage facilities. Chair of **Power Construction Corp of China**, Mr Ding Zanzhang, is reported to have indicated that the **PRC** is to construct more than **200** pumped storage facilities (having a combined generation capacity of **270 GW**) with construction on all of them starting by 2025.
- **PRC port refuelling:** On **June 27, 2022**, [fuelcellworks.com](#) reported that China's first port-based hydrogen refuelling station had commenced operation at **Qingdao Port. Shandong Port Group** (of which Qingdao Port is part) is reported as planning to develop three hydrogen refuelling stations, a hydrogen powered energy supply system, and 10 hydrogen-powered gantry cranes in port areas over the coming three to four years.
- **PRC photovoltaic solar revolution:** On **June 30, 2022**, it was reported widely that in 2021 of the **54.9 GW** of photovoltaic solar capacity installed in the PRC, **21.6 GW** was **residential roof-top photovoltaic solar**.

Europe and UK:

- **FlightPath to the Future:** On **May 26, 2022**, the UK Department of Transport announced a new policy setting for the aviation sector, [Flightpath to the Future](#). The **Flightpath to the Future** has a ten-point plan for the future of aviation.
- **First carbon storage licensing round:** On **June 14, 2022**, the **North Sea Transition Authority** [launched](#) the first carbon storage licensing round with 13 areas available, located off the coasts of Aberdeen, Lincolnshire, Liverpool and Teesside, being either saline aquifers or depleted oil and gas fields.

- **Scotland's role in Europe:** On **June 20, 2022**, scottish-enterprise-mediacentre.com published an editorial on the development of the Scotland to Germany Green Hydrogen trade opportunities, noting that the **Scot2Ger** initiative builds on the work of Scottish Enterprise earlier in 2021.
- **Finland to establish national hydrogen network:** On **June 23, 2022**, it was reported widely that Finland is to establish a national hydrogen network. For these purposes the **Government of Finland** has mandated **Gasgrid Finland Oy** to develop **hydrogen transmission infrastructure**, and to develop a hydrogen market in Finland.
- **UK Government releases draft CCS network code indicative HoT:** On **June 24, 2022**, the UK Government released the draft **[Carbon Capture, usage and storage \(CCUS\): business models](#)**, together with an **[explanatory note](#)**.
- **Shell to join VindØ consortium:** On **June 21, 2022**, offshorewind.biz reported that **Shell** had signed a letter of intent to join the **VindØ consortium** comprising **Andel, Copenhagen Infrastructure Partners** and **PensionDanmark, PFA** in the development of Denmark's first energy / power island.
- **All is well in the Kingdom of Denmark and getting better:** On **June 24, 2022**, the **Danish Parliament** reached political agreement to accelerate the development of renewable energy, critically, the development and deployment of **20.5 GW** of off-shore wind field capacity **by 2040**.

Americas:

- **Notice of Intent to fund clean hydrogen hubs:** On **June 6, 2022**, the **US Department of Energy (DOE)** published a **Notice of Intent** to fund the **Infrastructure Investment and Jobs Act (IIAJA)** also known as the Bipartisan Infrastructure Law (**BIL**).
US Secretary of Energy, Ms Jennifer Granholm stated: "*Hydrogen energy has the power to slash emissions from multiple carbon-intensive sectors and open a world of economic opportunity to clean energy businesses workers across the country. These hydrogen hubs will make significant progress towards President Biden's vision for a resilient grid that is powered by clean energy and built by American workers*".
- **Working Paper – pathway to 100% zero-emission vehicles by 2035:** On **June 10, 2022**, the icct.org published a working paper, **[Canada's Path to 100% zero-emission light-duty vehicle sales: regulatory options and greenhouse gas impacts](#)**.
The working paper provides a **Baseline Scenario** (reflective of current policy settings in Canada) and three **Alternative Scenarios**, **1.** under which **50%** of sales by 2030 are of electric vehicles, **2.** under which **61%** of sales by 2030 are electric vehicles, and **3.** under which by 2035 plug-in hybrid vehicles are to be phased-out.
The working paper notes that **none of the Scenarios** is consistent with achieving the **economy-wide GHG** reduction target of **40% to 45% by 2030**. The economy-side finding is salutary and telling.
- **Heat Pump Breakthrough:** On **June 17, 2022**, the **US Department of Energy (DOE)** announced a breakthrough in technology for next-generation electric heat pumps, with **DOE** and **Lennox International** to partner to develop cold climate heat pumps (**CCHPs**).
- **US Eastern States partner with Federal Government:** On **June 24, 2022**, it was reported widely that the **Biden Administration** and the **State Governors of 11 US east-coast States** had launched a **[Federal-State Offshore Wind Implementation Partnership](#)**.

France and Germany:

- **German two percent rule:** On **June 15, 2022**, cleanenergywire.org reported that as part of draft legislation, the Federal German Government plans to achieve acceleration of the energy transition by requiring **two percent of the land mass of Germany to be dedicated to the production of renewable electrical energy**.
The new legislation is reported as likely to be passed in **July 2022**, before the start of the summer recess. This initiative is consistent with the doubling of on-shore wind farm capacity to 115 GW by 2030, requiring an additional 10 GW a year from 2025.
- **German hydrogen supply and demand:** On **June 21, 2022**, **Guidehouse** published **[Imports will be a cornerstone for Meeting Germany's Hydrogen Demand](#)**. The **Guidehouse** report was prepared for the German Federal Ministry for Economic Affairs and Climate Action. The report is insightful, providing practical perspectives.
- **Air Liquide and Siemens Energy:** On **June 24, 2022**, it was reported widely that **Air Liquide** and **Siemens Energy** are to work together in joint venture so as to be able to accelerate the manufacturing capacity of proton exchange electrolyzers. **Air Liquide** and **Siemens Energy** will be able to achieve scale across the Green Hydrogen projects that each has in its portfolio.
- **Chile and Germany alignment:** On **June 29, 2022**, **Chile** and **Germany** signed a letter of intent to develop a bilateral alliance for hydrogen production and trade.
- **German demand for heat pumps defined and scoped:** On **June 30, 2022**, the German Federal Government stated that by 2024 **500,000 heat pumps a year** would be required to be manufactured for installation across Germany. This provides a clear signal to German industry of the scope and scale of demand.

Australia:

- **NSW to fast-track the development of NSW Renewable Energy Zones:** On **June 10, 2022**, the New South Wales Government **announced** its intention to fast-track the development of the **Renewable Energy Zones (REZs)**, to provide funding support for augmentation / development of the transmission network (with the funding to be sourced from a new **Transmission Acceleration Facility**), and to develop **BESS capacity** (including the **Warratah Super Battery**).
- **QLD study funding support:** On **June 13, 2022**, energy-storage.news reported that on **June 10, 2022**, the Queensland Government had allocated **AUD 35 million (USD 24.5 million)** in respect of a study to identify a site for a **second pumped hydro energy storage (PHES)** plant.
- **Australia increases its NDC to 43%:** On **June 16, 2022**, the **Australian Federal Government** submitted a revised nationally determined contribution (**NDC**) under the **Paris Agreement**, committing Australia to reduce **GHG**

emissions by **43% by 2030**, compared to 2005 levels, a **15% to 17% increase** in Australia's previous **NDC** of a 26% to 28% reduction. The revised **NDC** is most welcome, bringing Australia alongside other developed economies.

- **Western Australia states its determined contribution:** On **June 22, 2022**, the **State of Western Australia** announced that Western Australian State **Government agencies** will be required to reduce their **GHG** emissions to **80% below 2020 levels by 2030**.
- **Australian-German Hydrogen Taskforce white paper:** On **June 24, 2022**, the **Australian-German Hydrogen Taskforce** published its **White Paper** together with a **10-point action plan** (or possibly characterised as a 10 point description) entitled **Green Hydrogen Task Force – White Paper and 10 Point Action Plan**.

Blue and Green Carbon Initiatives and Biodiversity

- **World Bank supports mangrove conservation and restoration in Indonesia:** On **June 7, 2022**, **The World Bank** announced its support for projects to conserve and to restore mangrove growth in Indonesia, under **The Mangrove for Coastal Resilience Project**. The Project is stated to "focus on strengthening the policy and institutions for mangrove management and rehabilitation, promoting sustainable mangrove management, as well as improving the livelihood opportunities for Indonesian coastal communities living around mangrove forests".
- **Sustainability strategy without biodiversity is incomplete:** On **June 21, 2022**, [quantis.com](https://www.quantis.com) published an excellent article [Seeing the forest for the trees: Why an environmental sustainability strategy without biodiversity is incomplete](#). The article provides a compelling narrative of the criticality of biodiversity to the world economy, a value "often overlooked", in particular in the context of the focus on **GHG** emission reductions.

"Climate Change and biodiversity loss are two sides of the same coin; they're intertwined through mechanistic links and feedbacks ... Climate change exacerbates risks to biodiversity, while ecosystems and their biodiversity are key for climate mitigation and adaptation".

Bioenergy and heat-recovery:

- **Clariant clutched straw:** On **June 14, 2022**, **Clariant** announced that it had begun production at its sunliquid® cellulosic ethanol facility in **Podari, Romania**, of second-generation **biofuel** using feedstock sourced from **agricultural residues**. The biofuel produced at the Podari facility is to be off-taken by Shell.
- **Cargill opens biodiesel plant:** On **June 21, 2022**, it was reported widely that **Cargill** had opened a biodiesel plant, located in Ghent, Belgium. The biodiesel plant processes waste fats and oils, with the biodiesel intended to be used in the transportation industry. As reported, the plant will produce up to **115,000 metric tonnes** of biodiesel a year.
- **Hazer Group Woodman Point Project progressed:** On **June 28, 2022**, **Hazer Group Limited** [announced](#) that it had completed construction and commissioning of its **Commercial Demonstration Plant** at **Woodman Point, Western Australia**. The **Commercial Demonstration Plant**, using the **Hazer Process** (involving methane pyrolysis), processes biogas derived and produced from waste water at the **Woodman Point Water Recovery Facility** to produce graphite and turquoise hydrogen.

BESS and HESS (and energy storage, including CAES and PHES):

- **CAES connected to grid in the PRC:** On **June 1, 2022**, [energy-storage.news](https://www.energy-storage.news) reported that a **300 MWh CAES** had been connected to the grid in **Jiangsu, the PRC**.
- **US DOE provides USD 504.4 million loan guarantee:** On **June 8, 2022**, the **DOE** announced that it had provided the loan guarantee. The loan guarantee was key to allowing financial close to allow the development of the Advanced Clean Energy Storage (**ACES**) project in **Delta, Utah**. The **ACES** project will have **150 GWh** of energy storage capacity, making it the largest **HESS** project globally.

On **June 9, 2022**, **Haddington Ventures** [announced](#) the **USD 650 million** equity syndication program to provide finance for the **ACES** project. As announced, the equity investors are **Alberta Investment Management Corporation, GIC, Manulife Financial Corporation, and Ontario Teachers' Pension Plan Board**.

- **CO₂ battery storage:** On **June 8, 2022**, [electrek.co](https://www.electrek.co) reported that **Energy Dome** had announced that it was to launch the first **CO₂ battery storage (CO₂ Battery)** in **Sardinia, Italy**. As reported, the **CO₂ Battery** uses **CO₂** to store renewable electrical energy on the grid.
- **Spain Big BESS Tender:** On **June 10, 2022**, **Spain's Ministry of Ecological Transition and Demographic Challenge** announced plans to commence a tender process for up to **5.85 MW** of **renewable energy** and **BESS** capacity to access the grid at **17** nodes.
- **Bluestone and GIG energised:** On **June 14, 2022**, it was reported that **Bluestone Energy Ltd** and **Green Investment Group** are to work together to develop and to deploy **2 GW** of **BESS** projects across the UK. As reported, **Blue Energy** and **GIG** are already working together on the development of **970 MW** of **BESS** projects.
- **Edify achieves financial close:** On **June 14, 2022**, **Edify Energy** [announced](#) that financial close had been achieved in respect of **150 MW / 300 MWh** of **BESS** projects (across three **BESS** sites). The **BESS** projects have off-take agreements in place with **EnergyAustralia** and **Shell Energy**.
- **NREL maps PHES potential:** The US **National Renewable Energy Laboratory (NREL)** has developed an [interactive map](#) identifying potential pumped hydro energy storage (**PHES**) sites in the US. As reported, the US has **43 PHES** plants, with combined capacity of **23 GW**. **NREL** has assessed potential for **3.5 TW** of new **PHES** capacity. The **NREL report** on **PHES** potential is well-worth a read.
- **Sembcorp Industries to BOO BESS at Jurong Island:** On **June 15, 2022**, [theedgesingapore](https://www.theedgesingapore.com) reported that the **Energy Market Authority** of Singapore had appointed **Sembcorp Industries** (wholly-owned subsidiary of Sembcorp Utilities) to build, own and operate a **200 MW / 200 MWh BESS** on **Jurong Island, Singapore**.
- **Europe's need for energy storage:** On **June 20, 2022**, the **European Association of Energy Storage (EASE)** published [Energy Storage Targets 2030 and 2050](#). As might be expected, the headline from the report is that **by 2030** Europe needs to have installed **187 GW** of energy storage capacity and **by 2050 600 GW**. The report is well-worth a read, providing an assessment of the energy storage solutions that are likely to make up the **187 GW** of **energy storage** capacity **by 2030**.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

- **Ørsted CCS plans at Asnæs and Avedøre:** On **June 13, 2022**, [ørsted.com](https://www.ørsted.com) published a piece entitled [Ørsted to capture and store 400,000 tonnes of carbon in 2025](#). Previous editions of Low Carbon Pulse have covered Ørsted's wood-chip-fired **Asnæs Power Station**, in Kalundborg, and the straw-fired-boiler at its **Avedøre Power Station** in Greater Copenhagen.
- **Neptune Energy progressing with CCS at L 10:** On **June 20, 2022**, **Neptune Energy** [announced](#) that it had signed a **cooperation agreement** with **XTO Energy, Rosewood Exploration Ltd** and **EBN B.V** to develop L 10.
- **CNNOC CCS commissioned:** On **June 23, 2022**, [energyvoice.com](https://www.energyvoice.com) reported that the **China National Offshore Oil Corporation (CNOOC)** had commissioned the first offshore carbon capture and storage project to store **CO₂** permanently below the seabed.
- **CCS / CCUS commences in Cheshire:** On **June 24, 2022**, [theguardian.com](https://www.theguardian.com) reported that **Tata Chemicals Europe (TCE)** is to commence capturing **CO₂** from a co-generation plant with the **CO₂** captured (up to **40,000 metric tonnes** a year) to be used in the manufacture of products. The **TCE** carbon capture facility is reported to be the first industrial-scale carbon capture facility in the UK.
- **CNOOC combines with ExxonMobil and Shell:** On **June 28, 2022**, it was reported widely that **CNOOC, ExxonMobil** and **Shell** are to develop jointly a CCS project in **Guangdong Province, the PRC**. **Shell** [announced](#) that it had signed a memorandum of understanding with **CNOOC, Guangdong Provincial Development and Reform Commission** and **ExxonMobil** to explore the feasibility of developing a carbon capture and storage hub in the **Daya Bay National Economic and Technological Development Zone** in Huizhou, Guangdong Province, the **PRC**.
In addition, **Shell** published [Achieving A Carbon-Neutral Energy System in China by 2060](#). The publication is divided into three sections: **Section One: Achieving a Net-Zero CO₂ Energy System by 2060**; **Section Two: China's Energy System in 2060**; and **Section Three: Making Progress Towards Carbon Neutrality**.
- **Equinor and Fluxys progressing to CCS in North Sea:** On **June 29, 2022**, it was reported widely that **Equinor** and **Fluxys** are to work together to provide **CCS solutions** for the North-West European market.
- **DAC technologies assessed:** On **June 29, 2022**, **NREL** made a news release [Scientists Look to the Sky in Effort To Mitigate Carbon Problem](#). The news release from **NREL** is well-worth a read, providing a high-level assessment of **solvent- based** and **sorbent-based DAC** technologies.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

- **Plug Power plugs Port of Antwerp-Bruges concession:** On **June 13, 2022**, [plugpower.com](https://www.plugpower.com) released a piece on the execution by **Plug Power** and the **Port of Antwerp-Burges** of a **30 year concession agreement** to develop and to deploy a **100 MW Green Hydrogen production** facility, using Plug Power PEM electrolyzers, to produce up to **35 metric tonnes** daily, and up to **12,500 metric tonnes** annually, of Green Hydrogen. The **Green Hydrogen production** facility is to be located in the **NextGen District** of the Port, with first production expected in late 2024.
- **Neste and VTT to build power-to-liquids production facility:** On **June 14, 2022**, **VTT** [announced](#) that it and **Neste**, had agreed to develop a **Power-to-X- to-liquids** production facility, an **E-Fuel pilot project**. As announced, the **pilot project** will capture **CO₂**, produce **Green Hydrogen** and **E-Fuels**.
- **AGL leading two feasibility studies on BESS:** On **June 17, 2022**, it was reported widely that **AGL Energy Limited** is undertaking feasibility studies in respect of two sites, one at its **Liddell** site, in the Hunter Valley, New South Wales, and the other at **Torrrens Island**, its site in South Australia.
- **Tierra del Fuego wants to produce Green Hydrogen:** On **June 16, 2022**, **Bloomberg** reported that **Tierra del Fuego** wants to develop **USD 6 billion** Green Hydrogen and Green Ammonia production facilities powered by renewable energy produced from its world class wind resources.
- **CVX to invest USD 2.5 billion and Blue and Green Hydrogen:** On **June 17, 2022**, [rechargenews.com](https://www.rechargenews.com) reported that at **The Financial Times Hydrogen Summit**, **Mr Austin Knight** (vice-president of hydrogen and Chevron New Energies) had indicated that CVX intends to invest **USD 2 billion** in "broader energy solutions with hydrogen and moving into clean hydrogen".
- **Southland Hydrogen – final partner selection:** On **June 20, 2022**, it was reported widely that **Contact** and **Meridian Energy** had selected **Fortescue Future Industries** or **FFI** and **Woodside Energy Limited (WEL)** for the purposes of the choice of partner to develop the largest Green Hydrogen production facility in **Southland, New Zealand**.
- **OCI NV Project recast:** On **June 15, 2022**, it was reported widely that **OCI NV** had made a final investment decision to develop its ammonia receiving terminal in the precincts of the **Port of Rotterdam**. The final investment decision taken (in respect of phase 1) contemplates the development and deployment of more than **1.2 million metric tonnes** a year. The reported thinking is to provide for scaling-up of production to allow production capacity to be increased to **3 million metric tonnes** a year.
- **Linde, STT and YTL land in Singapore:** On **June 22, 2022**, [datacenterdynamics.com](https://www.datacenterdynamics.com) reported that **Linde** and **STT GDC** (short for **ST Telemedia Global Data Centers**) and **YTL Corporation** are working together to assess the use of hydrogen in Singapore.
- **EnBW and RWE JV:** On **June 24, 2022**, it was reported widely that **RWE** and **EnBW** intend to develop a **100 MW Green Hydrogen production facility** at the port of **Rostock, Germany**. The Green Hydrogen production facility is part of the **Hy Tech Hafen Rostock Project**.
- **Neste builds out at the Port of Rotterdam:** On **June 28, 2022**, it was reported widely that **Neste Corporation** had taken a final investment decision to expand its Future Fuels production capacity at the **Port of Rotterdam** by **1.3 million metric tonnes** a year, nearly doubling its Future Fuels production capacity to **2.7 million metric tonnes**.
- On **June 28, 2022**, **Air Products** [announced](#) that it and **Gunvor Petroleum Rotterdam** are planning to develop a hydrogen receiving terminal in the precincts of the **Port of Rotterdam**.

- **Gasunie starts construction of national hydrogen network:** On **June 29, 2022**, [Gasunie](#) announced that it had commenced construction of the national hydrogen network for the Netherlands, and, having constructed the network, that it will operate the network at the **Transmission System Operator** or **TSO**.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories and HVDC:

- **BASQUEVOLT energised:** On **June 10, 2022**, [batteriesnews.com](#) reported that **BASQUEVOLT** had been launched. **BASQUEVOLT** is a **€700 million** initiative to manufacture **solid-state** batteries, with the intention to manufacture batteries with combined capacity of **10 GWh** by **2027**. **BASQUEVOLT** is supported by the **Basque Government**, investors in it include **CIE Automotive**, **EIT InnoEnergy**, **Enagás**, and **Iberdrola**, each of which is a founding shareholder, together with **CIC energiGUNE** which is reported to have undertaken research, and to have reported on, **BASQUEVOLT**.
- **Greece-Italy interconnector to be expand capacity:** On **July 14, 2022**, [renewablesnow.com](#) reported that **Terna SpA** is to invest **€750 million (USD 783 million)** to double the exchange capacity through the Greece-Italy interconnector.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

- **Green Steel – a deeper dive:** On **June 15, 2022**, the good folk at [rechargenews.com](#) (under [Green steel moves a step closer to commercialisation with "first of its kind" hydrogen cavern storage](#)) provided an excellent overview of **Hydrogen Breakthrough Ironmaking Technology**, or **Hybrit**, consortium. While **Low Carbon Pulse** has covered **Hybrit** more often than any other initiative or project, the article in [rechargenews](#) is well-worth a read because it covers **Hybrit** in detail, including the recent progress in respect of the **HESS** using caverns proximate the location of the fossil free iron and steel mill.
- **Two global leaders connect:** On **June 15, 2022**, **Fortescue Metals Group Ltd** announced that it is to work with **Liebherr** to develop green mining haul trucks, using zero-emission power system technology being development by **FFI** and **Williams Advanced Engineering**.
- **Mineral Security Partnership:** On **June 14, 2022**, the US and key partner countries [announced](#) the establishment of the **Mineral Security Partnership (MSP)**. The purpose of the **MSP** is to ensure that critical minerals are mined and otherwise sourced, processed and recycled in a manner that supports the ability of countries to realise the economic benefit of their geological resources. As announced, **MSP** partner countries include Australia, Canada, Finland, France, Germany, Japan, the ROK, Sweden, the UK and the US, and the European Commission.
- **ArcelorMittal and RWE – off-shore to on-shore:** On **June 22, 2022**, **RWE** announced that it and **ArcelorMittal** had signed a memorandum of understanding (**MOU**) to work together to develop and to deploy **off-shore wind fields** and **hydrogen facilities** to produce hydrogen for use by **ArcelorMittal** at its iron and steel mills in Germany.

Wind round-up, on-shore and off-shore:

- **Ocean Winds seeks approval for 1.6 GW OWF project:** On **June 3, 2022** it was reported widely that **Ocean Winds** is progressing with the first phase of the consultation process as part of the approval process for its proposed **Réalt na Mara** off-shore wind field project, off the coast of the **Republic of Ireland**.
- **Ørsted Changhua County off-shore wind field projects progress:** On **June 8, 2022**, it was reported widely that the **two 750 MW** off-shore wind field projects (**Xufeng-2** and **Xufeng-3**), off **Changhua County, Taiwan**, were progressing as a result of the recommendation for approval of each Environmental Impact Statement (**EIA**) for each project.
- **Cirio offshore:**
 - **Australia: 2.5 GW off-shore wind field project down-under:** On **June 10, 2022**, it was reported widely that **Corio Generation** plans to develop a **2.5 GW** off-shore wind field project **22 km** off **Wellington Shire, Gippsland**, in the state of **Victoria**, Australia (**Great Eastern Offshore Wind** project).
 - **Brazil fixed-bottoms - 5 GW off-shore wind project off Brazil:** On **June 13, 2022**, it was reported widely that **Corio Generation** plans to develop **five fixed-bottom** off-shore wind fields off the coast of **Brazil**. The five fixed bottom off-shore wind fields are reported to be at early stage development, having made applications for investigation licences, which are with the **IBAMA** (the Institute for Environment and Natural Resources).
- **Shell to be found in the Baltic Sea:** On **June 13, 2022**, **Shell** [announced](#) that **Amber Baltic Wind Ltd** (a wholly-owned subsidiary of **Shell plc**) had submitted proposals for new off-shore wind locations in the Polish sector of the Baltic Sea, as part of the Polish Government's current procurement process.
- **The Netherlands tethers tendering timelines:** On **June 13, 2022**, [offshorewind.biz](#) reported that the Government of the Netherlands had announced the tendering timelines for **nine off-shore wind field projects** ranging in installed capacity from **700 MW** to **2 GW**.
- **Denmark not tethered by previous targets:** On **June 13, 2022**, it was reported widely that the **Danish Government** had announced plans to increase the of-shore wind field capacity of Denmark by 2030: the plan is to increase the capacity by a further **4 GW by 2030**, from **8.8 GW** to **12.9 GW**.
- **RWE and SGN look to water and wind:** On **June 14, 2022**, [renews.biz](#) reported that **RWE** and **SGN** signed an memorandum of understanding (**MoU**) under which they will work together to investigate the production of Green Hydrogen for use to satisfy heating demand in Campbeltown, Oban, Stornoway, Thurso and Wick in Scotland.
- **NZ Super Fund and CIP project NZ wind:** On **June 14, 2022**, [4coffshore.com](#) reported that **NZ Super Fund** and **Copenhagen Infrastructure Partners** or **CIP** are exploring the potential for the development of off-shore wind capacity off Aotearoa, New Zealand, off the South Taranaki coast, to support **1 GW** of off-shore wind field capacity.
- **Ocean Winds fixed on Brazil:** On **June 15, 2022**, it was reported widely that **Ocean Winds** (a 50:50 joint venture of **Engie** and **EDP Renewables**) plans to develop **15 GW.2** of off-shore wind field capacity off Brazil, and that for these purposes it had applied to **IBAMA** for approval to investigate five off-shore wind field areas.

- **Studying Troll Field floating wind field:** On **June 17, 2022**, it was reported widely that **Equinor** was leading a study, working with **Conocco Phillips, Pectoro, Shell** and **TotalEnergies**, to assess the feasibility of the development and deployment of a **1 GW** off-shore floating wind field project, 65 km off-shore of Bergen, Norway (**Trollvind project**).
- **Copenhagen Infrastructure Partners obtains EBLs:** On **June 20, 2022**, **CIP** announced that it had been granted **Electricity Business Licences** for its three floating off-shore wind field projects offshore of **Ulsan, South Korea**, once installed having **1.5 GW** of capacity.
- **Connection and transmission infrastructure:** On **June 22, 2022**, 4coffshore.com reported that **Svenska Kraftnät** intends to develop six offshore connection points off the Swedish coast between 2029 and 2035. The connection points will allow renewable electrical energy generated from 10 GW of off-shore wind field capacity to be accommodated into the grid in Sweden.
- **A Big Catch:** On **June 27, 2022**, it was reported widely that the **Kellybegs Fisherman's Organisation Ltd** and **Sinbad Marine Services Ltd** had signed a memorandum of understanding with **Hexicon AB** (Swedish headquartered off-shore wind and technology corporation) for the purposes of developing a **2 GW floating off-shore floating wind field** to be located around **50 km off-shore** of **County Donegal, Republic of Ireland**.

Solar and Sustainability (including NZE Waste):

- **West Dunbartonshire Council, Scotland, gives green light on plastics-to-hydrogen:** On **June 9, 2022**, utilityweek.co.uk reported that West Dunbartonshire Council had approved the development of the UK's second plastics-to-hydrogen (**P-to-H2**) project. The **P-to-H2** project comprises a **13,000 metric tonne** facility that will derive sustainable hydrogen from non-recyclable plastics.
- **Rio Tinto procuring 4 GW of renewables:** On **June 8, 2022**, **Rio Tinto** [announced](#) that it is seeking proposals to develop large-scale photovoltaic solar and wind in Central and Southern Queensland to power its Boyne smelter, Yarwun alumina refinery, and Queensland Alumina refinery, so as to allow it to achieve "its climate change ambitions and further encourage renewable development and industry in the region".
- **Prime Infrastructure Holdings plans 3.5 GW photovoltaic solar farm:** On **June 10, 2022**, pv.magazine-australia reported that **Prime Infrastructure Holdings** had announced plans to develop and to deploy a **2.5 GW** to **3.5 GW** photovoltaic solar farm and a **4** to **4.5 GWh BESS** in the Philippines.
- **NY awards 2.4 GW of photovoltaic solar and 159 MW of BESS:** On **June 13, 2022**, [energy-storage](#) reported that the US state of New York, New York State Energy Research and Development Authority (**NYSERDA**) had awarded **22** photovoltaic solar projects to install **2.4 GW** of capacity, including six projects with co-located **BESS** having a combined capacity of **159 MW**. The 22 photovoltaic projects will require **USD 2.7 billion** to develop and to deploy. The awards represent New York State's largest-shore-based procurement of renewable energy.
- **Shell swift to shift:** On **June 13, 2022**, it reported widely that **Shell UK** had [announced](#) plans invest up to **GBP 25 billion** so as to enable it to achieve its "five ambitions to help the UK to net zero".
- **Jinko searches for Keppel:** On **June 13, 2022**, sbr.com.sg reported that **Jinko Power** is to work with **Keppel Infrastructure Fund Management Pte Ltd** to identify up to **1 GW** of photovoltaic solar and **BESS** in which **Keppel** may invest "in key developed markets in Asia Pacific, Europe and the Middle East".
- **BASF to develop battery recycling plant in Germany:** On **June 22, 2022**, batteryindustry.tech reported that **BASF** is to develop a commercial scale **battery recycling black mass plant** in Schwarzheide, Germany: the concept of black mass refers to the first step in the recycling process, deriving metals used to produce cathode active materials (**CAMs**), including cobalt, lithium, manganese, and nickel.
- **24 bidders approved or 2 GW auction:** On **June 22, 2022**, pv-magazine.com reported that the **Green Energy Auction Bids Evaluation and Awards Committee** of the Philippines **Department of Energy (DOE)** had approved **24 bidders** to compete in an auction to allocate **2 GW** of capacity. As reported, of the **24 bidders**, **eight** are **photovoltaic solar**, **eight** are **wind**, **seven** are **run-of-river hydroelectric**, and **one** is **biomass**.
The Green Energy Auction Bids Evaluation and Awards Committee published details of 19 bidders successful in their bids, allocating **1.966 GW** of renewable energy among them, with around **1.490 GW** of **photovoltaic solar**, **374 MW** of **wind**, **120 MW** of **hydroelectric** and **3.5 MW** of **biomass**.
- **Sun Cable investment ready:** On **June 24, 2022**, **Sun Cable** [announced](#) that **Infrastructure Australia** had endorsed its **USD 30 billion** project as **investment ready**, among other things, providing an opportunity for **Sun Cable** to access funding from the **Clean Energy Finance Corporation** and the **Northern Australia Infrastructure Facility**.

Land Mobility / Transport:

- **Buses and coaches:**
 - **Melbourne to run hydrogen buses:** On **June 2, 2022**, it was reported widely that from March 2023 the State of Victoria, Australia, will trial the use of two hydrogen powered and propelled buses. As reported, **Transit Systems** will operate the buses, which are to be trialled on 15 school bus routes, and 26 other routes in the western suburbs of Melbourne.
 - **IVECO to recommence production of buses in Italy:** On **June 21, 2020**, fuelcellworks.com reported that **IVECO** intends to recommence the production of buses, including using battery electric and fuel-cell technologies to manufacture battery electric, and fuel-cell electric buses.
- **Cars (including taxis and air-taxis, and fast cars and racing cars!):**
 - **Have the cars been drinking?:** On **June 10, 2022**, hydrogen-central.com reported that **TotalEnergies** deployed a hydrogen refuelling station at the **Le Mans**, 24-hour race. In addition, it was reported that the 62 cars competing in the **90th Le Mans 24-hour race** (June 11 and 12, 2022) were powered and propelled by 100% renewable fuel produced and supplied by **TotalEnergies** – **Excellium Racing 100**. **Excellium Racing 100** is derived and produced from wine residues (grape marcs and lees).

- **Overair Funded:** On **June 14, 2022**, [fuelcellworks.com](https://www.fuelcellworks.com) reported that **Hanwha Group** had provided **USD 145 million** in funding to Overair for the development of the electric vertical and landing (eVTOL) **Butterfly**.
- **Ferrari to go electric:**
 - On **June 17, 2022**, [The Financial Times](https://www.thefinancialtimes.com) reported that **Ferrari** will power and propel 40% of its vehicles using battery electric technology by 2030, and 40% of its vehicles using hybrid technology by 2030.
 - On **June 23, 2022**, it was reported widely that **Ferrari** is work with **Bloom Energy** to decarbonise its motor vehicle manufacturing plant at **Maranello, Italy**.
- **Battery, Fuel Cell and ICE Technology:**
 - **Recharge will driving:** On **June 1, 2022**, [techspot.com](https://www.techspot.com) reported that **Electreon** had announced that it is planning the development and deployment a **wireless-charging** pilot road project in Detroit, Michigan, US.
 - **Cummins Inc zero-emissions for Komatsu:** On **June 28, 2022**, **Cummins Inc** announced that it was to work with **Komatsu Ltd** under a memorandum of understanding to develop zero-emissions haulage equipment.
 - **Hyundai Doosan ICE:** On **June 29, 2022**, it was reported widely that **Hyundai Doosan Infracore** had commenced development of a **hydrogen-fired engine** for use in **buses, commercial vehicles and construction machinery and vehicles, and heavy goods vehicles / trucks**.
- **Industrial Vehicles and Trucks:**
 - **JCB parades first hydrogen digger:** During the **Queen's 70th Jubilee Week** (during the first week of June), it was reported widely that the **JCB backhoe loader** had been introduced to the world (in one of the parades held to mark the Jubilee).
 - **Volvo CE tests first hydrogen articulated hauler:** On **June 13, 2022**, it was reported widely that **Volvo Construction Equipment (Volvo CE)** had commenced testing of a prototype articulated hauler – the **Volvo HXO4**.
 - **Amogy Ammonia tractor:** On **June 9, 2022**, the **Ammonia Energy Association** [announced](https://www.amogy.com) that **Amogy** had demonstrated successfully a new ammonia powered and propelled tractor in Stony Brook, New York: a **100 KW ammonia-to-power system** having been integrated successfully into a John Deere mid-sized standard tractor.
 - **Volvo testing fuel cell technology trucks:** On **June 20, 2022**, it was reported widely the **Volvo Trucks** is testing trucks powered and propelled by hydrogen fuel cells. As reported, the range of the Volvo Trucks using fuel-cells is up to **1,000 kms (or 620 miles)**, and having the ability to refuel in 15 minutes.
 - **Hydrogen key for heavy-duty long distance transportation:** On **June 23, 2022**, [Rethink Energy](https://www.rethinkenergy.com) published [Heavy duty transport transition WILL rely more on hydrogen than batteries](https://www.rethinkenergy.com/publications/heavy-duty-transport-transition-will-rely-more-on-hydrogen-than-batteries). At 20 pages, the publication is an easy, and thought provoking, read.
- **Recharging and refuelling infrastructure:**
 - **Portable hydrogen cartridge:** On **June 2, 2022**, **Toyota Motor Corporation**, and its subsidiary **Woven Planet Holdings**, [announced](https://www.toyota.com) the development of a prototype hydrogen cartridge for use in a number of applications.
 - **CLARA and Hydrogen Fuels provide clear hyway:** On **June 22, 2022**, it was reported widely that **CLARA Energy** and **Hydrogen Fuels Australia** are to work together to develop and to deploy **up to five hydrogen refuelling stations** along the Hulme Highway, the main highway between Australia's two most populous cities, Melbourne and Sydney. As reported, the cost of the development and deployment will be around **AUD 600 million**.
 - **Liquid hydrogen refuelling station:** On **June 27, 2022**, it was reported widely that a liquid hydrogen refuelling station had been installed at the **Daimler Truck** testing centre in Wörth am Rhein, Germany.
- **Trains:**
 - **Berlin-Brandenburg lines go hydrogen:** On **June 27 and 28, 2022**, it was reported widely that **Siemens Mobility** had contracted with **Niederbarnimer Eisenbahn (NEB)** to supply **seven** of its **two-car hydrogen** powered and propelled **Mireo Plus H trains** for a line in the region of Berlin-Brandenburg, Germany. As reported, Siemens is to deliver the trains for Q3 2024. The **Mireo Plus H trains** will replace diesel trains.
 - **Underground goes green:** On **June 28, 2022**, it was reported widely that the **Mayor of London, Mr Sadiq Khan**, got rolling the procurement process to procure green electrical energy to power and to propel the **London Underground** system. The procurement process will result in 10% of electrical energy to be supplied from renewable energy sources to Transport for London, with the long-term intention to move to 100%.

Ports Progress and Shipping Forecast:

- **Ferries and other craft (including tugs):**
 - **Approval in Principle (AiP) for H2 Ocean:** On **June 3, 2022**, it was reported widely that leading international shipping classification society, **Lloyds Register**, had granted **AiP** in respect of the design of the **H2 Ocean**, a harbour cruise vessel powered and propelled by fuel cell technology and battery electric technology.
 - **Launch of hydrogen-powered vessel concept:** On **June 13, 2022**, it was reported widely that **DNV, Ektank AB, Shell Shipping and Maritime**, and **TECO 2000** had launched the **Hy-Ektobank**. The concept manifest by the **Hy-Ektobank** is that existing **Ektank** vessels will be retrofitted with fuel cell technology to power and to propel them, using compressed and liquified hydrogen. The **Hy-Ektobank** is intended to allow **Ektank** to reduce its **GHG** emission footprint by **55% by 2030**, and to achieve **net-zero by 2050**.
 - **EV Ellen poster ferry:** On **June 20, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **EV Ellen** had set a new world record during the International Energy Agency 7th Annual Global Conference on Energy Efficiency held in **Sønderborg, Denmark**. **EV Ellen** travelled 92 kms (or 50 nautical miles) on a single charge of its battery. The **EV Ellen** has been operating since 2019, using **Danfoss' Editron** electric drivetrains and propulsion motor.
 - **Sparky the electric tug:** On **June 21, 2022**, it was reported widely that the **Port of Auckland, New Zealand**, had received **Sparky**, the electric tug (e-tug in some reporting). **Sparky** is the first **Damen RSD-E Tug 251**, having a 70 tonne bollard pull, and **2,240 batteries** producing **2,784 KWh** of power.

- **MV Hydrogen one hydrogen tug:** On **June 22, 2022**, [news.cision.com](https://www.news.cision.com) reported on the development of **MV / Hydrogen One** being developed by US-based **Maritime Partners LLC**, with **Maritime Partners** placing orders with **PowerCell Sweden AB** for its PowerCellution Marine System 200 fuel cells.
- **Green Ports (including infrastructure):**
 - **Ports need to be supercharged:** On **June 24, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that the UK ports sector has called on the UK Government "to supercharge the delivery of energy network infrastructure to ports with new research and a transformational funding programme".
 - **Stockholm Norvik Port development:** On **June 30, 2022**, it was reported widely that **CBM.TECH** and **Ports of Stockholm** are to work together to develop a hydrogen refuelling station in the vicinity of the **Norvik Port**. The refuelling station will supply hydrogen to fuel cell powered and propelled vehicles deployed at **Norvik Port**.
- **Green Freeports:**
 - **Bids on the way:** As reported in **Edition 40** of the Low Carbon Pulse, two Freeports in Scotland will benefit from lower tariffs and tax incentives within defined precincts of airports, seaports and rail terminals.
 - **Bids in:** As reported widely, bids for Freeport status were received on **June 20, 2022**, from the following (in alphabetical order): **Clyde** Green Freeport, Opportunity **Cromarty Firth**, **Firth of Forth** Green Freeport, **Orkney** Green Freeport, and North East Scotland Green Freeport (comprising **Port of Aberdeen** and **Aberdeen International Airport** and the **Peterhead Port Authority**).
- **Green Shipping:**
 - **Ocean Yield orders methanol -ready box-ship:** On **June 13, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Ocean Yield AS** is to order a **5,500 TEU box-ship** from **HJ Shipbuilding & Construction** (formerly Hanjin Heavy Industries & Construction).
 - **LMG Marin AS green ammonia carrier:** On **June 13, 2022**, **Sembcorp Marine Ltd** [announced](https://www.offshore-energy.biz) that its wholly-owned subsidiary, **LMG Marin AS**, working with **Grieg Edge** and **Wärtsilä** had been awarded **Approval in Principle (AiP)** for the design of a tanker (**MS Green Ammonia**) that is powered and propelled by **Green Ammonia**. The AiP was awarded by **DNV – Maritime (Den Norske Veritas)**.
 - **Acta Marine in the act:** On **June 14, 2022**, [4coffshore.com](https://www.4coffshore.com) reported that **Acta Marine** had ordered two next generation MDO / HVO powered and propelled DP2 methanol fuelled construction support operating vessels (CSOVs) from Turkish shipyard Tersan.
 - **MANNED up:** On **June 17, 2022**, [hydrogen-central.com](https://www.hydrogen-central.com) reported that dual fuel **MAN Engines** had been installed on a work boat: the **MAN Engines** are **V-12** marine diesel engines (**MAN D2862 LE448**) that have been supplemented with a hydrogen injection system by **CMB.TECH**.
 - **Howden E-compression:** On **June 17, 2022**, [h2-view.com](https://www.h2-view.com) reported that **Howden** had signed a contract with **European Energy** to provide hydrogen compressors to allow **European Energy** to deliver compressed Green Hydrogen as feedstock for the production of **E-Methanol** for use in maritime transportation.
 - **Proman Stena Bulk takes delivery of methanol fuelled tanker:** On **June 20, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Proman Stena Bulk** had taken delivery of the **first of six 49,990 dwt methanol-powered-and-propelled dual-fuel medium-range tankers** – the **Stena Pro Patria**.
 - **ESL Shipping to use Neste co-processed marine fuel:** On **June 20, 2022**, **Neste** announced that **ESL Shipping** is to use **Neste Marine™ 0.1 Co-processed** marine fuel to power and to propel **ESL Shipping** vessels in Finland and Sweden.
 - **WindWings flying:**
 - **Mitsubishi Corporation to sail:** On **June 21, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Mitsubishi Corporation** intends to install **Two WindWings** on the **Pyxis Ocean**, a 80,962 dwt **bulk carrier**. **BAR Technologies** has developed the **WindWings** technology, and Yara Marine will install the **WindWings** on the **Pyxis Ocean**.
 - **Berge Bulk Berge Olympus to sail:** On **June 29, 2022**, it was reported widely that **Berge Bulk** (leading dry bulk shipping corporation) is to equip its Newcastlemax bulk carrier, the **210,000 DWT Berge Olympus**, with four **BAR Technologies WindWings**.
 - **SeaShuttle on the drawing board:** On **June 23, 2021**, it was reported widely that **Enova** (Norwegian energy and climate technology company, operating under the Ministry of Climate and Environment) had provided funding support for the development of two fuel-cell technology hydrogen powered and propelled **500 TEU containerships** to be remotely controlled and autonomous ready.
 - **ENOVA supports hydrogen and ammonia ecosystem:** On **June 24, 2022**, it was reported widely that **Enova** is to support **five hydrogen production facilities** along the coast of Norway and **seven hydrogen and ammonia** powered and propelled **vessels**.
 - **Roll-on:** On **June 27, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Knud E. Hansen** and **Wallenius Marine** had signed a memorandum of agreement for **Knud E. Hansen** to join the team designing the **world's first wind-powered roll-on/roll-off (RoRo) 7,000 CEU** vessel.
- **Decarbonising the maritime sector:**
 - **Coordinated action needed across the maritime sector:** On **June 8, 2022**, [unctad.org](https://www.unctad.org) posted an article [Decarbonising the maritime sector: Mobilising coordinated action in the industry using an eco-systems approach](https://www.unctad.org/en/publications-and-statistics/publications/decarbonising-the-maritime-sector-mobilising-coordinated-action-in-the-industry-using-an-eco-systems-approach). The article starts with facts and stats that are known: the marine industry emitted about **1.2 gigatonnes of CO₂-e** in 2020, equivalent to about 3% of global **GHG** emissions.
 - **Green Shipping Corridors:** On **June 10, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that the **Port of Long Beach** (California) or **POLB** had joined the **Shanghai-Los Angeles Green Shipping Corridor**.

- **CO₂ carrier capacity:** On **June 16, 2022**, [Reuters](#) reported that **Shell** intends to develop **CO₂ carriers** with **12,000 m³** capacity, moving to **36,000, 40,000 and 70,000 m³**. Along with **Equinor** and **TotalEnergies**, **Shell** is developing the Northern Lights project (as part of the Longship project), on continental shelf of Norway.
- **Vessel Emission Reductions:** On **June 28, 2022**, Maersk McKinney Moller Center for Zero Carbon Shipping published [Determining the impact and role of onboard vessel emissions reduction](#). The publication is a helpful reminder that while **CO₂** is the focus of **GHG** emission reductions in the shipping sector, the other two well-mixed **GHG's**, **CH₄** and **N₂O**, need to be a focus too, not least because their global warming potential is considerable greater than **CO₂** by metric tonne equivalence.

Airports and Aviation:

- **Sustainable Aviation Fuel Grand Challenge:** On **June 6, 2022**, [LanzaJet](#) posted an article stating that **Southwest Airlines** is to co-invest in the **SAFFire renewables project**, which is developing technology devised in the ever-active **National Renewable Energy Laboratory (NREL)** to convert corn stover into ethanol as feedstock for the derivation / production of **SAF** at the **Freedom Pines Fuels** facility of **LanzaJet**.
- **Airbus and Kansai Airports look to deploy hydrogen:** On **June 10, 2022**, it was reported widely that **Airbus Industries** and **Kansai Airports** had signed a memorandum of understanding (**MOU**) under which they are to assess the use of hydrogen at three airports owned and operated by **Kansai Airports** – **Kansai International Airport, Kobe Airport** and **Osaka international Airport**.
- **ATR, Braathens and Neste teaming for first 100% SAF flight:** On **June 21, 2022**, **AFR, Braathens** and **Neste** each [announced](#) that on **June 21, 2022**, the first **100% SAF** commercial flight had taken place in Sweden, using **Neste MY Sustainable Aviation Fuel**.
- **The Netherlands committed to first hydrogen flights to the London by 2028:** On **June 13, 2022**, [fuelcellworks.com](#) reported that a consortium of **17 Dutch corporations and organisations** (with funding support from the Dutch Government) are committed to the first hydrogen flight by a medium- sized passenger aircraft from **Rotterdam, the Netherlands, to London, England (around 750 kms) by 2028**.
- **GHG emissions from aircraft must peak by 2025:** On **June 15, 2022**, the **International Council on Clean Temperature (ICCT)** published [Vision 2050: Aligning Aviation with the Paris Agreement \(Vision 2050\)](#). The **ICCT** publication assesses the progress that needs to be made to ensure that the aviation sector achieves **GHG** emission reductions consistent the **Paris Agreement**.
For these purposes, the **ICCT** provides **three** scenarios: **Action** consistent with achieving a **2°C** increase in average global temperatures compared to pre-industrial times, **Transformation** consistent with achieving a **1.75°C** increase, and **Breakthrough** consistent with achieving a **1.5°C** increase.
- **Jacob's Ladder:** On **June 15, 2022**, **Jacobs Engineering** published [Airports as Catalysts for Decarbonisation](#). The **Jacobs** publication complements the **Aerospace Technology** and **FlyZero** publication [Hydrogen Infrastructure and Operation, Airports, Airlines and Aerospace](#) reported on in **Edition 37** of **Low Carbon Pulse**.
- **Air Liquide and Groupe ADP shared aviation visions:** On **June 15, 2022**, it was reported widely that **Air Liquide** and **Groupe ADP** had entered into a joint venture to work together to combine the expertise and know-how of **Air Liquide** in respect of hydrogen with that of **Groupe ADP** in respect of airport infrastructure development and deployment and operations.
- **Bristling with promise:** On **June 21, 2022**, [hydrogen-central.com](#) reported that a hydrogen consortium had been established to develop hydrogen infrastructure. The consortium is reported to consist of **Airbus Industries, Bristol Airport, Bristol Port, Costain, Easyjet, GKN Aerospace, Hymamics, Wales and West Utilities** and **Wood (Hydrogen South West consortium)**.
- **ExxonMobil to produce SAF:** On **June 21, 2022**, [fuelsandlubes.com](#) reported that **ExxonMobil** intends to manufacture **SAF** from **renewable methanol**. The **renewable methanol** feedstock is derived from the gasification of biomass and waste, and "lower-carbon" hydrogen, and then compounded with **CO₂** that has been captured, with the **renewable methanol** then synthesised to produce **SAF**.
- **Airbus and Linde global MOU:** On **June 24, 2022**, **Linde** [announced](#) that it and **Airbus** had signed a memorandum of understanding (**MOU**) to work on the development of hydrogen infrastructure at airports globally, covering working together to establish global supply chains for hydrogen, from production to storage at airports, including the integration of refuelling into ground handling operations.

Low Carbon Pulse - Edition 41 – June 2022 (long-form)

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to the **Long Form Version** of **Edition 41** of Low Carbon Pulse – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Wednesday June 1, 2022** to **Thursday June 30, 2022**. The **Short Form Version** of **Edition 41** will be published on **Wednesday July 6, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering October 7, 2021 to March 31, 2022), and click [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39** and **40** of Low Carbon Pulse, covering **April** and **May 2022**).

Change in publishing cycle of Low Carbon Pulse:

Having sought feedback from readers of Low Carbon Pulse delivered in PDF, there was overwhelming support for a switch to publication of Low Carbon Pulse on a weekly basis. While the level of engagement with Low Carbon Pulse continues to increase, feedback suggests that its length in monthly form can be daunting. At the end of each month, the editions of Low Carbon Pulse published during that month will be consolidated into a monthly digest.

Continued emphasis on the Burning Platform:

The month of June has been a month in which there has been continued focus on the increased levels of **GHG** emissions in the climate system, and their impact, with both **CO₂** (carbon dioxide) and **CH₄** (methane) levels subject to increasing focus (and, it has to be said, concern), and increasingly **N₂O** (nitrous oxide) – the three well-mixed greenhouse gases.

- The **Bonn Climate Change Conference (BCCC)** took place between **June 6** and **June 16, 2022**, the first meeting of the [United Nations Intergovernmental Panel on Climate Change \(UN IPCC\)](#) since **COP-26**.

While progress was made on some matters, progress was not made on increased commitments to reduce **GHG** emissions (in the context of the global stocktake of commitments to reduce **GHG** emissions), funding commitments to developing countries to allow them to address the impacts of climate change, and compensation for loss and damage suffered by developing countries as a result of climate change.

UN Climate Change Executive Secretary, Ms Patricia Espinosa stated: "*Clearly, [implementation is needed] as rapidly as possible, and we need much more ambitious climate action. The global stocktake is a critical part of achieving both*".

Hopes were high before the **BCCC** (an intersessional conference) bridging **COP-26** in Glasgow, Scotland (in November 2021) and **COP-27** in Sharm el-Sheikh, South Sinai, Egypt (in November 2022). The good thing is that there is a clear sense of the work that needs to be done in preparation for, and at **COP-27**, including as part of the global stocktake and to progress funding for adaptation and compensation for loss and damage.

As reported, at the end of the **BCCC** **Ms Patricia Espinosa** was presented with a t-shirt sporting the slogan:

" **Science does not negotiate.**"

Reaching a little further back: "The time abides for, tarries for no man, stays no man, tide nor time tarry for no man", or as we have it now: "**Time and tide wait for no one**".

- **Nairobi Conference – Fourth meeting of the open-ended group on the Post-2020 Global Biodiversity Framework:** From **June 21 to June 26, 2022**, a group of experts met in **Nairobi, Kenya**, to prepare a series of **six science briefs** to provide scientific support for the negotiations of the **Post-2020 Global Biodiversity Framework**. The **six science briefs**, and the outcomes from the **Nairobi Conference** are outlined below under [Blue and Green Carbon Initiatives and Biodiversity](#). The work done at the Nairobi Conference will inform **Part 2** of the **15th Conference of Parties to the UN Convention on Biological Diversity**.

Ahead of the **Nairobi Conference**, **Wetlands International** published a [white paper](#) ([We need wetlands: The urgent cast for global wetlands targets](#)) calling for urgent action in respect of wetlands, critically, to preserve wetlands, and to allow wetlands to be restored where they have been degraded. **Wetlands International** notes that wetlands provide habitats for 40% of global biodiversity. The white paper outlines the importance of wetlands in combatting biodiversity loss and climate change, focusing on the role of wetlands in carbon storage (actual and potential). The white paper is excellent and well-worth a read.

- **Part 2 of COP-15 to be held in Canada:** On **June 20, 2022**, the [newscientist.com](#) reported that (in recognition of the continued impact of COVID-19 in the **PRC**), **Part 2** of the **15th Conference of Parties to the UN Convention on Biological Diversity** would take place in **Montreal, Canada**, over the period **December 5 to 17, 2022**. Later on **June 20, 2022**, this was [announced formally](#) by the **UN Convention on Biological Diversity**. As reported previously in a number of editions of Low Carbon Pulse, **Part 1** of **COP-15** was held in **Kunming, the PRC**, with **Part 2** deferred because of the continued impact of COVID-19.

As noted in previous editions of Low Carbon Pulse, the key purpose of **Part 2** of **COP-15** is to progress to a conclusion the **Post-2020 Global Biodiversity Framework**. While not discounting the other elements of biodiversity, it is critical that the revised Framework addresses wetlands fully. This is covered in greater detail below (under [Blue and Green Carbon Initiatives and Biodiversity](#)). As regular readers will have discerned, the preservation and restoration of wetlands is matter that the author of Low Carbon Pulse regards as existential, along with rainforests and tundra, and the preservation and restoration of mangrove forests and swamps.

- The **48th G7 Summit** took place between **June 26 and June 28, 2022** in **Schloss Elmau, Krün, Bavaria, Germany**. Attached is a link to the [communiqué](#) from **G7 Summit**.

The **Leaders of the Group of Seven (G7)**, **Canada, France, Germany, Italy, Japan, the UK and the US**, were joined by the leaders of **Argentina, India, Indonesia, Senegal, South Africa and Ukraine**.

Among other things, the communiqué covers the endorsement of an open and cooperative **Climate Club** ([G7 statement on Climate Club](#)), and working towards its establishment by the end of 2022. In this context, the **G7** commits to drive urgent, ambitious and inclusive action to align with **1.5°C** pathways and to accelerate implementation of the **Paris Agreement**, with a commitment to a "highly decarbonised" road transport sector by 2030, and a "fully or predominantly decarbonised" power sector by 2035. In addition, through the **G7 Partnership for Global Infrastructure**, the **G7** commits to mobilise **USD 600 billion** over the coming five years to narrow the global investment gap, stepping-up cooperation globally, including through working for **Just Energy Transition Partnerships** with **India, Indonesia, Senegal and Vietnam**, and building on the existing Partnership with **South Africa**.

Ahead of the **G7 Summit**, the **G7 Climate, Energy and Environmental Ministers** met in **Berlin, Germany** on **May 26 and 27, 2022**. Attached is a link to the [communiqué](#) from the meeting of the **G7 Climate, Energy and Environmental Ministers**.

- The **World Urban Forum** was held in **Katowice, Poland** from **June 26 to 30, 2022**. The [World Urban Forum](#) is held every two years under the auspices of, and convened by, the **UN Human Settlements Programme**. The **World Urban Forum** supports the implementation of **SDG 11** – making cities and human settlements inclusive, safe, resilient and sustainable. As reported widely, 56% of the global population lived in urban areas in 2021, with 68% expected to live in urban areas by 2050 or, stated another way, between 2021 and 2050 a further 2.2 billion people will live in urban areas. Attached is a link to the [communiqué](#) from **World Urban Forum**.

- **UN Ocean Conference 2022** took place between **June 27 to July 1, in Lisbon, Portugal**, co-hosted by **Kenya and Portugal**. The first high-level **UN Conference to Support the Implementation of SDG 14** was held in 2017. The **UN Ocean Conference** is the second **UN Conference to Support the Implementation of SDG 14**.

At the opening ceremony, **UN Secretary General, Antonio Guterres**, stated that: "Sadly, we have taken the ocean for granted and today we face what I would call an ocean emergency. We must turn the tide".

Ahead of the **UN Ocean Conference**, UN Member States met to frame the importance of the **Conference**. At that meeting, the **Conference Secretary General, Liu Zhenmin**, stated: "Despite the progress made in ocean actions, the health of our ocean is still deteriorating fast, due to multi-dimensional challenges of pollution, overfishing and climate change".

The stated theme for the **UN Ocean Conference** was: "Scaling up ocean action based on science and innovation for the implementation of [Sustainable Development] Goal 14: stocktaking, partnerships and solutions".

For these purposes, eight dialogues took place: **1.** Marine pollution, **2.** Promoting and strengthening sustainable ocean-based economies, **3.** Managing, protecting, conserving and restoring marine and coastal ecosystems, **4.** Minimising and addressing ocean acidification, deoxygenation, and ocean warming, **5.** Making fisheries sustainable, **6.** Increasing scientific knowledge and developing research capacity and transfer of marine technology, **7.** Enhancing conservation and sustainable use of oceans, and **8.** Leveraging interlinkages between SDG 14 and other [Sustainable Development] goals towards the implementation of the [2030 Agenda](#).

One of the more startling facts and stats that emerged in the lead up to the **UN Ocean Conference** was that 80% of the wastewater globally finds its way into the ocean without treatment. In addition, the fact that between 8 and 10 million metric tonnes of plastic finds its way into the oceans annually is reported often. Attached is a link to the [communiqué](#) from **UN Ocean Conference**.

Quote of the month:

As noted below (under [Blue and Green Carbon Initiatives and Biodiversity](#)), Ms Madeline Hodge (Lead Sustainability Advisor, Ørsted) published an article, *Why the health of our oceans is vital to us*. The quote of the month is taken from this article:

"Addressing climate change requires an unprecedented effort, but nature provides us with all the solutions we need – from wind and sun to the mighty oceans. By creating the conditions for nature to thrive, we can nurture healthy, biodiverse oceans and ensure they can keep supporting life on Earth".

The Month in the rear view mirror:

- **Stockholm+50:** On **June 2 and 3, 2022**, the **Stockholm+50** conference was held in **Stockholm, Sweden**, co-hosted by **Kenya and Sweden**. The **Stockholm+50** conference marked the **50th anniversary** of the **world's first conference** on the environment – **United Nations Conference on the Human Environment** held in Stockholm, Sweden, June 5 and 6, 1972, which gave rise to the establishment of the **United Nations Environment Programme (UNEP)**.

The agenda for the **Stockholm+50** conference was **Immediate action for people, planet and prosperity will create a better future for all**. The agenda reflecting the perspective of a **triple planetary crisis: climate, nature and pollution**.

On **June 8, 2022**, the **Government Offices of Sweden** published [Stockholm agenda shows way forward following Stockholm+50](#).

Among other things, the publication reports on: "**The Stockholm agenda: 10 recommendations following Stockholm+50**". The **10 recommendations** are: "**1.** Place human well-being at the centre of a healthy planet and prosperity for all. **2.** Recognise and implement the right to a clean, healthy and sustainable environment by fulfilling the vision articulated in Principle 1 of the [Stockholm Declaration](#) from 1972. **3.** Adopt system-wide change in the way our current economic system works to contribute to a healthy planet. **4.** Strengthen national implementation of existing commitments for a healthy planet by enhancing national environmental legislation, budgets, planning processes and institutional frameworks. **5.** Align public and private financial flows with environmental, climate and sustainable development commitments. **6.** Accelerate system-wide transformations of high-impact sectors, such as food, energy, water, buildings and construction, manufacturing and mobility. **7.** Rebuild relationships of trust for strengthened cooperation and solidarity. **8.** Reinforce and reinvigorate the multilateral system. **9.** Recognise intergenerational responsibility as a cornerstone of sound policy making. **10.** Take forward the Stockholm+50 outcomes by reinforcing and reenergising ongoing international processes, such as the UN high-level Summit of the Future in 2030".

IPCC Bonn intersessional conference: From **June 6 and June 16, 2022**, the **BCCC** reviewed progress and prepared for **COP-27**, including the global stocktake in respect of **GHG** emissions: the global stocktake provides of the exchange of information among countries and stakeholders in the context of achieving the goals of the **Paris Agreement**. The global stocktake allows each country to take stock on its nationally determined contribution (**NDC**). (For context, the **BCCC** was the 56th session of the Subsidiary Body for Scientific and Technological Advice (part of the **UNFCCC**).

Edition 29 of Low Carbon Pulse reported on the [UNFCCC NDC Synthesis Report \(Synthesis Report\)](#) As noted in **Edition 29**, the **Synthesis Report** and the **Commitment and Production gap** received most coverage in the week leading into **COP-26**. The same is likely to be true of the week leading into **COP-27**.

As reported, the discussions at the global stocktake have focussed on assessment of "*collective progress toward the Paris Agreement goal to limit global warming to 1.5 degrees Celsius*".

As noted in **Edition 36** of Low Carbon Pulse, there is an issue of contention between development nations and developing nations (including the Alliance of Small Island States (AOSIS)), and that issue of contention is compensation for **loss and damage** caused by climate change resulting from the actions of the developing nations.

Also at the **BCCC** there was further progress in respect of the operational aspects of **Article 6** of the **Paris Agreement** to respond to the **Paris Rulebook** (see **Editions 29** and **30** of Low Carbon Pulse). Since the **Paris Rulebook** was agreed at **COP-26**, the need for progress in respect of **Article 6** has been underlined, including the **IPCC Working Group III (Mitigation of Climate Change)** report **Climate Change 2022: Mitigation of Climate Change** (see **Edition 38** of Low Carbon Pulse), with a clear recognition that carbon dioxide removal (**CDR**) needs to be accelerated. To accelerate **CDR**, a clear basis of cooperation under **Article 6** is required. The International Emissions Trading Association (**IETA**) has made suggestions for Governments to consider, and to action. For the **IETA** paper, click [here](#). The ever-excellent [carbonbrief.org](#) (under [Bonn climate talks: Key outcomes from June 2022 UN climate conference](#)), provides a more detailed summary of the outcomes from the **BCCC**.

A daze of global and world days:

- **Sunday June 5, 2022**, was **World Environment Day 2022**. As with Biodiversity Day 2022, there was considerable coverage before, on and after World Environment Day 2022 about all aspects of the environment, but focusing on the theme **Only One Earth**, and **Living Sustainably in Harmony with Nature**.
- **Wednesday June 15, 2022**, was **Global Wind Day** or **World Wind Day**. As a creation of the **Global Wind Energy Council (GWEC)** and **WindEurope**, **Global Wind Day** celebrates and promotes wind energy.
- **Tuesday June 21, 2022**, was **International Yoga Day**.
- **Wednesday June 22, 2022**, was **World Rainforest Day**. To mark the day, Rhett A. Butler (an author mentioned previously in Low Carbon Pulse) published an [article](#) highlighting the 10 largest rainforests in the world: the Amazon, the Congo, New Guinea and Australia, Sundaland, Indo-Burma, Mesoamerica, Wallacea, the Guinean Forests of West Africa, the Atlantic forest, and the Choco. The article is packed with information on each rainforest, and is excellent.
- **Wednesday June 29, 2022**, was **International Day of the Tropics**.

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced.

Waste to Wealth Compendium published:

On **June 15, 2022**, the Ashurst [Waste-to-Wealth Compendium](#) was published. The Compendium contains a number of articles published over time by leading waste market practitioners.

In **September 2022**, a standalone article will be published on **NZE Waste: The recycling and reuse of waste arising on the road to NZE**. Along with plastic waste, these are areas of ever-increasing focus.

Balance of the content of this Edition 41:

Clicking on the contents list will take the reader to the section clicked:

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Pages 8 to 9:	Climate change reported and explained	Pages 27 to 29:	E-fuels / Future Fuels / Now Fuels
Pages 9 to 10:	Middle East including GCC Countries	Pages 30 to 31:	Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories
Pages 11 to 14:	Africa, India and Indonesia; Japan & ROK	Pages 31 to 33:	Green Metals / Minerals, Mining and Difficult to Decarbonise Industries
Page 14:	PRC and Russia	Pages 33 to 37:	Wind round-up, on-shore and off-shore
Pages 14 to 18:	Europe and UK; and Americas	Pages 38 to 41:	Solar, Sustainability and NZE Waste:
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Page 24 to 26:	Carbon Accounting, Carbon Capture, Carbon Capture and Use and CDR	Page 54:	The Ashurst Team

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

*This section considers news items that have arisen within the news cycle of this **Edition 40** of Low Carbon Pulse in respect of laws and regulation, and broader policy settings, in each case describing substance, progress and impact. Also this section details Helpful Publications that have been read during the month.*

- **European Parliament knocks-back three draft laws as part of Fit-for-55, and then circles back:** On **June 7, 2022**, the **European Parliament** voted to reject draft legislation as part of the **Fit-for-55** package (see **Editions 40** and **32** of Low Carbon Pulse), including in respect of revisions to the **EU Emissions Trading System (EU ETS)** and to enact the **EU Carbon Border Adjustment Mechanism (CBAM)**.

The reason for the rejection of the draft legislation was that it was not aligned with a more ambitious agenda on climate change. The draft legislation was returned to **European Parliament Committees** with a view to aligning the legislation with the **European Parliament**. Initial reporting after the vote on June 7, 2022, was that the optimistic thinking tended to indicate that the draft legislation may return for a vote during Q3 of 2022. Even if this timeline was achieved, it was regarded as unlikely that **CBAM** would start its transition phase on **January 1, 2023**.

On **June 22, 2022**, the **European Parliament** adopted its position on the regulation to establish **CBAM**. The position of the **European Parliament** is that additional products should be added to products proposed the **European Commission** in July 2021 (as part of the **Fit-for-55** package), the original products being aluminium, cement, fertilisers, iron and steel, and electrical energy production. The **additional** products that the **European Parliament** wants **CBAM** to cover are **ammonia, hydrogen, organic chemicals** and **plastics**. In addition, the **European Parliament** wants **CBAM** to include **indirect emissions** arising from the production of products, i.e., emissions arising from electrical and heat energy used to manufacture those products.

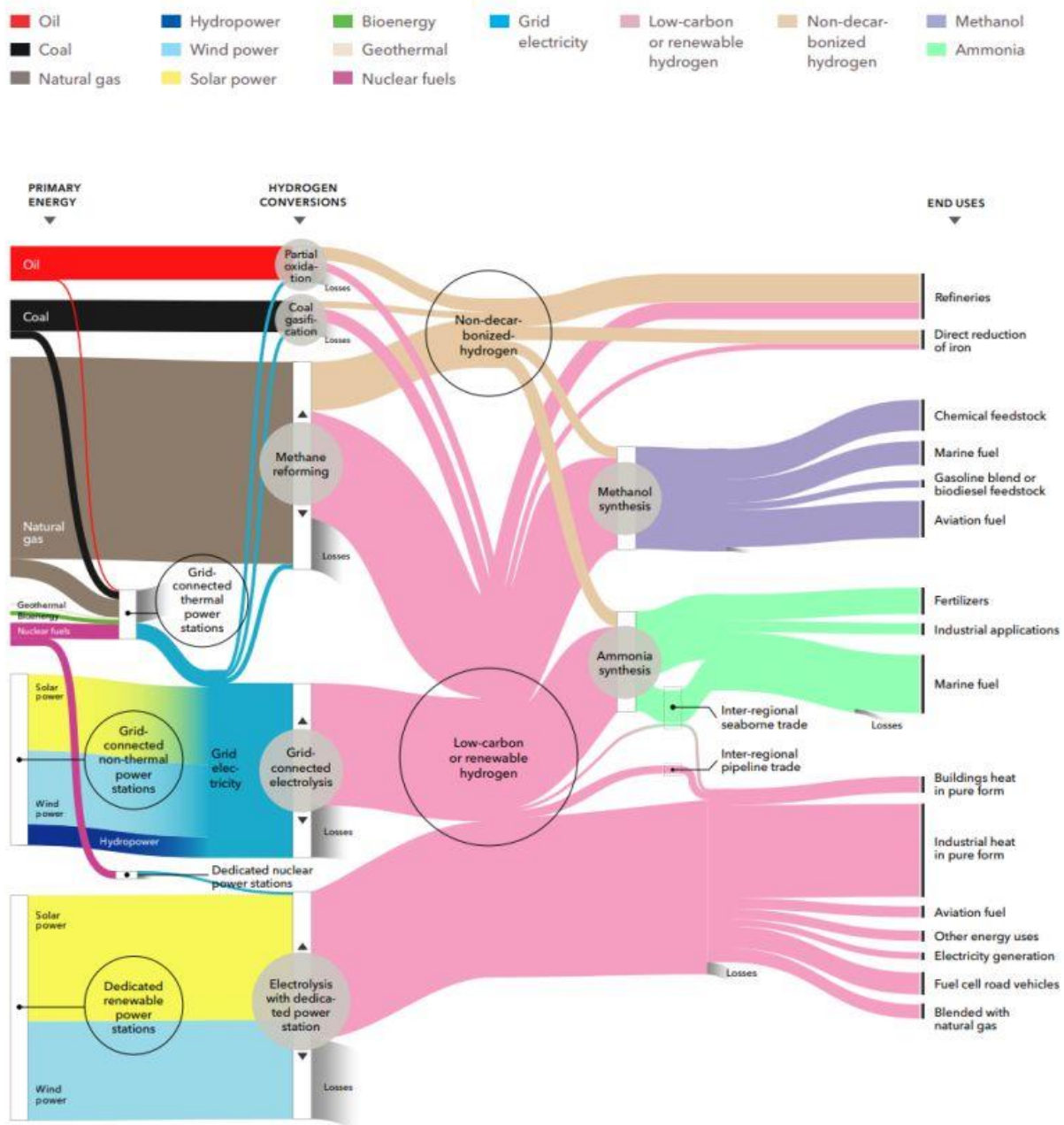
For a full description of the position of the **European Parliament** click on the following link europarl.europa.eu under [CBAM: Parliament pushes for higher ambition in new carbon leakage instrument](#).

- **European Parliament locks-in ban on sale of new diesel and motor spirit cars from 2035:** On **June 8, 2022**, the **European Parliament** voted to approve an effective ban on the sale of new diesel and motor-spirit-fuelled motor cars and vans from 2035. As part of the **Fit-to-55** legislative framework, the **European Commission** proposed a **100% reduction in CO₂** emissions arising from new motor-cars and vans by 2035, in effect, a ban on sales of motor-cars and vans giving rise to **CO₂**.

On **June 22, 2022**, it was reported widely that Germany is not aligned with the effective ban, and that it was likely that as a result the final form of the legislation may have to address the use of synthetic fuels (being fuels characterised as "**CO₂** neutral fuels") by motor-cars and vans.

Early on the morning of **June 28, 2022**, **Environment and Climate Change Ministers** from the European Union's 27-Member States "agreed to introduce a 100% **CO₂** emissions reduction target by 2035 for new cars and vans", accommodating the position of Germany to allow the use of "**CO₂** neutral fuels". This agreed position must be considered by the **European Parliament**.

- **European Parliament locks in shipping and aviation into the EU ETS:** In addition, to progress on **CBAM** and **motor-cars** and **vans**, the **European Parliament** voted to extend the application of the **European Union Emissions Trading Scheme (EU ETS)** to all ships having a gross tonnage above 400 metric tonnes and all off-shore vessels. What this means is that each metric tonne of **CO₂**, **CH₄** and **N₂O** emissions arising from those ships will have to be matched by the requisite number of permits under the **EU ETS**. The **European Community Shipowners' Association** is reported to have welcomed the vote of the European Parliament in respect of the package.
- **DNV Hydrogen Forecast:** On **June 14, 2022**, **DNV** published [*Hydrogen Forecast to 2050 – Energy Transition Outlook 2022*](#). The **DNV** publication is excellent, and, for those interested in the interface between policy settings and the development of hydrogen production capacity, compulsory reading. The following info-graphic provides an overview key findings, but the info-graphic is no substitute for a Sunday afternoon reading the **DNV** publication:



Source: [DNV](#)

The **DNV** publication provides a practical and realistic assessment of the progress towards the development of hydrogen production capacity, and its use, at levels consistent with the goals of the **Paris Agreement**. In this regard, the **DNV** publication makes sobering reading. The overarching theme that emerges (from the **DNV** publication and many others) is that considerably more needs to be done, and at pace, and that the role of Government is critical.

- **REN21 report:** On **June 15, 2022**, the **Renewable Energy Policy Network for the 21st century** or **REN21** (comprising Governments, Industry Associations, Inter-governmental organisations, NGOs and Science) published [*Renewables 2022 Global Status Report \(GSR\)*](#), with the titled by-line: "Record growth in renewables, but world

missed historic chance for a clean energy recovery". While the entirety of the **GSR** well-worth a read, the author commends folk to find the time to read the [Key Messages for Decision Makers](#).

- **Council and European Parliament reach provisional agreement:** On **June 21, 2022**, the **European Council** and the **European Parliament** reached a provision political agreement on the **corporate sustainability reporting directive (CSRD)**, which is covered fully under [New Rules on corporate sustainability reporting: provisional political agreement between the Council and European Parliament](#). This political agreement looks to **amend the 2014 non-financial reporting directive**. As proposed, more detailed reporting requirements will be required, and ensures that larger corporations are required to report on sustainability issues.

- **European Commission proposes legislation to address degradation:** On **June 21, 2022**, the **European Commission (EC)** outlined its proposal for a **Nature Restoration Law** (fully titled [Proposal for a Regulation of the European Parliament and of the Council on nature restoration](#)).

The context of the proposal is stated to be the loss of biodiversity and the degradation of ecosystems. Given the context, and the prevailing policy settings, the **EC** states that:

"More decisive action is ... needed to achieve the EU climate and biodiversity objectives by 2030, and for 2050, and to ensure the resilience of food systems".

By way of reminder: The **European Green Deal** commits to protecting and restoring nature. The **European Green Deal** states that the **EC** will identify measures, including legal measures, to help member states to restore damaged and carbon-rich ecosystems. The proposed **Nature Restoration Law** includes measures identified by the **EC**.

The **June 22, 2022** edition of **The Guardian** (under [EU plan to halve use of pesticides in "milestone" legislation to restore ecosystems](#)) provided a positive perspective on the proposals.

- **New Ember report published:** On **June 22, 2022**, **Ember** (leading independent energy think tank) published [New Generation – Building a clean European electricity system by 2035](#). As always from **Ember**, the publication is well-worth a read, both for those active in the European market, and those active in markets globally.
- **BP publishes Statistical Review of World Energy:** On **June 28, 2022**, **bp** (leading international energy corporation) published the [bp Statistical Review 2022](#), which is accompanied by a [seven page summary](#) of interesting facts and stats.

While the facts and stats are confirmatory rather than revelatory, they are of value, with the **bp Statistical Review** publication being compulsory reading each year.

- **International Energy Agency (IEA) publications during June:**

- On **June 1, 2022**, the **IEA** launched [Tracking SDG7: The Energy Progress Report 2022](#), which "assesses achievements in the global quest for universal access to affordable, reliable and sustainable, and modern energy, by 2030 [being Sustainable Development Goal 7]".

It will not be a surprise that the world is not on track to achieve **Sustainable Development Goal 7**. Among other things, the **Tracking SDG7** report considers the investments required to achieve **Sustainable Development Goal 7**, and for these purposes presents scenarios drawn from the **IEA World Energy Outlook 2021** and the **IRENA World Energy Transitions Outlook: 1.5°C Pathway**.

While United Nation Development Programme 17 Sustainable Development Goals are not a focus of **Low Carbon Pulse**, the subject matter of **Tracking SDG7** makes it well-worth a read. It will come as no surprise to those reading that the focus is **access to electricity, clean cooking, renewables, energy efficiency and international financial flows**.

This report is a joint report prepared by the **IEA** and **IRENA**.

- On **June 8, 2022**, the **IEA** published [The value of urgent action on energy efficiency](#), to accompany and to inform the **IEA's 7th Annual Global Conference on Energy Efficiency** held in Sønderborg, Denmark from **June 7 to June 9, 2022**. The publication is timely, and follows considerable coverage of energy efficiency during the first half of **2022**.

The publication outlines why faster action in respect of **energy efficiency** is needed, and that if the action suggested is taken it will be possible "to avoid an extra **95 EJ** of energy demand by 2030 even as the [world] economy grows". The publication states that in the near-term the greatest potential for **energy efficiency** gains arise in the building and the transport sectors.

For those development policy settings, **energy efficiency** offers "low-hanging fruit" in progress to **NZE**, and appears to be an increasing focus of those developing policy settings.

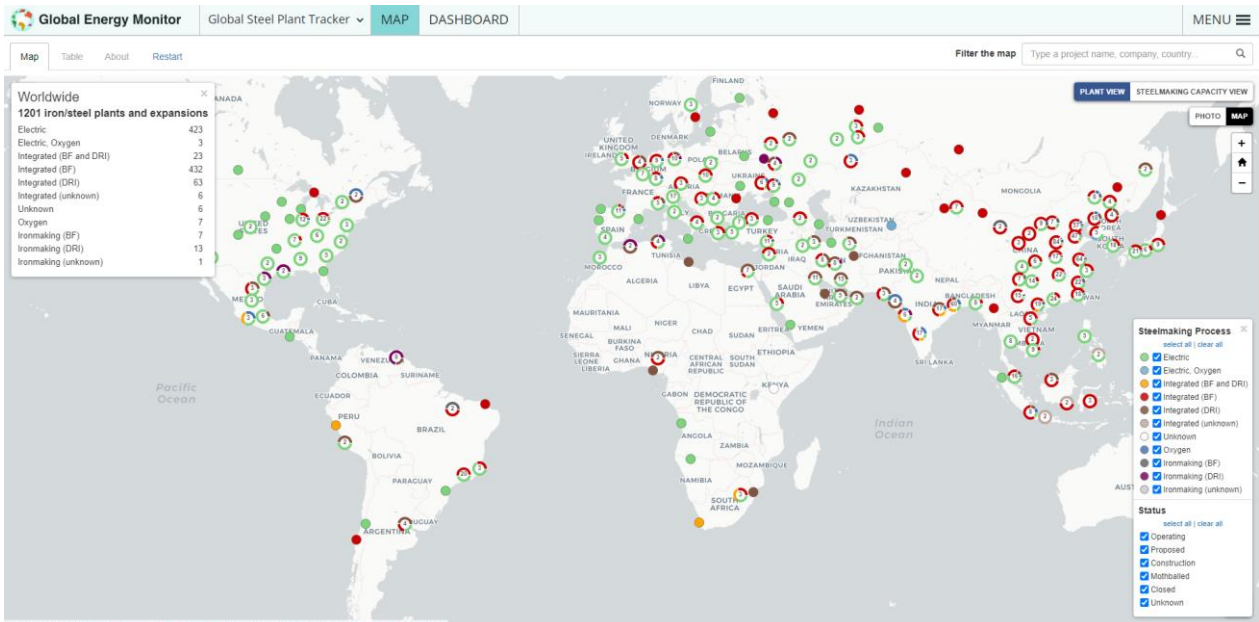
As with all publications from the **IEA**, [The value of urgent action on energy efficiency](#) refers back to the **IEA Roadmap: Net Zero by 2050**

- On **June 15, 2022**, the **IEA** launched a new interactive tool that provides [real-time information](#) on electricity markets around the world, including generation and load, and price at a country and regional level. The tool has become a daily source of information for the author of **Low Carbon Pulse**.
- On **June 15, 2022**, the **IEA** published [Achieving Net Zero Heavy Industry Sectors in G7 Members](#). The facts and stats on the iron and steel industry have been recounted in previous editions of **Low Carbon Pulse**, and sister publications.

One of the facts and stats that emerges from the **IEA** publication is that the iron and steel industry emits **1.85 metric tonnes of CO₂-e** for every metric tonne of iron and steel manufactured, now estimated to be around **11%** of total **GHG** emissions.

The projected increase in iron and steel manufacturing output of between **12%** and **15%** by 2050, emphasises the need to accelerate the decarbonisation of the iron and steel industry.

Global Energy Monitor has a [Global Steel Plant Tracker](#). It is included below.



- On **June 20, 2022**, the **IEA** published [Africa Energy Outlook 2022 – World Energy Outlook Special Report](#). This report is covered below under the **Africa** section of this **Edition 41** of Low Carbon Pulse.
- On **June 22, 2022**, the **IEA** published [World Energy Investment 2022](#);
- On **June 29, 2022** the **IEA** published [Norway 2022: Energy Policy Review](#) providing an in-depth review of the policy settings in Norway in the context of energy transition and the achievement of **GHG** emission reduction, and other climate change, targets. The publication is well-worth a read.
- On **June 30, 2022**, the **IEA** published a special report on the role of nuclear energy on the path to net-zero – [Nuclear Power and Secure Energy Transitions](#). The publication is excellent, among other things, noting (rightly) that achieving **NZE** will be harder without new nuclear energy capacity.

On **June 16, 2022**, the **IEA** [announced](#) that Ukraine is the newest association country of the **IEA**, and that the **IEA** is to develop an action plan with Ukraine to support energy security, and to provide reconstruction and transition plans.

By way of a reminder:

- During **May 2022**, the **IEA** published: [Renewable Energy Market Update – May 2022 – Outlook for 2022 and 2023](#); [Southeast Asia Energy Outlook 2022](#), the [Global EV Outlook 2022](#); [Enhancing China's ETS for Carbon Neutrality: Focus on the Power Sector](#); [Renewable Energy Market Update: Key Findings](#);
- During **April 2022**, the **IEA** published: [Direct Air Capture – A key technology for net-zero, Sustainable Recovery Tracker – Monitoring Progress towards sustainable recoveries from the Covid-19 crisis, Sustainable Recovery Tracker, Gas Market Report, Q2-Analysis, including Global Gas Review 2021, Belgium 2022 – Energy Policy Review Report](#).
- **International Renewable Energy Agency (IRENA) publications during June:**
 - On **June 1, 2022**, **IRENA** published [Tracking SDG 7: The Energy Progress Report](#). As noted above, this is a joint report with the **IEA**.
 - On **June 15, 2022**, **IRENA** published [Renewable Energy for Agriculture: insights from Southeast Asia](#), covers how renewable energy may be used to feed the growing energy needs of the agriculture sector.
 - On **June 20, 2022**, **IRENA** published [Powering Agri-food value Chains with Geothermal Heat: A Guidebook for Policy Makers](#), covering the use of geothermal heat, and providing recommendations as to how to accelerate its use in the agri-food sector.
 - On **June 21, 2022**, **IRENA** published [RE-organising Power Systems for the Transition](#).
 - On **June 29, 2022**, **IRENA** published [Republic of Palau Roadmap 2022-2050](#).
 - **IRENA** publications during:
 - **May 2022:** [Global Hydrogen Trade To Meet The 1.5°C Climate Goal – Part II – Technology Review of Hydrogen Carriers](#); [Global Hydrogen Trade To Meet The 1.5°C Climate Goal – Part III – Green hydrogen supply cost and potential](#); [Global Hydrogen Trade To Meet The 1.5°C Climate Goal – Part I – Trade outlook for 2050 and way forward](#); [Critical Materials for Energy Transition: Rare Earth Elements – Technical Paper 2/2022](#) and [Technical Paper 1/2022](#); and [Innovation Outlook: Renewable Ammonia](#) (with an accompanying press release [The Role of Renewable Ammonia in the Energy Transition](#)).
 - **April 2022:** [Decarbonising End-Use Sectors: Green Hydrogen Certification \(Certification Paper\)](#), [Renewable Capacity Statistics 2022](#), with a helpful three page summary [Renewable capacity highlights, Grid Codes for Renewable Powered Systems](#) (being an update on the **IRENA** publication from 2016, [Scaling Up Variable Renewable Power: The Role of Grid Codes](#)), and [Renewable Capacity Statistics 2022](#). While the content of the data is not surprising, the data is a helpful reference.
 - **March 2022:** [WETO 2022](#), [Decarbonising end-use sectors Green Hydrogen Certification](#); [Green Hydrogen For Industry – A Guide to Policy Making](#) (considered in detail in **Edition 37** of Low Carbon Pulse

under **A Guide to Policy Making**), [Collaborative Framework on Critical Materials For The Energy Transition](#), [Collaborative Framework on Critical Materials For The Energy Transition](#), and [Collaborative Framework on Critical Materials For The Energy Transition](#) following like-frameworks from **IRENA** (including on Hydropower, Ocean Energy / Offshore Renewable Energy, Green Hydrogen, Geopolitics of Energy Transformation, Just and Inclusive Energy Transition and Enhancing Dialogues of High Shares of Renewables in Energy Systems), and the [Renewable Energy Market Analysis: Africa and its Regions](#) report.

- **EC publishes technical regulations:** As noted in **Edition 40** of Low Carbon Pulse: "On **May 18, 2022**, among other things, the **EC** published two [draft Delegated Acts](#) to clarify **EU** rules applicable to renewable hydrogen under the **2018 Renewable Energy Directive**. The **two Delegated Acts** are: the **Delegated Act** on the production of renewable transport fuels – share of renewable electricity (requirements) and the **Delegated Act** on renewable energy – method for assessing **GHG** emission savings from certain fuels. The **Delegated Acts** work together.

Also **Edition 40** noted that: "A number of participants in the hydrogen industry (and the broader energy industry) have noted that the requirements for **additionality** and **coupling** may have unintended consequence of slowing the pace of development of Green Hydrogen production capacity. The form of the **two delegated acts** are [open for consultation](#) until **June 17, 2022**, having commenced on **May 20, 2022**. **Edition 41** of Low Carbon Pulse will consider each **Delegated Act**".

Given the length of this **Edition 41** of Low Carbon Pulse, the author has not included a more detailed consideration of each **Delegated Act** in this **Edition 41**, but intends to publish a stand-alone piece over the summer.

Climate change reported and explained:

*This section considers news items within the news cycle of this **Edition 40** of Low Carbon Pulse relating to climate change and its impact. The intention is to monitor significant and material data points and information, and to explain them.*

- **CO₂ at highest levels since well-before first hominids first walked:** During the first week of June, a number of news outlets reported that the level of **CO₂** in the atmosphere is at its highest level since the first hominids first walked, and 50% higher than at the start of the pre-industrial era (being the point in time from which average global temperature increases are measured for the purposes of the **Paris Agreement**).

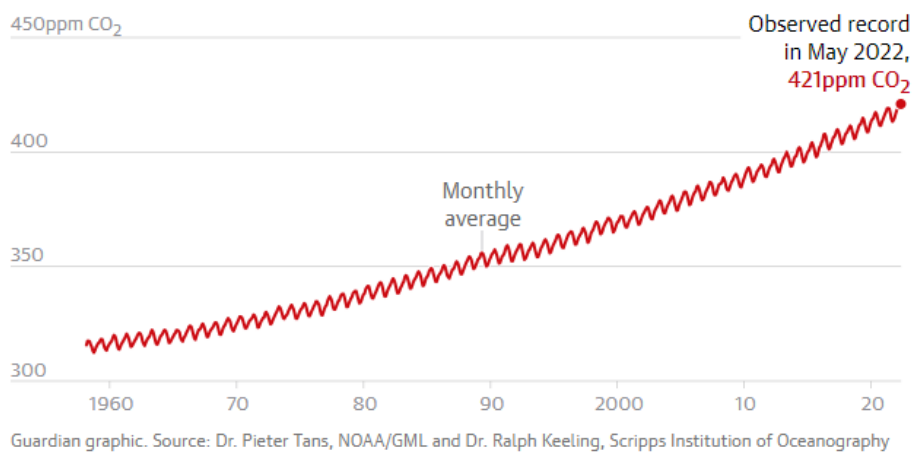
Stated another way: the current levels of **CO₂** in the atmosphere are at the highest they have been for between 4 and 4.5 million years (in an epoch named the Pliocene).

Stated another way still: in the words of **NOAA** Administrator, **Mr Rick Spinrad**, "The science is irrefutable: humans are altering our climate [system] in ways that our economy and our infrastructure must adapt [in response] to".

- **Another month, another graph:** As reported in previous editions of Low Carbon Pulse, the US **National Oceanic and Atmospheric Administration (NOAA)**, among other things, tracks the level of **CO₂** in the atmosphere. The graph below was published by the **NOAA** at the start of June.

Record levels of CO₂ observed at Mauna Loa Observatory

NOAA's measurements at the mountaintop observatory on Hawaii's Big Island were 1.8ppm higher than 2021



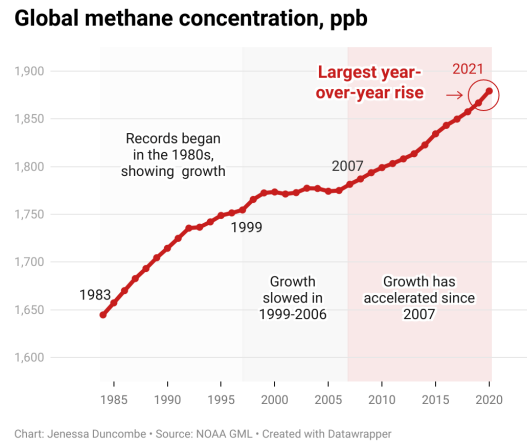
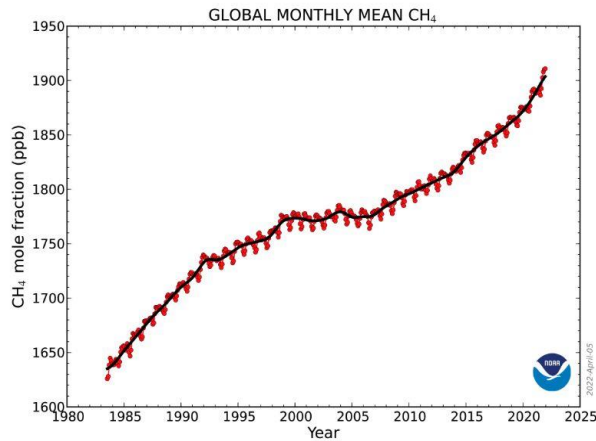
Source: [The Guardian](#)

- **Global Methane Pledge Energy Pathway:** On **June 17, 2022**, the **EU** and the **US** released a [media note](#). The media note stated that on **June 17, 2022**, the **EU** and the **US**, and **10** other countries launched the **Global Methane Pledge Energy Pathway** to catalyse **CH₄** emissions in the oil and gas sector, advancing both climate progress and energy security.

As reported in various editions of Low Carbon Pulse (see **Editions 27, 29, 32** and **34**) the **EU** and **US** committed to the **Global Methane Pledge** on **September 17, 2021**, in the expectation and hope that countries would take the pledge. At the time of the release of the media note (on June 17, 2022) **120 countries have taken the pledge**.

The **Global Methane Pledge Energy Pathway** represents progress to give effect to the **Global Methane Pledge**. The Pathway aims to encourage all countries: **1.** To capture the maximum potential of cost-effective methane mitigation in the oil and gas sector, and **2.** To eliminate routine flaring as soon as possible, and not later than 2030. The first movers committing to the **Global Methane Pledge Energy Pathway** are: **Argentina, Canada, Denmark, Egypt, Germany, Italy, Japan, Mexico, Nigeria and Oman**, along with the **EU** and the **US**. The national oil company of Malaysia **Petroleum Nasional Berhad (Petronas)** is stated to support the **Global Methane Pledge Energy Pathway**.

By way of reminder: The following two graphs illustrate the concentration of **CH₄** in the atmosphere:



Middle East including GCC Countries:

*This section of Low Carbon Pulse considers news items within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the Gulf Cooperation Council (**GCC**) Countries, being countries that are leading the way in the development of Blue Hydrogen and Green Hydrogen capacity for own use and for export.*

- Hydrogen from waste – MENA to Germany:** On **June 8 and 9, 2022**, the **MENA Europe Future Energy Dialogue (MEFED)** took place at the King Hussein Bin Tala Convention Centre, hosted by the **German and Jordanian Governments**.

As reported in **Edition 40** of Low Carbon Pulse, **EU** policy settings are progressing to reflect that up to **10 million metric tonnes** of hydrogen will be imported for use in Europe by 2030. To satisfy this projected demand, among other regions, hydrogen will need to be imported from **MENA**.

One of the positive outcomes to emerge from **MEFED** was that representatives of the **Federal German Government** agreed to facilitate connections between potential off-takers of hydrogen in Germany and **H-2 Industries**.

By way of reminder: **Edition 40** of Low Carbon Pulse (under **And another one!**) reported that: "... the **General Authority for Suez Canal Economic Zone (SCZONE)** and **H-2 Industries** (developer of hydrogen storage technology) plan to develop a **USD 4 billion waste-to-hydrogen facility** at **Port Said**.

As reported, the waste-to-hydrogen facility is to process **4 million metric tonnes** of **municipal solid waste** as feedstock, and to produce **300,000 metric tonnes** of hydrogen annually."

The agreement of the Federal German Government to facilitate connections to demand side may be regarded as a positive development, both in regulatory and trade terms. The potential for the deviation and production of hydrogen from organic waste has long been known – see **Hydrogen for Industry (H24I)** feature **Waste to Hydrogen**.
- Consortium to develop Green Hydrogen Facility at KIZAD:** On **June 10, 2022**, it was reported widely that **Korea Electric Power Corporation (KEPCO)**, **Korea Western Power** (South Korean energy company), **Samsung C&T**, and **UAE** corporation, **Petrolyn Chemie** had signed a memorandum of understanding (**MOU**) to provide a framework of the development of a **USD 1 billion** Green Hydrogen production facility in the **Khalifa Industrial Zone Abu Dhabi (KIZAD)**.

The **40,000 metric tonnes** a year of Green Hydrogen produced at the facility will be used as feedstock to produce **200,000 metric tonnes** a year of Green Ammonia. The renewable electrical energy required to power the electrolyzers will be sourced from a **800 MW** photovoltaic solar farm.
- Saudi Arabian Mining Company to by steam:** On **June 2, 2022**, it was reported that the **Saudi Arabian Mining Company (MA'ADEN) (KSA MC)** is to purchase steam from **GlassPoint** (US-based leader in industrial solar steam production), the steam produced to use electrical energy sourced from **1.5 GW** of photovoltaic solar installed capacity. As reported, the use of steam produced using electrical energy sources from photovoltaic sources will reduce the **GHG** emission footprint of **KSA MC** by more than 600,000 metric tonnes a year.
- Masdar commits to Azerbaijan:** On **June 5, 2022**, **Masdar** (Abu Dhabi Future Energy Company) announced that it had signed an agreement to develop **4 GW** of clean and renewable energy projects (**Mega-Projects**) with the **Republic of Azerbaijan**, with the right to develop an additional **6 GW** as a second phase. For the purposes of the **4 GW** first phase, **Masdar** signed two implementation agreements, one in respect of **1 GW** of on-shore wind farms and **1 GW** of photovoltaic solar farms, the second in respect of the integrated development of a **2 GW** off-shore wind field to be used to produce Green Hydrogen.

- **Saudi Aramco to invest in 12 GW of renewables by 2030:** On **June 16, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **Saudi Aramco** is to invest in the development and deployment of **12 GW** of photovoltaic solar and wind capacity **by 2030**.

In addition, it is reported that **Saudi Aramco** is targeting:

- a **15%** reduction in the carbon intensity of its upstream sector **by 2035**;
 - the production of **11 million metric tonnes** of hydrogen per annum **by 2030**; and
 - the storage of **11 million metric tonnes** of **CO₂** per annum by 2035.
- **IRENA partners with Masdar and Abu Dhabi Fund for Development:** On **June 16, 2022**, **IRENA** [announced](#) that it had strengthened its partnerships with **Masdar** (Abu Dhabi Future Energy Company) and the **Abu Dhabi Fund for Development (ADFD)**, by signing documents with both. The **Letter of Intent** with **Masdar** provides a framework for **Masdar** to invest equity and to provide technical advice in respect of renewable energy projects, further enhancing the role of **Masdar** as one of the elite group of equity investors in renewable energy project globally. The agreement with **ADFD** formalises the anchor investment of the **ADFD (USD 400 million)** in the **IRENA Energy Transition Financing (ETAF)** initiative.
 - **UAE to invest further USD 50 billion:** On **June 18, 2022**, [khaleejtimes.com](https://www.khaleejtimes.com) reported that the **President of the UAE, His Highness Sheikh Mohamed bin Zayed Al Nahyan**, had announced on **June 17, 2022**, that the **UAE** plans to invest an additional **USD 50 billion** to scale up climate action within the **UAE** and overseas.
 - **Aramco publishes inaugural sustainability report:** On **June 20, 2022**, **Aramco** [published](#) its inaugural sustainability report [Energy security in a sustainable world](#). The title of the report speaks to the prevailing mind-set globally. The author commends the report to readers of Low Carbon Pulse.

The report recognises that climate change in the words of the **Chair of Aramco**: "is ... the biggest long-term challenge that Aramco, or indeed any business, faces".

In passing the author notes that the title of the report reflects the perspective of **Mr Alok Sharma** (at the **Global Offshore Wind 2022**) to the effect that **climate security and energy security are now one and the same**.

- **Abu Dhabi developing hydrogen policy package:** On **June 20, 2022**, thenationalnews.com reported that the **Abu Dhabi Department of Energy (DoE)** is developing a **hydrogen strategy** and **hydrogen policy settings**, together with a licensing regime, and regulations and standards, to allow the development of the hydrogen industry in **Abu Dhabi**. Future editions of Low Carbon Pulse will cover the **hydrogen strategy** and **hydrogen policy settings**. The development of a **hydrogen strategy** and **hydrogen policy settings** marks the continued staged development of structure for the development of the hydrogen industry. Regular readers of Low Carbon Pulse will recall the establishment of the hydrogen alliance among **ADNOC, Mubadala** and **ADQ**. Under the hydrogen alliance, a road map was to be developed to accelerate the adoption of hydrogen.
- **Oman and the Netherlands meet to progress hydrogen value chain:** On **June 23, 2022**, hydrogen-central.com reported that **Oman** and the **Netherlands** are progressing discussions to formalise cooperation in Green Hydrogen production and transportation, logistics and port infrastructure development, including establishing joint ventures for these purposes. Future editions of Low Carbon Pulse will cover further progress of these discussions, and the outcomes of them.
- **OPAZ signs lease for the ACME and Scatec project:** On **June 24, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that the **Oman Public Authority for Special Economic Zones and Free Zones (OPAZ)** had signed a land lease with **Green Hydrogen and Chemicals Company** (a joint venture vehicle of **ACME** and **Scatec**) to develop the first phase of the **USD 2 billion** Green Hydrogen and Ammonia facilities.

By way of reminder:

- **Edition 37** of Low Carbon Pulse (under **Busy Day in paradise**) reported that: "On **March 7, 2022**, it was reported widely that **Acme Group** (Indian renewable energy company) and **Scatec** (Norway based renewable power producer) are to develop a Green Ammonia production facility in Oman. The Green Ammonia production facility is world scale, with nameplate Green Ammonia production capacity of 1.2 million metric tonnes a year on completion of planned development and deployment.
It is understood that the Green Ammonia production capacity is to be developed on a phased basis, with the first phase the development and deployment of 500 MW of photovoltaic solar capacity to power 300 MW of electrolyser capacity, to produce Green Hydrogen which in turn will be used as feedstock to produce Green Ammonia".
- **Edition 39** of Low Carbon Pulse (under **Green Ammonia Certification**) reported that: "On **April 20, 2022**, hydrogen-central.com reported that **TÜV Rheinland** (a global leading technical service provider) had [announced](#) the issue of the **First Green Hydrogen and Green Certificate Globally** to **Green Hydrogen & Chemicals SPC** for the production of Green Hydrogen and Green Ammonia from the project being developed by **ACME Group** and **Scatec ASA**. To all intents and purposes, **TÜV Rheinland** provides a green light to the effect that the proposed greenfield project will produce a Product Carbon Footprint of less than or equal to zero along with the planned production capacity of 1.2 million tonnes of ammonia in Oman".
- **UAE and Germany continue high level engagement:** On **June 27, 2022**, it was reported widely that Government teams from the **UAE** and the **German Federal Government** were holding further meetings during the week-beginning **June 27, 2022**, this time Germany. **Editions 37** or **39** of Low Carbon Pulse reported on earlier meetings. The **UAE** delegation was led by **Ministry of Energy and Infrastructure undersecretary, Mr Sharif Al Olama**, with the delegation including representatives from **ADNOC** and **Masdar**.
As reported The focus of the on-going dialogue is clean energy, including hydrogen and hydrogen based fuels.
- **Alpha knows better:** On **June 27, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that Alpha Dhabi Holding subsidiary, **W Solar Investment**, and the **General Electricity Company of Libya (Gecol)** had signed a memorandum of understanding under which W Solar Investment is to develop a **2 GW photovoltaic solar facility in Libya**.

Africa:

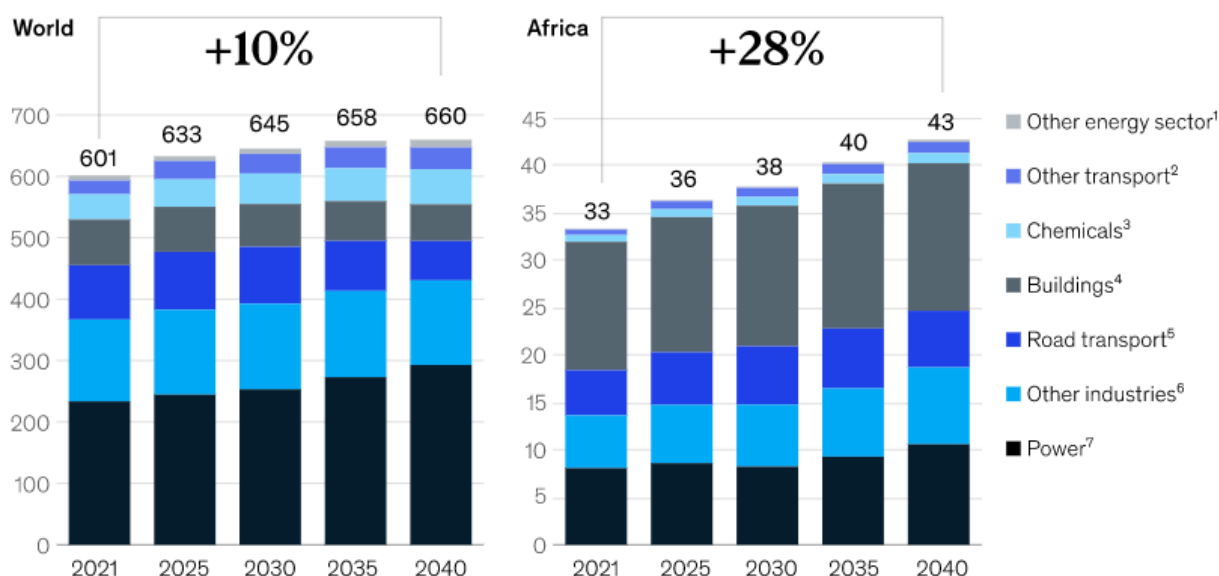
This section considers news items within the news cycle of this **Edition 41** of *Low Carbon Pulse* relating to Africa. Africa remains the continent with the most developing countries, the most **Least Developed Countries** and the most countries vulnerable to climate change, and the continent with some of the lowest levels of electrification.

- **Hyphen Hydrogen Energy announces progress:** On **June 3, 2022** **Hyphen Hydrogen Energy (H2E)** announced at the **World Economic Forum**, held in Davos, Switzerland, that in the light of findings from feasibility and planning work done by the Government of Namibia and **H2E** it is anticipated that construction of the **USD 10 billion Namibian Green Hydrogen Project** will commence in Q1 of the 2025.
- **Positioning Africa for the energy transition:** On **June 8, 2022**, **McKinsey & Company** published an article entitled [The future of African oil and gas: Position for the energy transition](#). The headline from the article is that most oil and gas producing countries in Africa "are highly exposed to the global energy transition, as their economies depend on oil and gas revenues, while their reserves both costs more to produce and are, on average, more carbon-intensive than oil and gas from other regions".

The article notes that: "... energy demand on the continent threatens to outstrip supply. Over the next two decades, rapid population growth and industrialisation are expected to drive strong energy demand growth across the continent ... McKinsey modelling estimates that African energy demand by 2030 could be around 30 percent higher than it is today".

Africa's energy demand in 2040 could be 30 percent higher than it is today, compared with a 10 percent increase in global energy demand.

Primary energy demand by industry, million terajoules



¹Energy for refining processes and hydrogen production. ²Energy to operate other forms of transport (eg, airplanes, ships). ³Energy to operate petrochemical plants. ⁴Energy for residential and commercial buildings (eg, cooking, cooling, water, and space heating). ⁵Energy to power motor vehicles. ⁶Energy to support agriculture, iron, and steel sectors. ⁷Energy for power generation and heating.
Source: McKinsey Energy Insights Global Energy Perspective 2021

McKinsey
& Company

In this context, the article unpacks "how the energy transition ... could shape the future of Africa's oil and gas sector" and provides, at a high-level, "options that affected countries could consider to encourage the necessary investments and build long-term resilience at this critical juncture. The article is excellent, and, for those involved in the energy sector in Africa, essential reading.

- **Angola and German Green Hydrogen and Ammonia:** On **June 15, 2022**, [Reuters](#) reported that Angola was set to be the first supplier of Green Hydrogen to Germany. In context, on **June 15, 2022**, **Sonangol** (Angolan state-owned corporation) signed a letter of intent with two German corporations for the production and export of 280,00 metric tonnes a year of Green Ammonia by 2024.
- **Egypt and EU Partnership centred around clean energy transition:** On **June 16, 2022**, **Egypt** and the **EU** released a [joint statement](#) marking the meeting in Cairo, Egypt, between **Egyptian President, Mr El Sisi**, and **EU Commission President, Ms Ursula von der Leyen**. The joint statement addresses climate, energy and green transition, which reflects that the **EU** and **Egypt** are to work together to implement the **Paris Agreement** (including promoting ambitious outcomes at **COP-27**, which takes place in Sharm El-Sheikh, Egypt in November 2022).

In working together, the **EU** and **Egypt** will focus on energy efficiency, hydrogen and renewable energy sources. In this context, a **Mediterranean Hydrogen Partnership** is to be established to promote investment in renewable energy and extending and increasing the integrity and stability of grids, including development of clean and low carbon hydrogen production capacity, trans-Mediterranean interconnectors and renewable energy generation, storage, transmission and distribution capacity.

- **African Energy Outlook:** As noted above, on **June 20, 2022**, the **IEA** published **[Africa Energy Outlook 2022 – World Energy Outlook Special Report \(AEO\)](#)**. The **AEO** provides an excellent overview of the energy resources of Africa, noting the vast natural gas resources, and the potential for Africa to develop bioenergy, hydro-electric power, photovoltaic solar.

As the **Executive Director of IEA, Mr Fatih Birol**, stated: "The ... [AEO] explores the huge potential of renewables, especially solar, to power Africa's development, the role of natural gas, key opportunities in areas such as critical minerals and hydrogen, and the vital importance of increased investment in clean energy and climate adaptation".

While the **AEO** will be considered in detail in the **May and June Report on Reports** that will be published at the same time as **Edition 44** of Low Carbon Pulse (in particular the **Sustainable Africa Scenario**).

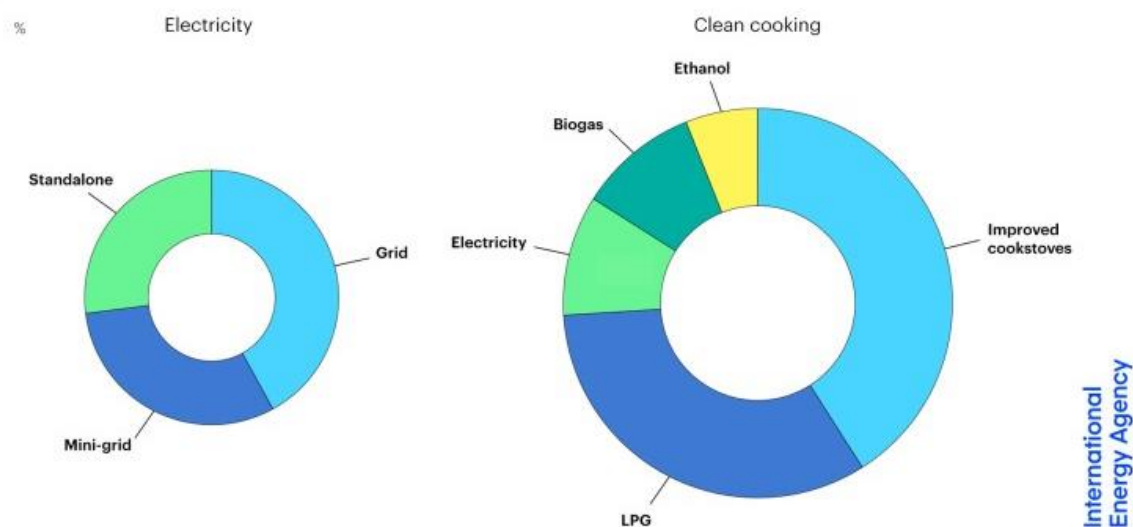
By way of a short summary the key themes identified in the **AEO**:

1. Today's global energy crisis has underscored the urgent need for, and the benefit of, acceleration in the development of cheaper and cleaner sources of energy;
2. Africa needs to accelerate as quickly as anywhere else, because it is facing more severe effects of climate change than most other parts of the world;
3. The clean energy transition holds considerable promise for the economic and social development of Africa; and
4. The **AEO** outlines a **Sustainable Africa Scenario** under which Africa would achieve "all African energy-related development goals on time and in full".

The consistent headline that emerged from the **AEO** is the estimate of the **IEA** that investment of **USD 25 billion** a year through 2030 is needed to progress to the **Sustainable Africa Scenario**.

- **Electrification in Africa:** Previous editions of Low Carbon Pulse have covered the levels of electrification in Africa. The **AEO** provides the most recent analysis – **600 million** people in Africa do not have access to electricity, and over **1 billion** people do not have clean-cooking facilities. The **USD 25 billion** a year investment takes into account the level of investment to progress towards 100% electrification and clean-cooking facilities by 2030.

Share of people gaining access by technology type in the Sustainable Africa Scenario, 2022-2030
Africa Energy Outlook 2022



Source: Africa Energy Outlook 2022, IEA

- **ACWA Power to develop 1.1 GW on-shore wind project in Egypt:** On **June 22, 2022**, it was reported widely that a consortium, comprising **ACWA Power** and **Hassan Allam**, had agreed with the **Egyptian Electricity Holding Company** to develop a **1.1 GW** on-shore wind project in Egypt, located in the Gulf of Suez and Gabal el Zeit. This agreement was one of 14 agreements signed on June 22, 2022.
- **14 agreements in a day:** On **June 22, 2022**, it was reported widely that the **General Authority for Free Zones and Investment (GAFI)** hosted the signing of 14 agreements between the Egyptian and Saudi Arabian interests across the following sectors: conventional and renewable energy, digital and financial and information, e-payment, food, infrastructure, logistics and port management, and pharmaceutical.

India and Indonesia:

*This section considers news items within the news cycle of **Edition 41** of Low Carbon Pulse relating to India and Indonesia, two countries with increasing populations and urbanisation, attendant increased levels of electrification, and being the countries with the third and seventh most **GHG** emissions.*

- **India's first Green Hydrogen refuelling station:** On **June 13, 2022**, [outlookindia.com](https://www.outlookindia.com) reported that **NTPC Limited** (state-owned, and India's largest energy, corporation) had contracted with **Amara Raja Power Systems** (as its EPC contractor) to develop and to deploy **India's first Green Hydrogen refuelling station** in Leh, in the Ladakh union territory. As reported, **NTPC** is to deploy five buses, using fuel-cell technology using Green Hydrogen to power and to propel those buses.
- **Assam on the tee:** On **June 13, 2020**, **The Economic Times** reported **NLC** (Indian government-owned mining and thermal power generator) is to develop and to deploy a **1 GW** photovoltaic solar farm in the Indian state of **Assam** (located in Dima Hasao) in joint venture with the state **Government of Assam**. The state **Government of Assam** will host the **1 GW** photovoltaic solar farm on approximately 1,250 hectares of state land.
- **Adani and TotalEnergies to create Green Hydrogen giant:** On **June 14, 2022**, **TotalEnergies** [announced](https://www.totalenergies.com) that **Adani Enterprises Limited (AEL)** and it had entered into an agreement under which **TotalEnergies** would acquire a 25% interest in **Adani New Industries Limited (ANIL)**. **ANIL** will be the exclusive platform of **AEL** for the production and commercialisation of Green Hydrogen in India. **ANIL** is to target the production of **1 million metric tonnes** of Green Hydrogen a year **by 2030**, requiring the development of up to **30 GW** of renewable electrical energy generation capacity.
- **Azure Powers to giga-factory development:** On **June 15, 2022**, [pv-magazine.com](https://www.pv-magazine.com) reported that **Azure Power** (New Delhi-based renewable power producer) had agreed with **Premier Energies** (leading manufacturer of photovoltaic solar cells and modules) to invest in the development of a **1.2 GW** mono PERC cell and module production facility in the **state of Telangana**.
- **Floating solar in state of Kerala:** On **June 24 and 25, 2022**, it was reported widely that **NTPC Limited's 92 MW** floating photovoltaic solar facility at **Kayamkulam** is operating. The photovoltaic solar arrays comprising the **Kayamkulam** facility have been deployed on reservoirs that are owned by **NTPC Limited's** Rajiv Gandhi gas-fired power station.
- **India Hydrogen Alliance (IHA) presents 25/25 National Green Hydrogen Hub Development Plan (25/25 Plan):** On **June 30, 2022**, [h2-view.com](https://www.h2-view.com) reported that the **IHA** had presented its **25/25 Plan** to the **Ministry of New Renewable Energy** and **NITI Aayog**. As the title suggests, the **25/25 Plan** outlines a plan to develop **25 National Green Hydrogen Projects**, and five **National Hydrogen Hubs, by 2025**. As presented, the **National Hydrogen Hubs** are to be developed in the states of **Andhra Pradesh, Gujarat, Karnataka, Kerala** and **Maharashtra**.
- **India Hydrogen Alliance – May 2022:** Attached is the link to the May edition of [India H2 Monitor – May 2022](https://www.india-h2-monitor.com). The link to the June edition will be attached in the next edition of Low Carbon Pulse when available. As noted in previous editions of Low Carbon Pulse, we intend to include the link rather than repeat the content of the **India H2 Monitor**. (The **India H2 Monitor** tends to be published three to five days after the end of each calendar month, and as such is not published when we publish Low Carbon Pulse – within two days after the end of each calendar month.)

Japan and Republic of Korea (ROK):

*This section considers news items within the news cycle of this **Edition 41** Low Carbon Pulse relating to Japan and ROK, being the countries with the fifth and tenth most **GHG** emissions, and the greatest dependence on imported energy carriers.*

- **ROK tendering 2 GW of photovoltaic solar:** On **June 14, 2022**, [pv-magazine-australia.com](https://www.pv-magazine-australia.com) reported that the **ROK Energy Agency** had launched the first of two tenders for photovoltaic solar capacity that it intends to run during 2022. As reported, the **Energy Agency** intends to allocate **2 GW** across four categories of project: less than 100 kW; 100 kW to 500 kW, 500 kW to 3 MW, and over 3 MW. The projects that are successful in the tender will be awarded **20 year contracts** under **ROK's renewable energy certificate (REC)** scheme.
- **ROK move to biomass:** On **June 15, 2022**, **The Daily Express** ([express.co.uk](https://www.express.co.uk)) reported that **LG Chem Ltd** (leading chemical manufacturing corporation) had announced that it had signed a Letter of Intent with **GS EPS** (a leading energy supply corporation) for the development of a biomass-based eco-friendly energy project. While this may appear to be a passing news item, the author of Low Carbon Pulse, is seeing increasing activity across **Japan** and **ROK** in respect of the procurement of biomass. It is to be expected that momentum will be gained around biomass supply and biomass projects.
- **Air Liquide Korea, Lotte Chemical and SK Gas signed strategically: Edition 40** of Low Carbon Pulse reported that (under **Air Liquide and Lotte Chemical aligned strategically**): "... **Air Liquide** (one of the Big Three Industrial Gas Giants), [announced](https://www.airliquide.com) that it had entered into a strategic joint venture with **Lotte Chemical** under which **Air Liquide** (as a 40% participant) and **Lotte Chemical** (as a 60% participant) are to co-invest though the joint venture in new generation, large-scale, hydrogen refuelling stations in the industrial basins of **Daesan** (including Seoul and Gyeonggi province) and **Ulsan** (including Busan, Daegu and Ulsan and Gyeongsang province). Over the weekend of **June 18 and 19, 2022**, it was reported widely that **SK Gas, Lotte Chemical** and **Air Liquide Korea** had agree on **June 16, 2022**, to establish a joint venture for power generation using by-product hydrogen and hydrogen-powered transportation. Under the joint venture, **Lotte Chemical** and **SK Gas** will each hold a **45%** equity stake, and **Air Liquide Korea** will hold a 10% stake. Subject to approval of the joint venture from the Fair Trade Commission, the joint venture will commence in Q3 of 2022. As reported, the first project of the joint venture will be the construction of a **hydrogen fuel-cell power plant** in **Ulsan** where **Lotte Chemical** and **SK Gas** are able to procure by-product hydrogen. In addition, it is stated that the joint venture will establish hydrogen-refuelling stations across South Korea.

- Covestro, Neste and SK geo centric coalesce:** On **June 20, 2022**, [Neste](#) announced that it was working with **Covestro** (German producer of polyurethane and polycarbonate based raw materials) and **SK geo centric** (South Korean petrochemical importer/exporter) to produce a feedstock to produce polyurethane from "raw material based on renewable raw materials via mass balance".
 As announced, **Neste** will provide **SK geo centric** with renewable **NesteRE** and International Sustainability Carbon Certification (**ISCC**) certified feedstock for polymers to be derived or produced from **100%** renewable raw materials, including from renewable fats and oils. **SK geo centric** will derive **benzene** from the feedstock provided by **Neste** at its petrochemical and refining facilities. The **benzene** will be supplied by **SK geo centric** to **Covestro** to use as feedstock to produce **methylene diphenyl diisocyanate (MDI)** at **Covestro's** facility in Shanghai, with the **MDI** then used to produce rigid **polyurethane**.
- LG Chem create CO₂ "circulation system":** On **June 20, 2022**, [h2-view.com](#) reported that **LG Chemical** had announced the development of a plant to produce **50,000 metric tonnes** of hydrogen a year, at **Daesan, South Korea**.
 As reported, the hydrogen production facility is to produce hydrogen from **CH₄** (using pyrolysis), resulting in **CO₂** and hydrogen. The hydrogen produced will be used for naphtha cracking to produce butadiene, ethylene, and propylene. The **CO₂** will be captured (up to **140,000 metric tonnes** a year) will be supplied to **Taekyung Chemical**. This has been tagged **CO₂** "circulation system"
- ROK and US cooperate on hydrogen safety:** On **June 23, 2022**, [fuelcellworks.com](#) reported that the **ROK**, Korean Gas Safety Corporation, and the **US**, American Academy of Chemical Engineers' Center for Hydrogen Safety, had signed a memorandum of understanding under which each organisation is to exchange information with the other about hydrogen safety, including accidents and best practices, with each to educate and to promote hydrogen safety.
- Japan to increase rate of off-shore wind field installation:** On **June 24, 2022**, [asia.nikkei.com](#) reported that draft rules were released on **June 23, 2022** intended to increase wider competition for the development of off-shore wind fields, and to limit the ability of a single bidder "to win multiple projects in one fell swoop".
 As reported, the new rules would limit a single bidder to the award of no more than **1 GW** of off-shore wind field capacity in any bidding process: while a single bidder could bid for multiple projects, the single bidder would be awarded the off-shore wind field in respect of which it achieves the highest points assessment score. It is understood that this approach will be applied in the next call for proposals.

PRC and Russia:

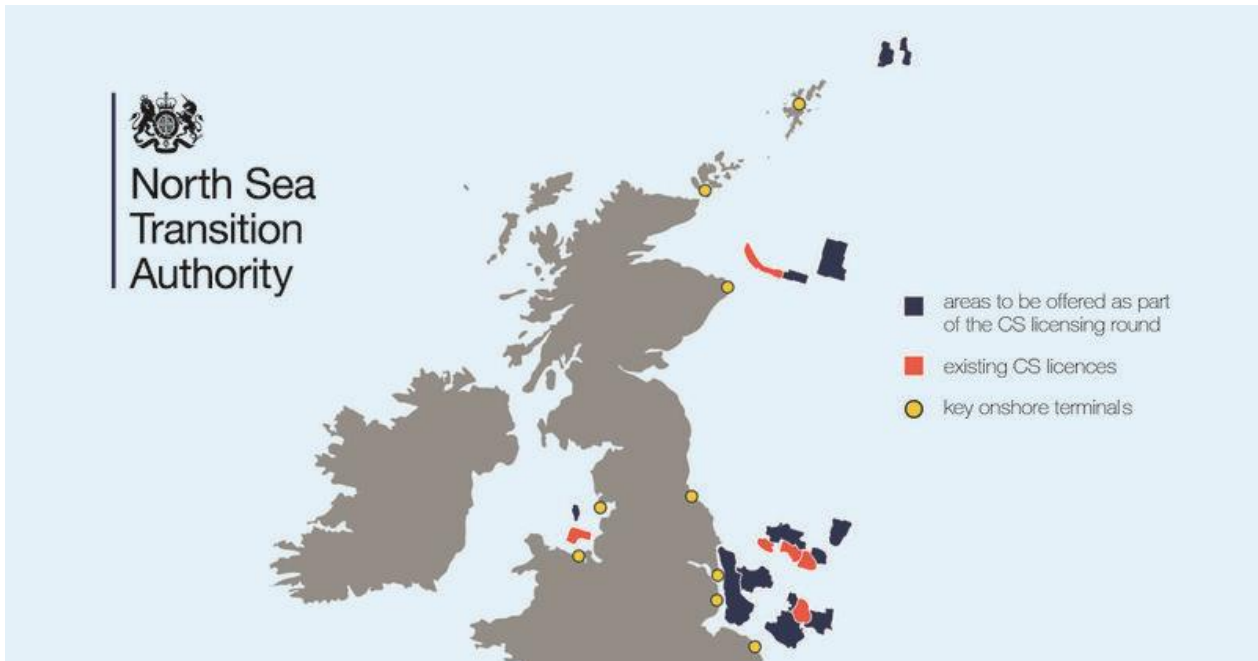
*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the **PRC** and **Russia**, being countries that give rise to the most and the fourth most **GHG** emissions.*

- PRC pumping:** On **June 14, 2022**, [The Straits Times](#) reported (under [China's massive hydro energy storage goals may be getting bigger](#)) that the largest dam builder in the **PRC** is seeking to develop hydro-energy storage or pumped storage facilities. Chair of **Power Construction Corp of China**, Mr Ding Zanzhang, is reported to have indicated that the **PRC** is to construct more than **200** pumped storage facilities, having a combined generation capacity of **270 GW**, with construction on all of them starting by 2025. If these pumped storage facilities are developed as outlined by Mr Zanghang, at current peak load across the **PRC**, the new pumped storage facilities will be able to match around 23% of peak load.
- PRC port refuelling:** On **June 27, 2022**, [fuelcellworks.com](#) reported that China's first port-based hydrogen refuelling station had commenced operation at **Qingdao Port**. The hydrogen refuelling station has a daily supply capacity of **1,000** kilograms - the capacity to refuel fully 50 hydrogen fuel cell vehicles a day. **Shandong Port Group** (of which Qingdao Port is part) is reported as planning to develop three hydrogen refuelling stations, a hydrogen powered energy supply system, and 10 hydrogen-powered gantry cranes in port areas over the coming three to four years.
 The refuelling station at **Qingdao Port** adds to the **250 hydrogen refuelling stations** developed in the **PRC** to date (stated to be around 40% of the total globally). While there is progress across the **PRC** generally, three regions are progressing with great enthusiasm – Bohai Economic Rim, Guangdong-Hong Kong – Macau Greater Bay Area, and Yangtze River Delta.
- PRC photovoltaic solar revolution:** On **June 30, 2022**, it was reported widely that in 2021 of the **54.9 GW** of photovoltaic solar capacity installed in the **PRC**, **21.6 GW** was **residential roof-top photovoltaic solar**.

Europe and UK:

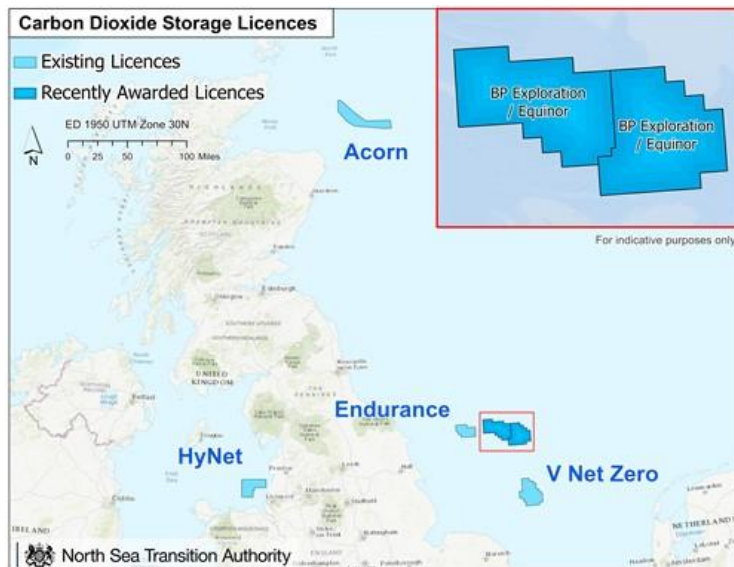
*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to countries within the European Union (**EU**) and the **EU** itself (as an economic bloc) and the **UK** given geographical proximity, and similar policy settings and progress towards **NZE**. In combination, countries comprising the **EU** give rise to the most **GHG** emissions after the Peoples Republic of China (**PRC**) and the **US**. The **UK** is a top-twenty **GHG** emitter, but has been a front-runner in progress towards **NZE**.*

- FlightPath to the Future:** On **May 26, 2022**, the UK Department of Transport announced a new policy setting for the aviation sector, [Flightpath to the Future](#). The **Flightpath to the Future** has a ten-point plan for the future of aviation as follows: **1.** Recover and sustainably grow the sector; **2.** Enhance the UK's global aviation impact and leadership; **3.** Support growth in airport capacity where it is justified, ensuring that capacity is used in a way that delivers for the UK; **4.** Put the sector on course to achieve Jet Zero; **5.** Capture the potential of new technology and its uses; **6.** Unlock local benefits and level-up; **7.** Unleash the potential of the next generation of aviation professionals; **8.** Make the UK the best place in the world for General Aviation; **9.** Improve the consumer experience; and **10.** Retain our world-leading record on security and safety.
- First carbon storage licensing round:** On **June 14, 2022**, the **North Sea Transition Authority** [launched](#) the first carbon storage licensing round with 13 areas available, located off the coasts of Aberdeen, Lincolnshire, Liverpool and Teesside, and being either saline aquifers or depleted oil and gas fields.



By way of reminder: Edition 40 of Low Carbon Pulse reported (under **NSTA awards carbon storage licences to BP and Equinor**) reported that: "On **May 12, 2022**, the **North Sea Transition Authority (NSTA)** [announced](#) in a press release that it had awarded carbon storage (CS) licences to **bp Exploration** and **Equinor**.

The award of the licences to **bp** and **Equinor** brings to **six** the **CS** licences that the **NSTA** is now stewarding. As stated by the **NSTA**, the current project estimates indicate the earliest injection under **CSs** could occur in 2025, given the progress being made in by HyNet, Northern Endurance's East Coast Cluster and V Net Zero Humber Cluster Projects."



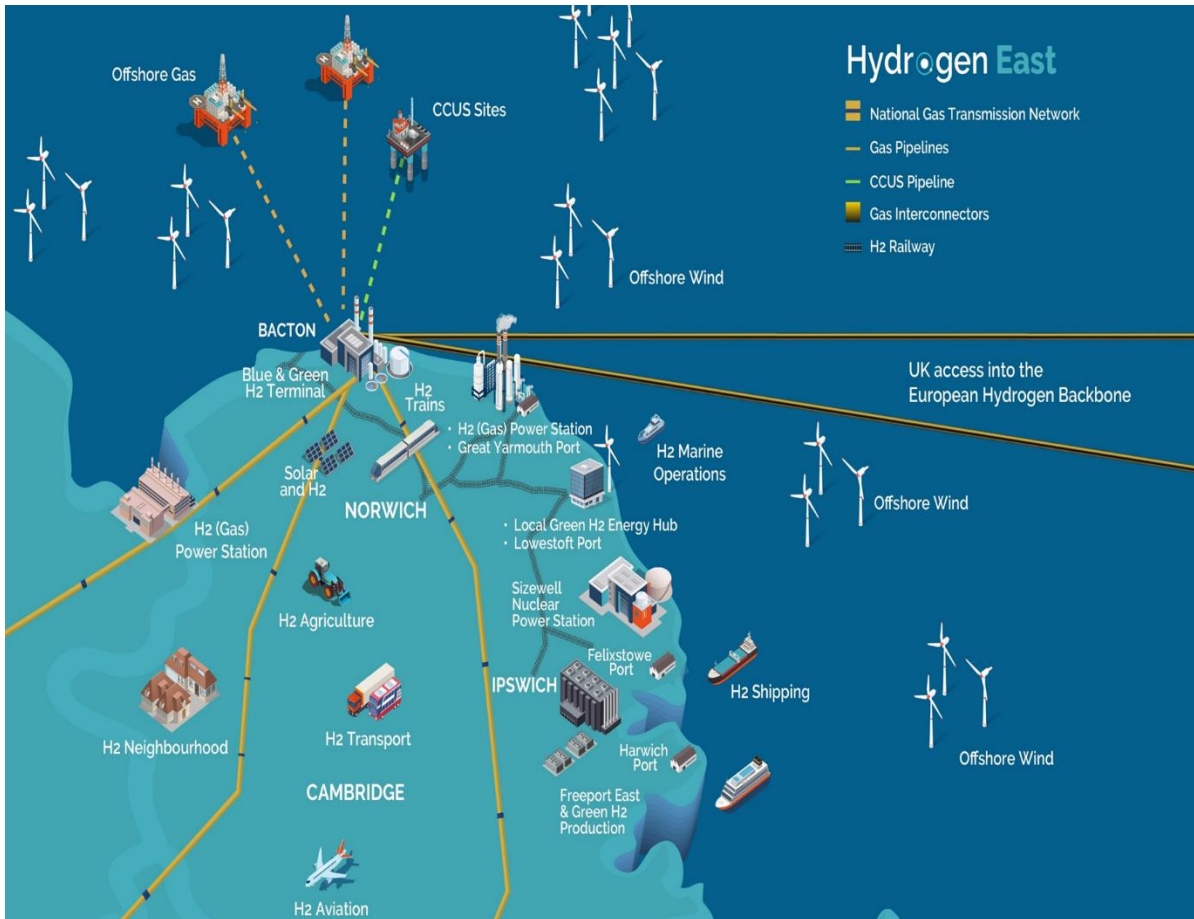
- **Scotland's role in Europe: Edition 32** of Low Carbon Pulse reported on activity to assess the development of the hydrogen production capacity in Scotland, including the [Scot2Ger](#) initiative (assessing the basis for development of hydrogen production capacity in Scotland to produce Green Hydrogen for the German market).

The [Scot2Ger](#) initiative is the subject of a report: [Scot2Ger – Development of a Green Hydrogen Supply Chain from Scotland to Germany](#). The report is focused and realistic.

On **June 20, 2022**, [scottish-enterprise-mediacentre.com](#) published an editorial on the development of the Scotland to Germany Green Hydrogen trade opportunities, noting that the [Scot2Ger](#) initiative builds on the work of Scottish Enterprise earlier in 2021.

- **East of England hydrogen hub vision revealed:** On **June 21, 2022**, [h2-view.com](#) reported that **Hydrogen East** had announced its vision for the development of hydrogen production facilities across the counties of Norfolk and Suffolk, England.

The info-graphic below provides an overview of that vision.



Source: HydrogenEast

- Finland to establish national hydrogen network:** On **June 23, 2022**, it was reported widely that Finland is to establish a national hydrogen network. For these purposes the **Government of Finland** has mandated **Gasgrid Finland Oy** (a state-owned corporation) to develop **hydrogen transmission infrastructure**, and to work to develop a hydrogen market in Finland.

It would be reasonable to assume that the **Climate and Energy Strategy** (soon to be released by the Government of Finland) will emphasise the need for diversification of energy supply and energy security, and, aligned with **REPowerEU** (see **Editions 37, 39 and 40** of Low Carbon Pulse), the decarbonisation of energy supply and use.

- UK Government releases draft CCS network code indicative HoT:** On **June 24, 2022**, the UK Government released the draft **Carbon Capture, usage and storage (CCUS): business models**, together with an **explanatory note**.

Under the regime to license **CO₂** transportation and storage, it will be unlawful to transport and to store **CO₂** without a licence (those licensed being **T&SCos**), and to obtain a licence a **T&SCo** will have to develop a **CCS Network Code** under which it will contract for access and use by users. The concept of a network code is well-established in the UK (the author having worked on the TransCo Network Code back in the day), providing for true open-access for users.

- Shell to join VindØ consortium:** On **June 21, 2022**, offshorewind.biz reported that **Shell** had signed a letter of intent to join the **VindØ consortium** comprising **Andel** (Denmark's largest energy and distribution company), **Copenhagen Infrastructure Partners** and **PensionDanmark, PFA** (Denmark's largest commercial pension company) in the development of Denmark's first energy / power island.

As reported, it is expected that **Shell** will agree to off-take renewable electrical energy to produce Green Hydrogen at Green Hydrogen production facilities located on the island. The consortium intends to participate in the tender process for the award of the concession to develop Denmark's first energy / power island.

The tender process will be run by the **Danish Energy Agency** (see **Edition 40** of Low Carbon Pulse under **Alliance Investment Management and CIP to assess feasibility of energy island**), and is expected to commence Q3 of 2022.

- All is well in the Kingdom of Denmark and getting better:** On **June 24, 2022**, the **Danish Parliament** reached political agreement to accelerate the development of renewable energy, critically, the development and deployment of **20.5 GW** of off-shore wind field capacity **by 2040**.

Americas:

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the US, Brazil, Canada, and Mexico, being countries that give rise to the second, sixth, ninth and eleventh most **GHG** emissions.*

- **Notice of Intent to fund clean hydrogen hubs:** On **June 6, 2022**, the **US Department of Energy (DOE)** published a **Notice of Intent** to fund the **Infrastructure Investment and Jobs Act (IIAJA)** also known as the Bipartisan Infrastructure Law (**BIL**).

US Secretary of Energy, Ms Jennifer Granholm stated: "Hydrogen energy has the power to slash emissions from multiple carbon-intensive sectors and open a world of economic opportunity to clean energy businesses workers across the country. These hydrogen hubs will make significant progress towards President Biden's vision for a resilient grid that is powered by clean energy and built by American workers".

Edition 31 of Low Carbon Pulse reported on the commitment under the **BIL**. **Edition 31** of Low Carbon Pulse, and recent editions of Low Carbon Pulse have reported on the US states that have developed plans to develop hydrogen hubs (see **Editions 33, 35, 36, 37, 39** and **40**).

- **Canada announces a carbon credit system:** On **June 8, 2022**, it was reported widely that Canada had announced a carbon credit scheme, with the initial focus of the scheme being the creation of carbon credits as a result of capturing **GHG** emissions arising as landfill gas (comprising **CO₂** and **CH₄** primarily) as a result of the decomposition of organic matter in landfill. While the initial focus of the scheme is landfill gas capture, the Government is reported to have indicated among others, that the agriculture and forestry sector will come within the scheme in due course. Also, it is reported that carbon capture may be included in the scheme.

As reported in previous editions of Low Carbon Pulse, Canada has placed a price on carbon: currently **CAND 50** per metric tonne, and increasing over time to **CAND 170** per metric tonne by 2030. The price on carbon will provide a basis for the carbon credits to be priced, allowing the viability of projects giving rise to carbon credits to be established.

- **Working Paper – pathway to 100% zero-emission vehicles by 2035:** On **June 10, 2022**, the [icct.org](https://www.icct.org) published a working paper, [Canada's Path to 100% zero-emission light-duty vehicle sales: regulatory options and greenhouse gas impacts](#). For those interested in the transportation sector, and policy settings generally, the working paper is well-worth a read.

The working paper provides a **Baseline Scenario** (reflective of current policy settings in Canada) and three **Alternative Scenarios**, **1.** under which **50%** of sales by 2030 are of electric vehicles, **2.** under which **61%** of sales by 2030 are electric vehicles, and **3.** under which by 2035 plug-in hybrid vehicles are to be phased-out.

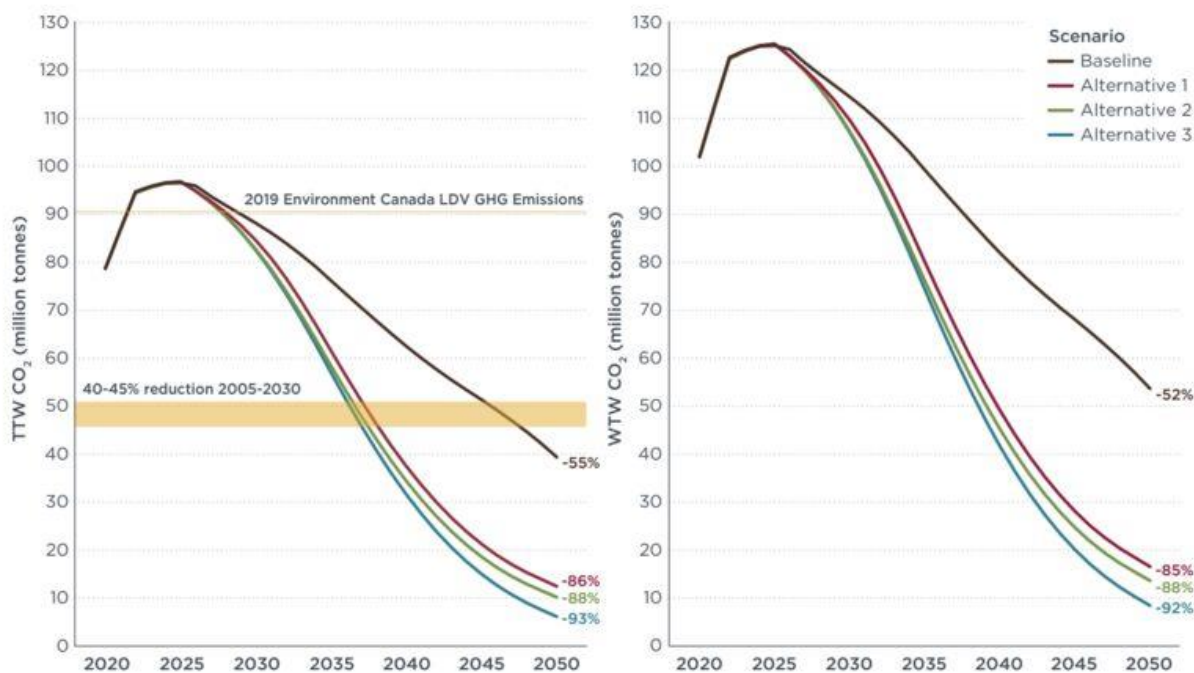


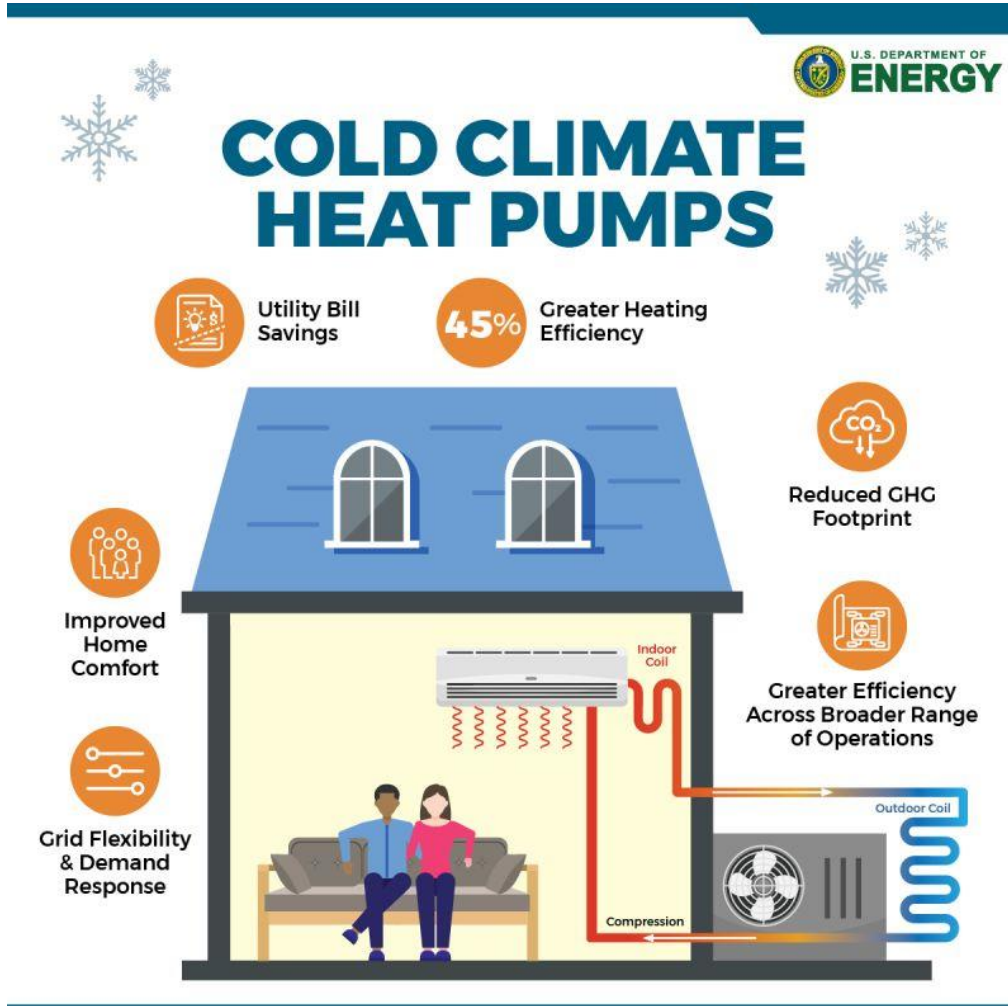
Figure 6. TTW and WTW CO₂ emissions from Canada's LDV fleet between 2020 and 2050. The data labels in 2050 show the percent reduction from 2021 emissions. WTW emissions include TTW emissions and upstream emissions from fuel production, refining, and distribution, as well as electricity generation.

Source: [Canada's Path to 100% zero-emission light-duty vehicle sales: regulatory options and greenhouse gas impacts](#)

The working paper notes that **none of the Scenarios** is consistent with achieving the **economy-wide GHG** reduction target of **40% to 45% by 2030**. The economy-side finding is salutary and telling.

- **Heat Pump Breakthrough:** On **June 17, 2022**, the **US Department of Energy (DOE)** announced a breakthrough in technology for next-generation electric heat pumps, with **DOE** and **Lennox International** (global provider of climate control solutions for the heating, air conditioning and refrigeration markets) to partner to develop cold climate heat pumps (**CCHPs**).

The graphic below provides a sense of how CHPPs work, and their benefits:



- **US Eastern States partner with Federal Government:** On **June 24, 2022**, it was reported widely that the **Biden Administration** and the **State Governors of 11 US east-coast States** had launched a [Federal-State Offshore Wind Implementation Partnership](#).

France and Germany:

*This section considers news items within the news cycle of this **Edition 41** of Low Carbon Pulse relating to France and Germany.*

- **France and Germany leading the way:** While well-known it is not stated often that in the **European biogas** market **Germany** leads in terms of the number of plants, and **France** leads in the **biomethane** market (followed by Denmark, Italy and the Netherlands).

As noted in recent edition of Low Carbon Pulse, **biogas** and **biomethane** has a key role to play in displacing the use (or at least a percentage of the use) of natural gas.

By way of reminder: **Edition 40** of Low Carbon Pulse (under **Biomethane Action Plan for the EU**) reported that: "On **May 18, 2022**, as part of the [REPowerEU Plan](#), the **EU** proposed a [Biomethane Action Plan](#), with the objective of producing **35 billion cubic metres (BCM)** of **biomethane** by **2030**."

The increased derivation and production of **biogas**, and its processing to upgrade it to produce **biomethane** will require the scaling up the value chain to ensure that sufficient **biomass** (of appropriate specification) is collected to allow the derivation and production of **biogas**."

One matter that is gaining increasing attention (rightly) is that **CH₄** emissions arising from the production, storage and transportation of biogas and biomethane need to be monitored and regulated closely.

- **German two percent rule:** On **June 15, 2022**, [cleanenergywire.org](#) reported that as part of draft legislation, the Federal German Government plans to achieve acceleration of the energy transition by requiring **two percent of the land mass of Germany to be dedicated to the production of renewable electrical energy**.

The new legislation is reported as likely to be passed in **July 2022**, before the start of the summer recess. This initiative is consistent with the doubling of on-shore wind farm capacity to 115 GW by 2030, requiring an additional 10 GW a year from 2025.

- **German hydrogen supply and demand:** On **June 21, 2022**, **Guidehouse** published [Imports will be a cornerstone for Meeting Germany's Hydrogen Demand](#). The **Guidehouse** report was prepared for the German Federal Ministry for Economic Affairs and Climate Action. The report is insightful, providing practical perspectives.

- **Air Liquide and Siemens Energy:** On **June 24, 2022**, it was reported widely that **Air Liquide** (one of the Big Three Gas Giants, with Air Products and Linde) and **Siemens Energy** are to work together in joint venture so as to be able to accelerate the manufacturing capacity of proton exchange electrolyzers. **Air Liquide** and **Siemens Energy** will be able to achieve scale across the Green Hydrogen projects that each has in its portfolio.
- **Chile and Germany alignment:** On **June 29, 2022**, **Chile** and **Germany** signed a letter of intent to develop a bi-lateral alliance for hydrogen production and trade.
- **German demand for heat pumps defined and scoped:** On **June 30, 2022**, the German Federal Government stated that by 2024 **500,000 heat pumps a year** would be required to be manufactured for installation across Germany. This provides a clear signal to German industry of the scope and scale of demand.

Australia:

*This section considers news items that have arisen within the news cycle of this **Edition 41** Low Carbon Pulse relating to Australia, a top-twenty **GHG** emitting country, and a developed country with the highest **GHG** emissions per capita. Australia is however progressing to **NZE** at a faster rate than many other developed countries, and, along with the GCC Countries, is one of four countries rich in solar resources (and wind resources) that appear likely to lead in the development of the hydrogen economy over the next five years (and beyond): Australia, Chile, the **PRC** and Spain.*

- **Australian Federal and State Government agree national energy plan:** Like many countries around the world, Australia has been working its way through energy market disruption in recent times. On **June 8, 2022**, it was reported widely that the Energy Ministers (at Federal and State and Territory level) had agreed a **national energy transition plan**, including the phase out the use of fossil fuels and to provide funding support to ensure that the electricity grid is robust in all weather conditions. In addition, the national electricity market (**NEM**) operator (**Australian Energy Market Operator** or **AEMO**) is to have the power to store natural gas, and is to develop a new capacity mechanism.
- **NSW solar program to reach 1 million homes:** On **June 8, 2022**, the New South Wales Government **Energy Bill Buster** program was reported widely: as reported, the program will include up to **AUD 3,000** (per household) of funding to be applied to roof-top solar installation and devices and equipment resulting in energy-saving. The program is part of the policy setting program from the Government of New South Wales to address the impact of increased energy costs on the Eastern Seaboard of Australia.
- **NSW to fast-track the development of NSW Renewable Energy Zones:** On **June 10, 2022**, the New South Wales Government [announced](#) its intention to fast-track the development of the **Renewable Energy Zones (REZs)**, to provide funding support for augmentation / development of the transmission network (with the funding to be sourced from a new **Transmission Acceleration Facility**), and to promote **BESS capacity** (including the **Warratah Super Battery**).

By way of reminder: Editions [4](#), [26](#), [30](#), [34](#) and [40](#) of Low Carbon Pulse has reported on the renewable energy zone (**REZ**) initiatives of the State Government of New South Wales, Australia.

- **QLD study funding support:** On **June 13, 2022**, [energy-storage.news](#) reported that on **June 10, 2022**, the Queensland Government had allocated **AUD 35 million (USD 24.5 million)** in respect of a study to identify a site for a **second pumped hydro energy storage (PHES)** plant. The first **PHES** being the **Genex Power's Kitson PHES**.

In addition to funding support for the **second PHES**, further funding has been allocated to allow a detailed feasibility study in respect of the **Borumba Dam Pumped Hydro project** (see [Edition 19](#) of Low Carbon Pulse).

- **Australia increases its NDC to 43%:** On **June 16, 2022**, the **Australian Federal Government** submitted a revised nationally determined contribution (**NDC**) under the **Paris Agreement**, committing Australia to reduce **GHG** emissions by **43% by 2030**, compared to 2005 levels, a **15% to 17% increase** in Australia's previous **NDC** of a 26% to 28% reduction. The revised **NDC** is most welcome, bringing Australia alongside other developed economies.
- **Western Australia states its determined contribution:** On **June 22, 2022**, the **State of Western Australia** announced that Western Australian State **Government agencies** will be required to reduce their **GHG** emissions to **80% below 2020 levels by 2030**.
- **Australian-German Hydrogen Taskforce white paper:** On **June 24, 2022**, the **Australian-German Hydrogen Taskforce** (see Editions [20](#), [31](#) and [40](#) of Low Carbon Pulse) published its **White Paper** together with a **10-point action plan** (or possibly characterised as a 10 point description) entitled **Green Hydrogen Task Force – White Paper and 10 Point Action Plan**.

A key finding of the White Paper is that Germany is **hydrogen ready** now to take up to **5 million metric tonnes** a year, developing to **27 million metric tonnes** over time.

The **10-point action plan** is (its findings are): **1.** In Australia and Germany it is necessary to scale-up plans for electrolyser and ammonia capacity; **2.** Develop standardised hydrogen farms, with modularised components, undertaken by a manufacturing coalition comprising core market participants; **3.** Provide early fiscal support to enable hydrogen to be competitive in price compared to liquid natural gas (LNG); **4.** Encourage risk taking by infrastructure investors to help scaling-up; **5.** Develop Green Hydrogen and Ammonia corridors from host country ports to importing country ports, with appropriate legislation and regulation in both host and import country; **6.** Develop community and political support for policy settings that impose Green Quotas to accelerate demand for Green Hydrogen and Ammonia, and hydrogen-based fuels; **7.** Leverage the Australian-German corridor as the basis for an 80% solution; **8.** Develop a positive perception by broad multi-faceted communication; **9.** Progress from an 80% solution to a 100% solution "while on the run"; **10.** Economic and energy security in both Australia and Germany requires the development of a Green Economy.

Blue and Green Carbon Initiatives and Biodiversity

*This section considers news items that have arisen within the news cycle of this **Edition 41** Low Carbon Pulse relating to the Blue Carbon and Green Carbon initiatives and Biodiversity.*

- **World Bank supports mangrove conservation and restoration in Indonesia:** On **June 7, 2022**, **The World Bank** announced its support for projects to conserve and to restore mangrove growth in Indonesia, under **The Mangrove for Coastal Resilience Project**. The Project is stated to "focus on strengthening the policy and institutions for mangrove management and rehabilitation, promoting sustainable mangrove management, as well as improving the livelihood opportunities for Indonesian coastal communities living around mangrove forests".

As stated, Indonesia has around **3.4 million hectares** of mangrove growth, accounting for 20% of mangrove growth globally, and provides habitat for 40 of the 54 species of mangrove. The mangrove growth in Indonesia stores **3.14 giga-tonnes** (3.14 billion metric tonnes) of **CO₂**. As noted in previous editions of Low Carbon Pulse, mangrove growth improves the eco-system for marine life, and as such provides improved fishery opportunities. In Indonesia, around **55%** of the **fish catch** consists of **mangrove-dependent** marine life.

By way of reminder:

Edition 29 reported that it is estimated that one mangrove tree will absorb 12.4 kg of **CO₂** a year on average. Taking the benchmark of the Kingdom of Saudi Arabia to plant 50 billion trees (see **Edition 13** of Low Carbon Pulse), 50 billion mangrove trees will absorb 620 million metric tonnes per annum. It is possible to plant 5,000 mangrove trees per hectare, with each hectare absorbing 62 metric tonnes per annum of **CO₂**. 50 billion mangrove trees could be planted on 10,000,000 hectares.

In contrast, a palm tree will absorb around 2.3 kg of **CO₂** a year. On October 25, 2021, the US State of Florida announced plans to replace palm trees with native canopy trees, which absorb a greater mass of **CO₂**. Palm oil trees are different, and the data on their ability to absorb **CO₂** has quite a spread. Taking the highest estimate of the spread at 57.6 metric tonnes per hectare, palm oil trees appear comparable with mangrove swamps. This is not to suggest deforestation and planting of palm oil trees, rather it is to provide a point of comparison.

By way of further comparison, a pine tree will absorb around 10 kg of **CO₂** a year. On the basis that there are approximately 1,000 trees per hectare, the pines trees in that hectare will absorb 10 metric tonnes per annum of **CO₂**.

- **More about mangrove forests and swamps: July 26 is International Mangrove Day.** Mangroves are unique, surviving and thriving along watercourses and coastlines, protecting coastlines, absorbing pollutants and oxygenating the water in which they grow.
- **Focus on Oceans:**
 - **"Ocean assisted" carbon removal:** In many reports on the impacts of climate change it is acknowledged that the oceans have absorbed around one third of the **CO₂** arising from anthropogenic activities. As **CO₂** is absorbed by the oceans it dissolves and increases the acidity of the oceans.
On **June 9, 2022**, carbonfuture.earth reported on the deployment of a pilot project that removes carbon and reduces ocean acidification: the pilot project processes saltwater from the ocean, removing compounds to reduce its acidity (through the removal of HCl), with the mineral-hydroxides arising from the process being returned to the ocean to absorb **CO₂**: the de-acidified saltwater, with an increased PH, will sequester **CO₂** in the form of precipitated carbonates (i.e., sand).
The underlying technology involves electrolysis with the electrical energy required sourced from photovoltaic solar.
 - **Ørsted article: Lead Sustainability Advisor, Ørsted, Ms Madeline Hodge,** posted an excellent article, [Why the Health of our oceans is vital to us](#). In the article, Ms Hodge outlines five (of the many) ways in which oceans are critical to modern life. The fifth way outlined is that oceans are key to the development of renewable electrical energy. In this context, Ms Hodge states that "Ørsted aims to create net-positive impact on biodiversity". Ms Hodge explains that "net-positive" means that **Ørsted** is going beyond mitigating any potential negative effects that it may have on marine environments and species by developing projects that will outweigh the impact on natural eco-systems and seek to leave nature in a better state than it was found. One example given is the creation of artificial reef structures to provide homes for marine fauna and flora, "enhancing the marine food web".
 - **UNDP facts and stats:** On **June 24**, the **UN Development Program** published material ahead of the commencement of the second UN Ocean Conference 2022. Oceans cover 70% of the surface area of the earth, are home to around 80% of life, and produces around 50% of the earth's oxygen.
- **The UN Convention on Biological Diversity:**
 - **The Convention on Biological Diversity background:** The Convention on Biological Diversity (aka Biodiversity Convention) has been ratified by 196 countries.
The Convention has three principal goals:
 1. the conservation of biological diversity;
 2. the sustainable use of biological diversity (and associated eco-systems);
 3. fair and equitable sharing of benefits.
 - **Part 2 of COP-15:** As note above, **Part 2** of the **15th Conference of Parties to the UN Convention on Biological Diversity** is to take place in **Montreal, Canada**, over the period **December 5 to 17, 2022**. As reported previously in a number of editions of Low Carbon Pulse, **Part 1** of **COP-15** was held in **Kunming, the PRC**, with **Part 2** deferred because of the continued impact of COVID-19. As noted in previous editions of Low Carbon Pulse, the key purpose of **Part 2** of **COP-15** is to progress to a conclusion the **Post-2020 Global Biodiversity Framework**.
 - **Ahead of COP-15:** As noted above, ahead of **COP-15** a meeting was held in Nairobi, Kenya, for experts to discuss **six science briefs** ahead of **COP-15**, for the purposes of informing discussion about the **Post-2020 Global Biodiversity Framework**. The graphic below indicates the subject matter of each of the six science briefs:



- **Sustainability strategy without biodiversity is incomplete:** On **June 21, 2022**, [quantis.com](https://www.quantis.com) published an excellent article [Seeing the forest for the trees: Why an environmental sustainability strategy without biodiversity is incomplete](#). The article provides a compelling narrative of the criticality of biodiversity to the world economy, a value "often overlooked", in particular in the context of the focus on **GHG** emission reductions.

"Climate Change and biodiversity loss are two sides of the same coin; they're intertwined through mechanistic links and feedbacks ... Climate change exacerbates risks to biodiversity, while ecosystems and their biodiversity are key for climate mitigation and adaptation".

- **Seychelles Blue Carbon Roadmap:** On **June 24, 2022**, the Seychelles released its [Blue Carbon Roadmap](#) the primary purpose of which is to protect and to preserve its mangrove and sea-grass ecosystems, as part of the broader policy settings to mitigate the effects of climate change. As noted by BlueCarbonLab, while the Seychelles is smaller than the city of New York, it has around 2.1 million hectares of blue carbon ecosystems comprising over 250 million metric tonnes for organic carbon.

- **By way of background: Edition 40** of Low Carbon Pulse provided the following background about biodiversity: "In the broadest sense, **biodiversity** describes the variety of the fauna and flora globally, and in any particular area. At the highest level, **biodiversity** is important. The preservation of **biodiversity** is therefore a key policy setting. In this context, human activities and the clearing of land to undertake agricultural, forestry or other land use (**AFOLU**) is a key focus of policy settings. Desertification and deforestation are key concerns (both as a result of **AFOLU**), as is the broader impact of climate change on habitats, critically, the impact on change in temperature on land and in the ocean.

There is a balance in habitats, with eco-systems that have developed overtime, and that continue to develop. The balance of habitats and their eco-systems are impacted by **AFOLU** and climate change. There are many examples, but a consistent example (that many will recognise) is the need to preserve the habitats of bees and other pollinators, and to avoid loss of bees and other pollinators. As a policy setting, the rewilding of habitats is one element of preservation, and, in some cases, restoration of eco-systems. As a broad statement, preserving wilderness areas, and rewilding of areas, and reducing old growth forestry, and afforestation and reforestation, are key to the

preservation and restoration of **biodiversity**. These are policy settings over which we have control in the near, medium and long term. In addition, overtime, policy settings may extend to addressing optimal use of land, optimal in the sense of preserving or restoring **biodiversity** while at the same time addressing climate change. As always, what is needed is known. As always, the challenge is acting upon it.

Climate change will impact the effectiveness of these policy settings (in particular coastal habitats, and areas of increased drought and desertification, driven by rising sea-levels and changes in weather patterns, as a result of climate change), but they are policy settings that are necessary and need to be progressed in the near term. In addition, acting to preserve and to restore **biodiversity** is likely to yield benefits, economic and social.

As noted by the **UNEP**:

"Healthy, biodiverse eco-systems sustain life on Earth by providing air, wate and other essential elements. From forests to farmlands to oceans, the planet's eco-systems are the basis of resources, services and industries".

Existing impact: It is widely understand that **75%** of the Earth's **land** and **66%** of its **oceans** have been altered by human activity, with associated impact on eco-systems".

Bioenergy and heat-recovery:

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to bioenergy, being energy, whether in gaseous, liquid or solid form, derived or produced from biomass.*

Bioenergy includes any energy derived or produced from biomass (organic matter arising from the life-cycle of any living thing, flora or fauna, including from organic waste streams), whether in gaseous, liquid or solid form.

In addition, recovered heat and waste heat (derived from any source, including waste water) has been added to this section.

*From recent activity and reporting, it appears likely that the avoidance of waste heat energy, and the recovery of waste heat energy will become a priority under the first pillar as a part of Energy Efficiency (**IEA**) and Energy conservation and efficiency (**IRENA**). By some estimates, up to 67% of energy arising is wasted. The increased awareness of sourcing heat reflects increased awareness of the energy used to heat buildings, and its source: heating buildings results in around 25% of total final energy demand, with around 75% of the feedstock used to satisfy that energy demand derived from fossil fuels.*

- **Clariant clutched straw:** On **June 14, 2022**, **Clariant** (Swiss multinational speciality chemicals company) announced that it had begun production at its sunliquid® cellulosicethanol facility in **Podari, Romania**, of second-generation **biofuel** using feedstock sourced from **agricultural residues**. The biofuel produced at the Pordari facility is to be off-taken by Shell.
- **Cargill opens biodiesel plant:** On **June 21, 2022**, it was reported widely that **Cargill** (American global agricultural corporation) had opened a biodiesel plant, located in Ghent, Belgium. The biodiesel plant processes waste fats and oils, with the biodiesel intended to be used in the transportation industry. As reported, the plant will produce up to **115,000 metric tonnes** of biodiesel a year.
- **Hazer Group Woodman Point Project progressed:** On **June 28, 2022**, **Hazer Group Limited** [announced](#) that it had completed construction and commissioning of its **Commercial Demonstration Plant** at **Woodman Point, Western Australia**. The **Commercial Demonstration Plant**, using the **Hazer Process** (involving methane pyrolysis), processes biogas derived and produced from waste water at the **Woodman Point Water Recovery Facility** (owned and operated by the **Water Corporation**) to produce graphite and turquoise hydrogen.
- **By way of reminder:** [Edition 39](#) of Low Carbon Pulse under (**NREL on top of biogas potential:**) reported that the US **NREL** (the **National Renewable Energy Laboratory** of the US Department of Energy) has published [Biogas Potential in the United States \(Fact Sheet\), Energy Analysis](#). The headline is the **CH₄** that could be derived and produced from waste that would otherwise be landfilled, animal manure, wastewater, and organic waste streams from commercial, industrial and commercial sources is estimated to be sufficient to provide 9% of the natural gas demand of the US. The by-product of the production of biogas is digestate, which is can be used, in processed form, as a fertiliser.
- **By way of background:**

BIOENERGY

Biogas and **Synthetic Gas** (or **Syngas**): arises as a result of: (a) the decomposition of organic material (in an oxygen free or scarce environment, explained in **Chapters 5** and **6** of the [Ashurst Waste Compendium](#)), consisting of between 60 to 70% **CH₄** and 30 to 40 % **CO₂**, with other compounds and elements in gaseous form, ammonia (**NH₃**), hydrogen sulphide (**H₂S**) and nitrogen (**N₂**), and water vapour; or (b) the thermo-chemical treatment of organic matter to derive **Biogas**.

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "upgrading") so that it can be used as pipeline gas (i.e., complying with the specification for hauling through the applicable natural gas pipeline, including the removal of **CO₂**, and other compounds and elements, such that the gas hauled through the pipeline is **CH₄**). **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel (typically, as a gas that is combusted / oxidised to produce electrical energy or heat energy or both) or as a feedstock. Also either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia:** being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;

- **Bio-butanol:** being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel:** being diesel (i.e. synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol:** being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene:** being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF),** is a synthetic paraffinic kerosene. Currently most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams (typically using some natural gas). As noted below, typically fatty acids and hydrogenated acids are used to produce synthetic paraffinic kerosene. If the feedstock is sourced from Biomass it is a Bio-kerosene;
- **Bio-LNG:** being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and
- **Bio-methanol:** being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

BESS and HESS (and energy storage, including CAES and PHES):

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to battery electric storage systems (**BESSs**) and hydrogen energy storage systems (**HESSs**). In addition to **BESSs** and **HESSs**, other forms of energy storage systems are covered, including use of compressed air energy storage (**CAES**) and pumped hydro energy storage (**PHES**). In this context, long duration energy storage (**LDDES**) is considered, being energy technology that is able to allow the off-take electrical energy out of storage for a duration of more than four hours. In the brave new world described in **Edition 13** of Low Carbon Pulse: "**BESS** storage of 10/12/24 hours is being contemplated for business users, and up to 72 hours for telecommunications companies, including to guard against the consequences of land-borne weather events".*

- **Compressed Air Storage:**
 - **CAES connected to grid in the PRC:** On **June 1, 2022**, [energy.storage.news](#) reported that a **300 MWh CAES** had been connected to the grid in **Jiangsu**, the **PRC**.
 - **By way of a reminder: Edition 40** of Low Carbon Pulse (under **CAES preferred for Broken Hill**) reported that: "a compressed air storage solution had been chosen to provide back-up electrical energy supply at Broken Hill, New South Wales, Australia. **Hydrostor** (a Canadian headquartered corporation) with a proprietary technology – advanced compressed air energy storage (**A-CAES**). The **A-CAES** is a long duration energy storage (**LDDES**) system capable of dispatching stored energy to the grid, and to help address the capacity constraints across the grid regionally".
- **US DOE provides USD 504.4 million loan guarantee: Edition 37** of Low Carbon Pulse reported that the **US Department of Energy (DOE)** had agreed in principle to provide funding support in the form of a loan guarantee: On **June 8, 2022**, the **DOE** announced that it had provided the loan guarantee. The loan guarantee was key to allowing financial close to allow the development of the **Advanced Clean Energy Storage (ACES)** project in **Delta, Utah**. The **ACES** project will have **150 GWh** of energy storage capacity, making it the largest **HESS** project globally. On **June 9, 2022**, **Haddington Ventures** [announced](#) the **USD 650 million** equity syndication program to provide finance for the **ACES** project. As announced, the equity investors are **Alberta Investment Management Corporation, GIC, Manulife Financial Corporation, and Ontario Teachers' Pension Plan Board**. In addition, the initial **USD 650 million**, as might be expected, the foundation investors have the right to participate to increase their collective investment to **USD 1.5 billion**.
- **CO₂ battery storage:** On **June 8, 2022**, [electrek.co](#) reported that **Energy Dome** (described as an Italian start-up) had announced that it was to launch the first **CO₂ battery storage (CO₂ Battery)** in **Sardinia, Italy**. As reported, the **CO₂ Battery** uses **CO₂** to store renewable electrical energy on the grid.
- **Spain Big BESS Tender:** On **June 10, 2022**, **Spain's Ministry of Ecological Transition and Demographic Challenge** announced plans to commence a tender process for up to **5.85 MW** of **renewable energy** and **BESS** capacity to access the grid at **17** nodes.
- **Bluestone and GIG energised:** On **June 14, 2022**, it was reported that **Bluestone Energy Ltd** and **Green Investment Group** are to work together to develop and to deploy **2 GW** of **BESS** projects across the UK. As reported, **Blue Energy** and **GIG** are already working together on the development of **970 MW** of **BESS** projects.
- **Edify achieves financial close:** On **June 14, 2022**, **Edify Energy** (leading Australian renewable energy corporation) [announced](#) that financial close had been achieved in respect of **150 MW / 300 MWh** of **BESS** projects (across three **BESS** sites). The **BESS** projects have off-take agreements in place with **EnergyAustralia** and **Shell Energy**. As announced, the **BESS** projects were "Designed and developed by Edify, [the] energy storage systems using Tesla Megapacks [being] the most advanced in the [Australian] National Electricity Market, equipped with grid forming inverters that operate in "virtual synchronous generator" mode".
- **NREL maps PHES potential:** The **US National Renewable Energy Laboratory (NREL)** has developed an [interactive map](#) identifying potential pumped hydro energy storage (**PHES**) sites in the US. As reported, the US has

43 PHES plants, with combined capacity of **23 GW**. NREL has assessed potential for **3.5 TW** of new **PHES** capacity. The NREL [report](#) on **PHES** potential is well-worth a read.

- **Sembcorp Industries to BOO BESS at Jurong Island:** On **June 15, 2022**, [theedgesingapore](#) reported that the **Energy Market Authority** of Singapore had appointed **Sembcorp Industries** (wholly-owned subsidiary of Sembcorp Utilities) to build, own and operate a **200 MW / 200 MWh BESS** on **Jurong Island, Singapore**.
- **Hybrid energy storage project may progress:** On **June 17, 2022**, [energy-storage.news](#) provided an update on a prospective hybrid energy storage project (**Aurora**): the **Aurora** project is reported to involve the use of concentrated solar power (**CSP**), **70 MW** of photovoltaic solar, a **140 MW / 280 MWh BESS**, and molten silicon thermal storage. During the week beginning **June 13, 2022**, **Vast Solar** and **14D** formed a joint venture to progress the hybrid project. The development of a **20 MW CSP** plant has received funding support from the Federal Australian Government.
- **Europe's need for energy storage:** On **June 20, 2022**, the **European Association of Energy Storage (EASE)** published [Energy Storage Targets 2030 and 2050](#). As might be expected, the headline from the report is that **by 2030** Europe needs to have installed **187 GW** of energy storage capacity and **by 2050 600 GW**.
The report is well-worth a read, providing an assessment of the energy storage solutions that are likely to make up the **187 GW** of **energy storage** capacity **by 2030**.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to carbon accounting and carbon dioxide removal (**CDR**), including bioenergy carbon capture (**BECCs**), bioenergy carbon capture use and storage (**BECCUS**), carbon capture and storage (**CCS**), carbon capture use and storage (**CCUS**) and direct air capture (**DACS**). Effective accounting for carbon arising and **CDR** go hand-in-hand. By way of background **CDR** is recognised in the 2021 Report as including: afforestation, soil carbon sequestration, bioenergy with carbon capture and storage (**BECCS**), wet land restoration, ocean fertilisation, ocean alkalisation, enhanced terrestrial weathering and direct air capture and storage (**DACS**) are all means of **CO₂** removal. The IEA pathway to **NZE** estimates that in order to achieve **NZE** it will be necessary to capture and to remove up to 7.6 giga-tonnes of **CO₂** each year through **CCS**, **CCUS** and **CDR**. **CCS** and **CCUS** (and **BECCS** and **BECCUS**) involve the capture at the source of **CO₂**, preventing release to the climate system. The following provides a helpful overview of carbon capture as things currently stand.*

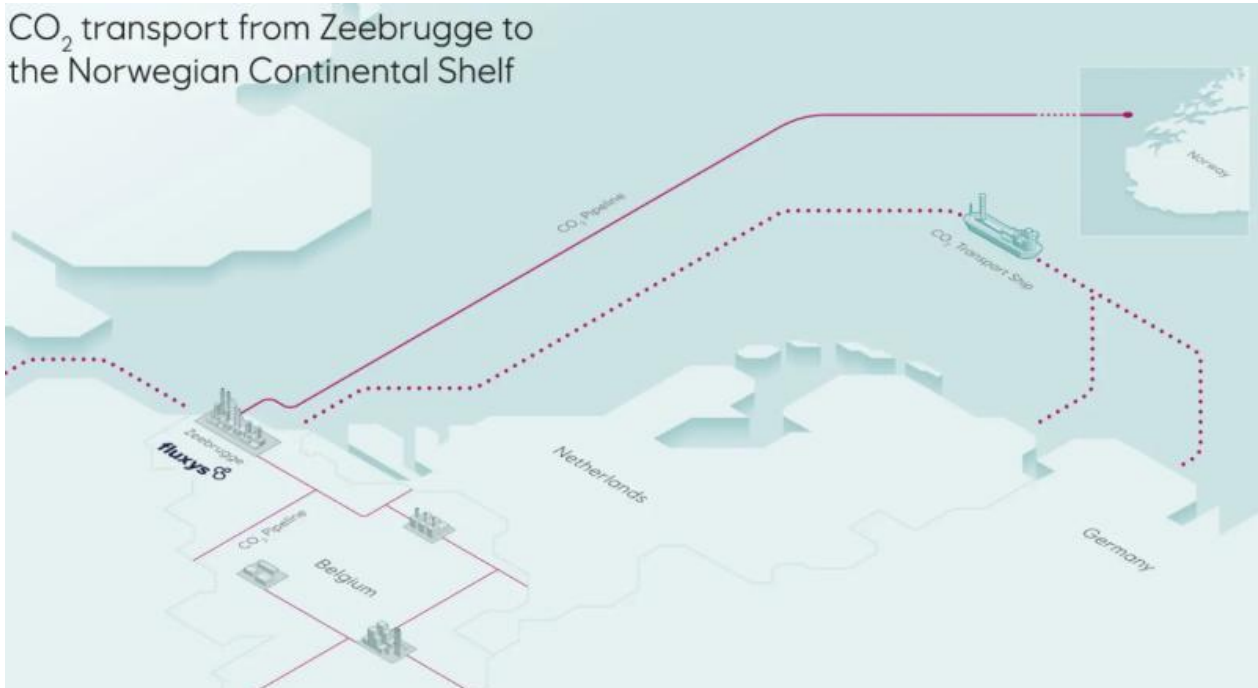
- **Land management and sustainability:** On **June 9, 2022**, [Science](#) published [Land management can contribute to net zero](#).
The publication draws a clear and firm line between the source of carbon credits issued between 2000 and 2021 (and capable of use in the voluntary carbon market), and land use: "Approximately half of call credits ... relate to land use, mostly forestry projects".
The article proposes: "three pathways to overcome shortcomings in the carbon market, improve integrity of credits, and promote long-lasting change to achieve nontrivial climate mitigation and [that] co-benefits the land [use] sector: (i) target major sources of land-based emissions by increasing activities that reduce or avoid non-**CO₂** greenhouse gases (GHG) emissions; (ii) promote the longevity of low-GHG land management by ensuring that locally relevant co-benefits accrue to local land users; and (iii) encourage region-wide [activities / initiatives] over individual project-based activities to promote systemic change, provide equitable access to benefits, enable realistic accounting, and scale opportunities for emissions reductions".
While there is nothing new in these pathways, for those working in the **AFOLU** and carbon credit sector, the article provides an excellent summary.
- **Ørsted CCS plans at Asnæs and Avedøre:** On **June 13, 2022**, [orsted.com](#) published a piece entitled [Ørsted to capture and store 400,000 tonnes of carbon in 2025](#).
Previous editions of Low Carbon Pulse have covered **Ørsted's** wood-chip-fired **Asnæs Power Station**, in Kalundborg, and the straw-fired-boiler at its **Avedøre Power Station** in Greater Copenhagen.
The piece notes that if funding support is obtained from the current tender for carbon capture and storage facilities, **CO₂** arising from each power station will be captured from each power station, and stored, with **CCS** commencing as early as 2025.
- **Neptune Energy progressing with CCS at L 10: Edition 19** of Low Carbon Pulse reported on Neptune Energy's **L 10 project**.
On **June 20, 2022**, **Neptune Energy** [announced](#) that it had signed a **cooperation agreement** with **XTO Energy** (a subsidiary of global international energy corporation, ExxonMobil), **Rosewood Exploration Ltd** (US independent owned energy company) and **EBN B.V** (Dutch oil exploration service provider).
As announced, the cooperation agreement brings together the commercial and technical capabilities to develop the **L 10 project** as a "robust carbon storage offering for industrial customers in the Dutch sector [of the North Sea]".



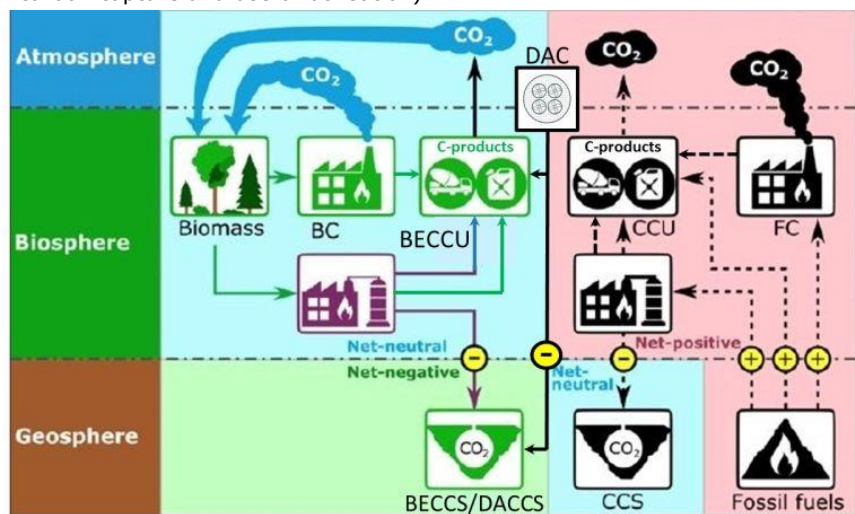
- **CNNOC CCS commissioned:** On **June 23, 2022**, [energyvoice.com](https://www.energyvoice.com) reported that the **China National Offshore Oil Corporation (CNOOC)** had commissioned the first offshore carbon capture and storage project to store **CO₂** permanently below the seabed.
- **CCS / CCUS commences in Cheshire:** On **June 24, 2022**, [theguardian.com](https://www.theguardian.com) reported that **Tata Chemicals Europe (TCE)** is to commence capturing **CO₂** from a co-generation plant (generating electrical energy and producing heat) with the **CO₂** captured (up to **40,000 metric tonnes** a year) to be used in the manufacture of products, including food, glass, and pharmaceuticals (including sodium bicarbonate and sodium carbonate salt) and washing powder. The **TCE** carbon capture facility is reported to be the first industrial-scale carbon capture facility in the UK.
- **Climeworks introduces Mammoth:** On **June 28, 2022**, **Climeworks** [announced](#) the introduction of **Mammoth** – its largest direct air capture and storage facility.
Mammoth is to be located in Iceland (as is the case with Climeworks's **Orca** – see **Editions 25, 26** and **27**). As announced, **Mammoth** will be developed over 18 to 24 months, and will have the capacity to direct capture and storage **36,000 metric tonnes of CO₂** a year.
- **CNOOC combines with ExxonMobil and Shell:** On **June 28, 2022**, it was reported widely that **CNOOC**, **ExxonMobil** and **Shell** are to develop jointly a CCS project in **Guangdong Province**, the **PRC**.
Shell [announced](#) that it had signed a memorandum of understanding with **CNOOC**, **Guangdong Provincial Development and Reform Commission** and **ExxonMobil** to explore the feasibility of developing a carbon capture and storage hub in the **Daya Bay National Economic and Technological Development Zone** in Huizhou, **Guangdong Province**, the **PRC**.
 In addition, **Shell** published [Achieving A Carbon-Neutral Energy System in China by 2060](#). The publication is divided into three sections: **Section One: Achieving a Net-Zero CO₂ Energy System by 2060**; **Section Two: China's Energy System in 2060**; and **Section Three: Making Progress Towards Carbon Neutrality**.
 Among other things, **Section One** covers **Removal of Carbon Emissions**, including the scaling-up of CCUS. In this context the publication outlines the role of industrial clusters and ports in scaling-up CCUS. While all parts of the publication are excellent, this part of the publication is particularly helpful, providing the facts and stats to support the basis for the development of CCUS capacity in the **PRC**.
By way of background: Around **45%** of **CO₂** emissions from the power and heavy industrial sectors in the **PRC** are within **50 kms** of potential **carbon storage structures**, and **65%** within **100 kms**.
 In this context, industrial clusters provide the opportunity to achieve economies of scale in **CO₂** capture, intermediate storage, transportation and storage permanently.
 Ports provide an early opportunity for CCUS development because of they are often proximate to potential off-shore storage sites. The prime example is the ports of **Guangzhou Province**.
 In addition to CCUS, the bioenergy and negative emissions are considered in detail in the Shell publication. The publication is excellent and well-worth a read.
- **Equinor and Fluxys progressing to CCS in North Sea:** On **June 29, 2022**, it was reported widely that **Equinor** and **Fluxys** are to work together to provide **CCS solutions** for the North-West European market.
 As reported, **Equinor** will develop and operate a **1,000 km trunkline** to transport **CO₂** into storage on the Norwegian continental shelf, and **Fluxys** will develop and operate the **on-shore transportation infrastructure**, together with an **off-shore trunkline**.

The following diagram provides an overview of the project.

CO₂ transport from Zeebrugge to the Norwegian Continental Shelf



- **DAC technologies assessed:** On **June 29, 2022**, NREL made a news release [Scientists Look to the Sky in Effort To Mitigate Carbon Problem](#). The news release from NREL is well-worth a read, providing a high-level assessment of **solvent-based** and **sorbent-based** DAC technologies.
- **Definition and diagram:** Mr Reinier Grimbergen has produced the following diagram explaining **CCS** (carbon capture and storage), **CCU** (carbon capture and use or utilization), **BECCS** (bioenergy carbon capture and storage), **BECCUS** (bioenergy carbon capture and use or utilization), **DACCS** (direct air carbon capture and storage), and **DACCUS** (direct air carbon capture and use or utilisation).



- **CCS / CCUS Databases:** Previous editions of Low Carbon Pulse have included databases, which are included here for reference.
 - US **DOE** National Renewable Energy Laboratory (**NREL**) [Carbon Capture and Storage Database](#), which includes information on active, proposed and discontinued CCS projects around the world.
 - US **DOE** [Carbon Storage Atlas](#).
 - [Atlas of Carbon and Hydrogen Hubs from the Great Plains Institute](#)
 - **CO2 Value** launched a [New CCU Project Database](#), provides reference for CCS / CCUS projects across Europe.
 - The **Clean Air Task Force** [Carbon Management Tracker](#), maps Middle East and North Africa CCS / CCUS.

Carbon Credits and Hydrogen Markets and Trading:

This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the creation of carbon credits, the role of carbon credits, and the trading of them. Also this section covers the development of hydrogen markets and trading (bilateral and likely wholesale).

Given the length of this **Edition 41** of Low Carbon Pulse, this **Edition 41** does not include any news items on carbon credits and hydrogen markets and trading.

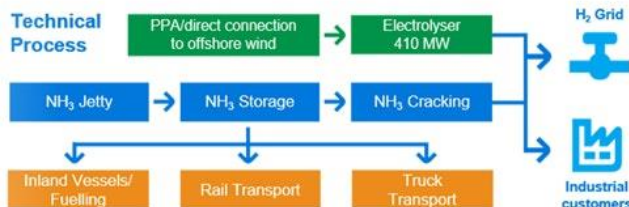
E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the development of production capacity to derive and to produce **E-fuels** (energy carriers derived or produced using renewable energy) and **Future Fuels** (energy carriers derived and produced that are characterised as clean carbon or low carbon fuels). **E-fuels** include Green Hydrogen and Green Ammonia, and **Future Fuels** include Blue Hydrogen and Blue Ammonia.

- **Plug Power plugs Port of Antwerp-Bruges concession:** On **June 13, 2022**, [plugpower.com](https://www.plugpower.com) released a piece on the execution by **Plug Power** and the **Port of Antwerp-Bruges** of a **30 year concession agreement** to develop and to deploy a **100 MW Green Hydrogen production** facility, using Plug Power PEM electrolyzers, to produce up to **35 metric tonnes** daily, and up to **12,500 metric tonnes** annually, of Green Hydrogen. The **Green Hydrogen production** facility is to be located in the **NextGen District** of the Port, with first production expected in late 2024.
- **Wilhelmshaven Hub:**
 - **TES impresses:** On **June 12, 2022**, it was reported widely that **Tree Energy Solutions (TES)**, developing the hydrogen and LNG facilities at Wilhelmshaven, Germany, had received a positive reaction to its **open-season** in respect of capacity to receive and re-gasify LNG at its **TES-Wilhelmshaven project**, with 25 expressions of interest received.
 - On **April 25, 2022**, **TES** announced that it was running an **open-season** process to fast-track the import of **LNG** to its **TES-Wilhelmshaven project**. It is understood that under the first phase of **open-season** process non-binding expressions of interest are sought. The second phase will involve binding commitments, with the third phase involving conclusion of the binding commitments (see **Edition 39** of Low Carbon Pulse).
 - By way of reminder:**
 - **Edition 40** of Low Carbon Pulse reported under (**TES-Wilhelmshaven project continues to accelerate**) that the: "**TES-Wilhelmshaven project** was given priority project status by the German Federal Government. The priority project status was conferred by the Acceleration Law (reported in **Edition 39** of Low Carbon Pulse)".
 - **Edition 39** of Low Carbon Pulse (under **TES Fast-tracks**) reported that **TES** (a green hydrogen corporation, reported on in **Editions 36** of Low Carbon Pulse) was reported to be "fast-tracking" the development of a **green hydrogen hub** at **Wilhelmshaven** in Northern Germany (the **TES-Wilhelmshaven project**).
"Clean hydrogen will be used as a bridging fuel in the early years. By 2030, there will likely be a 50:50 split between clean and green hydrogen. In the initial phase, 25 [TWh a year] of green methane, from which more than half a million [metric tonnes] of [clean] hydrogen can be produced, will be imported into Wilhelmshaven. That will increase to 250 TWh [a year] and more than 5 million metric tonnes of hydrogen in a final stage. The green hydrogen will be produced using exclusively renewable sources, mainly solar in several cased wind or hydroelectricity [or both]."
 - **Edition 37** of Low Carbon Pulse included a map-graphic outlining the plans of **TES** in visual form, for ease of reference a [link](#) to the map-graphic is included. As will be apparent from the map-graphic, clean hydrogen will be sourced from the Middle East, **CO₂** will be captured and shipped to the Middle East, the **CO₂** will be combined with hydrogen to produce green methane, which is then liquified, with the green **LNG** shipped to Germany. As reported, the **TES-Wilhelmshaven project**, on full development, will comprise **six berths**, and **eight** on-site **storage tanks**, with combined storage capacity of **1,600,000 m³**.
- **Uniper Green Wilhelmshaven unleashed:** On **June 28, 2022**, **Uniper** announced that its Germany Hydrogen Hub project had been listed in the Ten-Year Network Development for 2022 published by the European Network of Transmission System Operators for Gas. For more detail on the Green Wilhelmshaven project click on [the link](#).

Key Facts

- Construction of a scalable H₂-Import terminal for import of green ammonia, potential for liquid hydrogen.
- H₂-recovery from Ammonia-Cracking, feed in H₂-grid and ammonia direct distribution.
- Construction of a 410 MW electrolyser on an industrial scale for supply of local industry and feed in H₂ grid.
- Total supply of around 295,000 tons of H₂ (10% of expected demand in Germany in 2030).



- **Neste and VTT to build power-to-liquids production facility:** On **June 14, 2022**, **VTT** announced that it and **Neste**, had agreed to develop a **Power-to-X- to-liquids** production facility, an **E-Fuel pilot project**. As announced, the **pilot project** will capture **CO₂**, produce **Green Hydrogen** (using high-temperature electrolysis) and **E-Fuels**. The **E-Fuels** produced will be used to power and to propel aircraft and ships, and heavy and light road vehicles.

- **To Japan:** On **June 15, 2022**, **TotalEnergies**, **Toho Gas** and **Toyota Tshusho Corporation**, together, launched a feasibility study in respect of the establishment of a supply / value chain for the supply of low carbon and renewable fuels, including hydrogen and synthetic methane.
- **AGL leading two feasibility studies on BESS:** On **June 17, 2022**, it was reported widely that **AGL Energy Limited** (one the Big Three integrated energy corporations in Australia) is undertaking feasibility studies in respect of two sites, one at its **Liddell** site, in the Hunter Valley, New South Wales, and the other at **Torrens Island**, its site in South Australia.
In respect of the **Liddell** site, **AGL Energy** is working with **Fortescue Future Industries** (see **Edition 32** of Low Carbon Pulse) and **Osaka Gas Australia**.
In respect of the **Torrens Island** study, **AGL Energy** is working with (in alphabetical order), **Adbri** (leading cement manufacturer), **Brickworks** (leading building products manufacturer), **Flinders Ports** (the leading port operator in South Australia), **Inpex** (leading international energy corporation), **Osaka Gas Australia** (leading international gas and power corporation), **SK ecoplant** (a wholly-owned subsidiary of SK Group), and **Spark Renewables** (leading renewable energy development corporation)
- **Tierra del Fuego wants to produce Green Hydrogen:** On **June 16, 2022**, **Bloomberg** reported that **Tierra del Fuego** wants to develop **USD 6 billion** Green Hydrogen and Green Ammonia production facilities powered by renewable energy produced from its world class wind resources. As reported, **TotalEnergies** and **MMEX** have shown interest.
- **CVX to invest USD 2.5 billion and Blue and Green Hydrogen:** On **June 17, 2022**, [rechargenews.com](https://www.rechargenews.com) reported that at **The Financial Times Hydrogen Summit**, **Mr Austin Knight** (vice-president of hydrogen and Chevron New Energies) had indicated that CVX intends to invest **USD 2 billion** in "broader energy solutions with hydrogen and moving into clean hydrogen".
- **Southland Hydrogen – final partner selection:** On **June 20, 2022**, it was reported widely that **Contact** and **Meridian Energy** had selected **Fortescue Future Industries** or **FFI** (subsidiary of Fortescue Metals Group) and **Woodside Energy Limited (WEL)** for the purposes of the choice of partner to develop the largest Green Hydrogen production facility in **Southland, New Zealand**. As reported, each of **FFI** and **WEL** is to provide a more detailed proposal to **Contact** and **Meridian Energy** by the end of August 2022, with a decision expected as to the selected partner soon after.
- **OCI NV Project recast:** On **June 15, 2022**, it was reported widely that **OCI NV** (producer and distributor of natural gas-based fertilizers and industrial chemicals based in the Netherlands) had made a final investment decision to develop its ammonia receiving terminal in the precincts of the **Port of Rotterdam** (see **Editions 29** and **39** of Low Carbon Pulse for previous reporting on the terminal, and **Editions 33** and **37** for previous reports on OCI).
Previous reports had indicated that the ammonia receiving terminal would have capacity of **400,000 metric tonnes** a year. The final investment decision taken (in respect of phase 1) contemplates the development and deployment of more than **1.2 million metric tonnes** a year. The reported thinking is to provide for scaling-up of production to allow production capacity to be increased to **3 million metric tonnes** a year.
By way of reminder about OCI and Port of Rotterdam:
- **Edition 40** of Low Carbon Pulse (under **HyNetherlands Project recast**) reported that: "On **May 10, 2022**, **Engie** (global French energy company) intended to recast its **HyNetherlands Project** to produce **Green Methanol**, using **Green Hydrogen** (produced from **Engie's** planned **100 MW** electrolyser, using renewable electrical energy sourced from 200 MW of off-shore wind field capacity) as a feedstock to be synthesised with **CO₂** to produce low-carbon methanol in Eemshaven, the Netherlands.
The **Green Hydrogen** produced by **Engie's HyNetherlands Project** will be synthesised with **biogenic CO₂** captured from the **EEW Energy** waste-to-energy facility located at **Farmsum**, at the **OCI Delfzijl Chemical Park**. The **HyNetherlands Project** will be connected with the **OCI Delfzijl Chemical Park** via the hydrogen network developed by **Gasunie**.
As reported, **Engie** intends to develop its **HyNetherlands Project** from **100 MW** of electrolyser capacity to **1.85 GW** of electrolyser capacity by 2030, with the Green Hydrogen produced capable of used both as a **Future Fuel** itself and as a feedstock for the production of other **Future Fuels**.
The recast **HyNetherlands Project** is a great example of the role of Green Hydrogen in **Future Fuels** (see sibling publication, [Future Fuels](#) for background) and of how hydrogen hubs and carbon clusters work.
- **Edition 40** of Low Carbon Pulse (under **Port of Rotterdam Authority (PORA) continues to lead the way**) reported that: "The **PORA** and 70 corporations will be able to achieve, represented most consistently by a representation of a hydrogen molecule marked with "**4.6 mega tonnes hydrogen in 2030**" and "**Rotterdam Europe's Hydrogen Hub**". The news items and the photo-opportunities arose ahead of the presentation of **REPowerEU** on **May 18, 2022**. While the news items and the photo-opportunities were jolly, the underlying message is clear – for the **EU** to achieve the objectives of **REPowerEU** production and import capacity has to be increased at ports (has hydrogen hubs), across Europe".
- **Linde, STT and YTL land in Singapore:** On **June 22, 2022**, [datacenterdynamics.com](https://www.datacenterdynamics.com) reported that **Linde** and **STT GDC** (short for **ST Telemedia Global Data Centers**) and **YTL Corporation** are working together to assess the use of hydrogen in Singapore. For these purposes, the three leading corporations are working "on a hydrogen energy proof of concept to boost Singapore's sustainability" initiatives.
- **EnBW and RWE JV:** On **June 24, 2022**, it was reported widely that German Giants, **RWE** and **EnBW**, intend to develop a **100 MW Green Hydrogen production facility** at the port of **Rostock, Germany**. The Green Hydrogen production facility is part of the **Hy Tech Hafen Rostock Project** (which has applied for Important Project of Common European Interest (**IPCEI**) status, and the attendant funding support that comes with it).
As reported, it is understood that a final investment decision (**FID**) is dependent on funding support under the **IPCEI** program, but on **FID** it is understood that the capacity of the **Green Hydrogen production facility** may be scaled up over time to **1 GW**.

- **Neste builds out at the Port of Rotterdam:** On **June 28, 2022**, it was reported widely that **Neste Corporation** had taken a final investment decision to expand its Future Fuels production capacity at the **Port of Rotterdam** by **1.3 million metric tonnes** a year, nearly doubling its Future Fuels production capacity to **2.7 million metric tonnes** a year.

As reported in previous editions of Low Carbon Pulse, **Neste** had been considering the expansion of its production capacity for a while, responding to increased demand for Future Fuels (including **SAF**), and is expanding its production capacity in Singapore (see **Edition 35** of Low Carbon Pulse). As the announced expansions progress, **by the end of 2026 Neste** will have close to **7 million metric tonnes of Future Fuels production capacity**.

- **Equinor and SSE Thermal acquire Saltend Power Station:** On **June 28, 2022**, **Equinor** announced that it and **SSE Thermal** had acquired **Triton Power** (owner of the Saltend Power Station) from owners Energy Capital Partners. This is consistent with the plans to develop **Saltend Power Station** (a 1.2 GW gas-fired power station) to blend blue hydrogen with natural gas, displacing 30% of the natural gas use with blue hydrogen by 2027. The blue hydrogen will be supplied from **Equinor's Saltend Hydrogen** project, which is to reform natural gas, capturing the **CO₂**, to produce blue hydrogen.

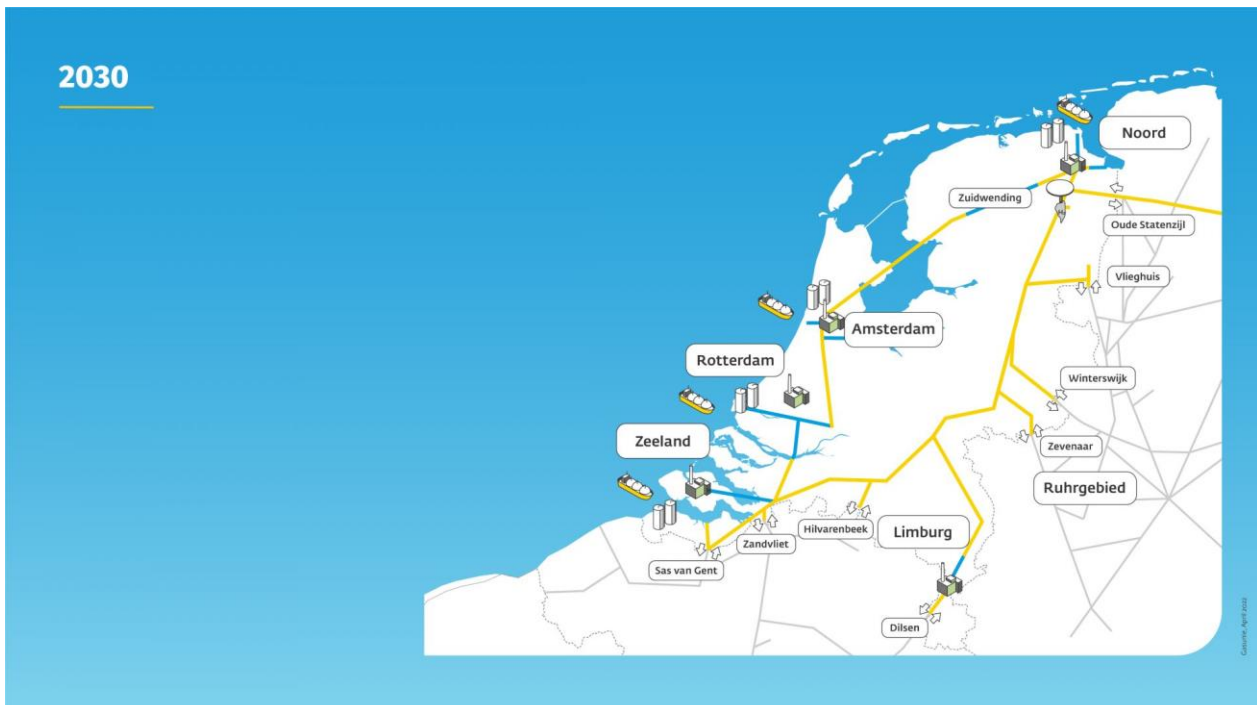
By way of reminder: Edition 22 of Low Carbon Pulse (under **Hydrogen Storage**) reported that:

"One of the key requirements for industrial users of hydrogen is the real time availability of hydrogen. For these purposes, hydrogen storage is key.

On **July 15, 2021**, it was announced that **Equinor** (global international energy company) and **SSE** (Scottish energy giant) were working together to develop hydrogen storage capacity close to a cluster of industrial users. The focus of the initial work is the use of the existing Aldborough natural gas storage capacity (**Aldborough Gas Storage Facility** or **AGSF**) on the east coast of England, with the focus contemplating use for the storage of low carbon hydrogen by 2028 (**H2S Capacity**). (**Equinor** and **SSE** own jointly the **AGSF**, comprising non sub-surface salt caverns, each large enough to house St Paul's Cathedral.) It is estimated that the storage capacity would equate to **320 GWh**, converting salt caverns within the existing **AGSF** or creating new caverns.

The development of the **H2S Capacity** would be part of an integrated hydrogen production, storage, transportation and supply chain: **Equinor** has proposed the development of **1.8 GW** low carbon hydrogen (in the form of Blue Hydrogen) production capacity, comprising the **600 MW H2H Saltend Project** and **1.2 GW** of production capacity to supply low carbon hydrogen to the Keadby power station (see **Edition 21** of Low Carbon Pulse)".

- On **June 28, 2022**, **Air Products** (one of the Big Three industrial global gas producers, the other two being Air Liquide and Linde) **announced** that it and **Gunvor Petroleum Rotterdam** (a member of the **Gunvor Group**) are planning to develop a hydrogen receiving terminal in the precincts of the **Port of Rotterdam**, and for these purposes have signed a joint development agreement.
- **Gasunie starts construction of national hydrogen network:** On **June 29, 2022**, **Gasunie** announced that it had commenced construction of the national hydrogen network for the Netherlands, and, having constructed the network, that it will operate the network at the **Transmission System Operator** or **TSO**. As stated, around 85% of the national hydrogen network will be constructed using recycled / repurposed natural gas pipelines.



Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories and HVDC:

This section considers news items that have arisen within the news cycle of this **Edition 41** of *Low Carbon Pulse* relating to the development of:

- areas in which: **1.** infrastructure will be developed and deployed to support the development and deployment of hydrogen production capacity and use (**Hydrogen Hubs**), the capture of carbon dioxide, and the consolidation of captured carbon dioxide for storage or use or both (**Carbon Clusters**); and **2.** technologies facilitating energy transition will be concentrated and supported (**Hydrogen Corridors and Valleys**); and
- giga-factories that fabricate and manufacture photovoltaic solar panels (and associated equipment), wind-turbine blades and towers (and associated equipment), electrolysers (and associated equipment), electric batteries and hydrogen fuel cells, and transmission cabling (including HVDC transmission cabling).

Also the section considers developments in cities to decarbonise (including using waste heat), and to cool, cities. The development of infrastructure at ports and installation and support vessels for off-shore wind developments are considered in the **Ports Progress and Shipping Forecast** section of each edition.

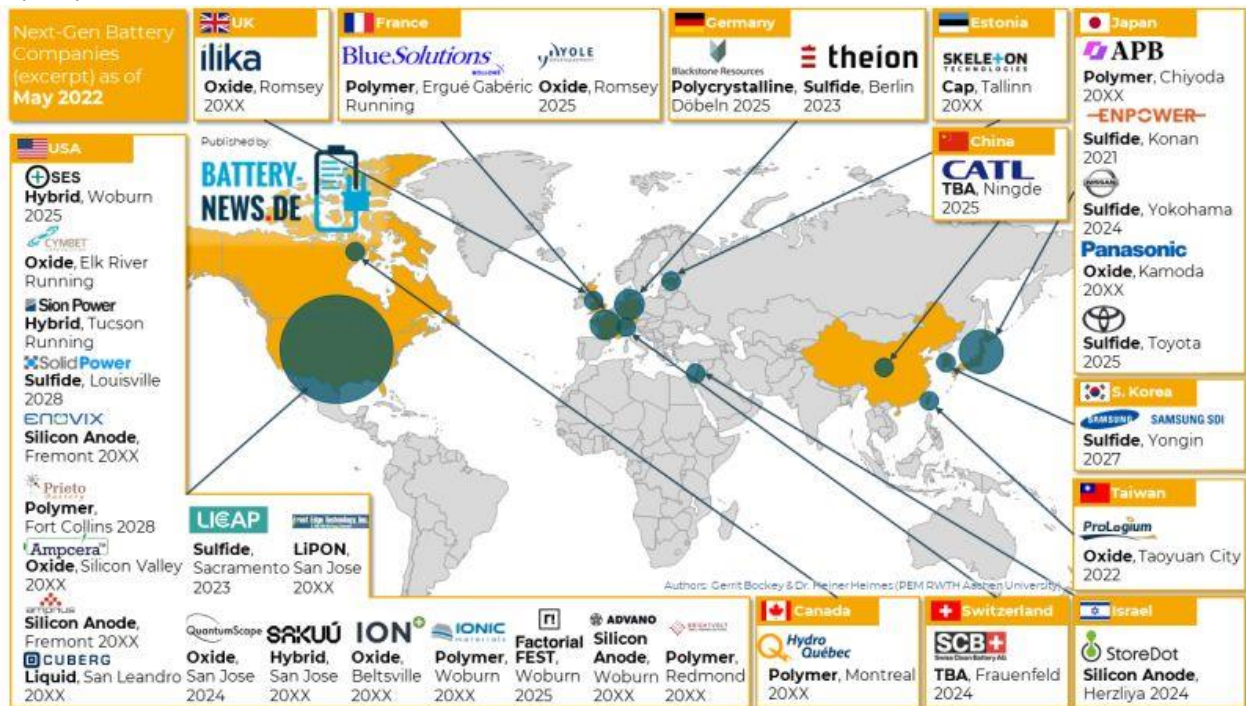
- **BASQUEVOLT energised:** On **June 10, 2022**, batteriesnews.com reported that **BASQUEVOLT** had been launched. **BASQUEVOLT** is a **€700 million** initiative to manufacture **solid-state** batteries, with the intention to manufacture batteries with combined capacity of **10 GWh** by **2027**.

BASQUEVOLT is supported by the **Basque Government**, investors in it include **CIE Automotive**, **EIT InnoEnergy**, **Enagás**, and **Iberdrola**, each of which is a founding shareholder, together with **CIC energigUNE** which is reported to have undertaken research, and to have reported on, **BASQUEVOLT**.

As reported, **BASQUEVOLT** "will make the Basque Country a European benchmark in the development of solid-state batteries".

By way of background: At the moment, it is estimated that globally there is around **2 GWh** of solid-state battery (**SSB**) production capacity, which prospectively may develop to between **15 to 40 GWh** by 2030. This contrasts with lithium-ion battery (**LiB**) production capacity, which prospectively may develop to between **3 to 6 TW** by 2030. For further information, please read the [Fraunhofer Institute for Systems and Innovation Research ISI](#) paper.

The following map from **Battery-News.de** provides a sense of the location and size by location of **SSB** production capacity.



Source: battery-news.de

- **Greece-Italy interconnector to be expand capacity:** On **July 14, 2022**, renewablesnow.com reported that **Terna SpA** (the Italian grid operator) is to invest **€750 million (USD 783 million)** to double the exchange capacity through the Greece-Italy interconnector.

The doubling of exchange capacity will give the interconnector **1 GW** of exchange capacity, thereby facilitating the integration of more renewable electrical energy sources across Greece and Italy.

The increase in exchange capacity is part of the planned national electricity grid development program of Italy, which contemplates investment of up to **€18.1 billion** over the next decade.

- **CIC energigUNE giga-factory map:** On **June 21, 2022**, the ever-ready and good folk at **CIC energigUNE** published an updated version of their **giga-factory map**.

EUROPEAN GIGAFACTORIES

Analysis by CIC energiGUNE
Version 10. Last update: 08/2022



Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the extraction of metals and minerals necessary for the decarbonisation of activities to progress towards achievement of **NZE**, the use of **E-fuels** and **Future Fuels** to power and to propel vehicles used to extract and to transport metals and minerals, and the use of E-fuels and Future Fuels to process and to treat those metals and minerals. Also this section considers the Difficult to Decarbonise industries, including the iron and steel sector.

- **Green Steel – a deeper dive:** On **June 15, 2022**, the good folk at rechargenews.com (under [Green steel moves a step closer to commercialisation with "first of its kind" hydrogen cavern storage](#)) provided an excellent overview of **Hydrogen Breakthrough Ironmaking Technology**, or **Hybrit**, consortium (comprising **LKAB** (iron ore mining corporation), **SSAB** (iron and steel maker), and **Vattenfall** (utility corporation providing renewable electrical energy)). While Low Carbon Pulse has covered **Hybrit** more often than any other initiative or project, the article in rechargenews.com is well-worth a read because it covers **Hybrit** in detail, including the recent progress in respect of the **HESS** using caverns proximate the location of the fossil free iron and steel mill.
- **Two global leaders connect:** On **June 15, 2022**, **Fortescue Metals Group Ltd (FMG)** announced that it is to work with **Liebherr** (global leading manufacturer of construction and mining equipment) to develop green mining haul trucks, using zero-emission power system technology being development by **Fortescue Future Industries (FFI)** and **Williams Advanced Engineering** (see **Edition 36** of Low Carbon Pulse). As reported, **FMG** will purchase up to **120** haul trucks from **Liebherr**.
- **Mineral Security Partnership:** On **June 14, 2022**, the US and key partner countries [announced](#) the establishment of the **Mineral Security Partnership (MSP)**. The purpose of the **MSP** is to ensure that critical minerals are mined and otherwise sourced, processed and recycled in a manner that supports the ability of countries to realise the economic benefit of their geological resources. As announced, **MSP** partner countries include Australia, Canada, Finland, France, Germany, Japan, the ROK, Sweden, the UK and the US, and the European Commission.

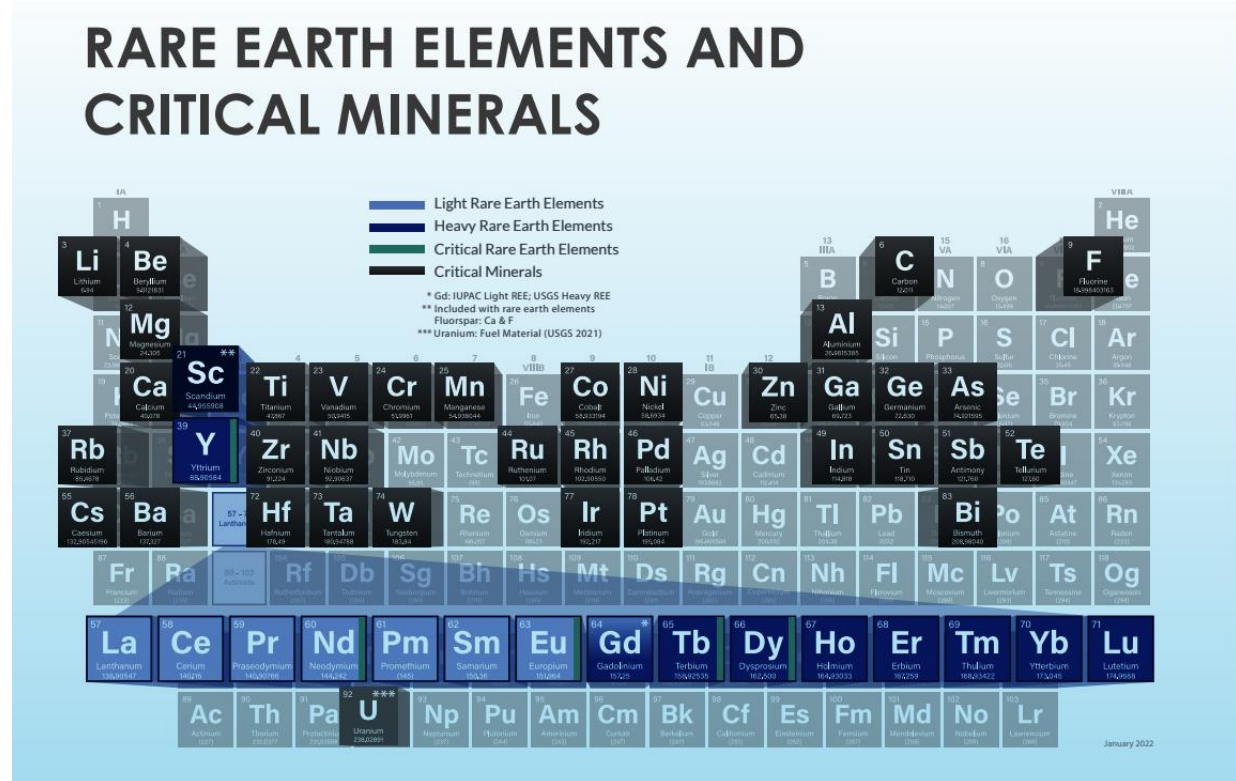
Consistent with the theme of the **MSP**, the US Bipartisan Infrastructure Law provides **USD 127 million** for the purposes of the development and deployment of **Rare Earth Security Activities**. The **International Energy Agency (IEA)** has been highlighting the need for sufficient supply of metals and minerals necessary for progress towards to **NZE (critical minerals)** in the lingua franca of the **IEA**.

By way of reminder: **Edition 40** (and earlier editions) of Low Carbon Pulse recounted that aluminium, cobalt, copper and gold, lithium, manganese, and nickel, are key to the energy transition, and that the price of each commodity had reached record levels in recent times.

In addition, **rare earth elements (REE)**, sometimes referred to a **rare earth metals** or **rare earth oxides** are key. There are **17 rare earth elements**, including the following **REE** which are key for the purposes of energy transition: cerium, dysprosium, europium, gadolinium, lanthanum, neodymium, praseodymium, samarium, scandium, terbium, and yttrium.

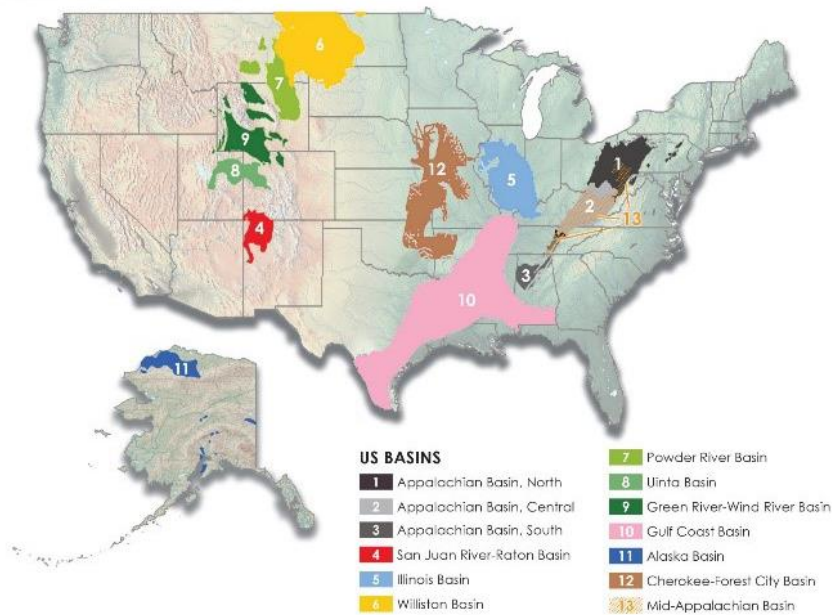
LANTHANIDE REES								
Light REE	Cerium	Europium	gadolinium	Lanthanum	neodymium	Praseodymium	promethium	samarium
Heavy REE	dysprosium	Erbium	Holmium	Lutetium	Terbium	Thulium	Ytterbium	
NON – LANTHANIDE REES								
Scandium				Yttrium				

As part of the ever-increasing body of publications, the US **National Energy Technology Laboratory (NETL)** has published [Rare Earth Elements and Critical Minerals](#). The NETL provides a helpful representation of the periodic table.



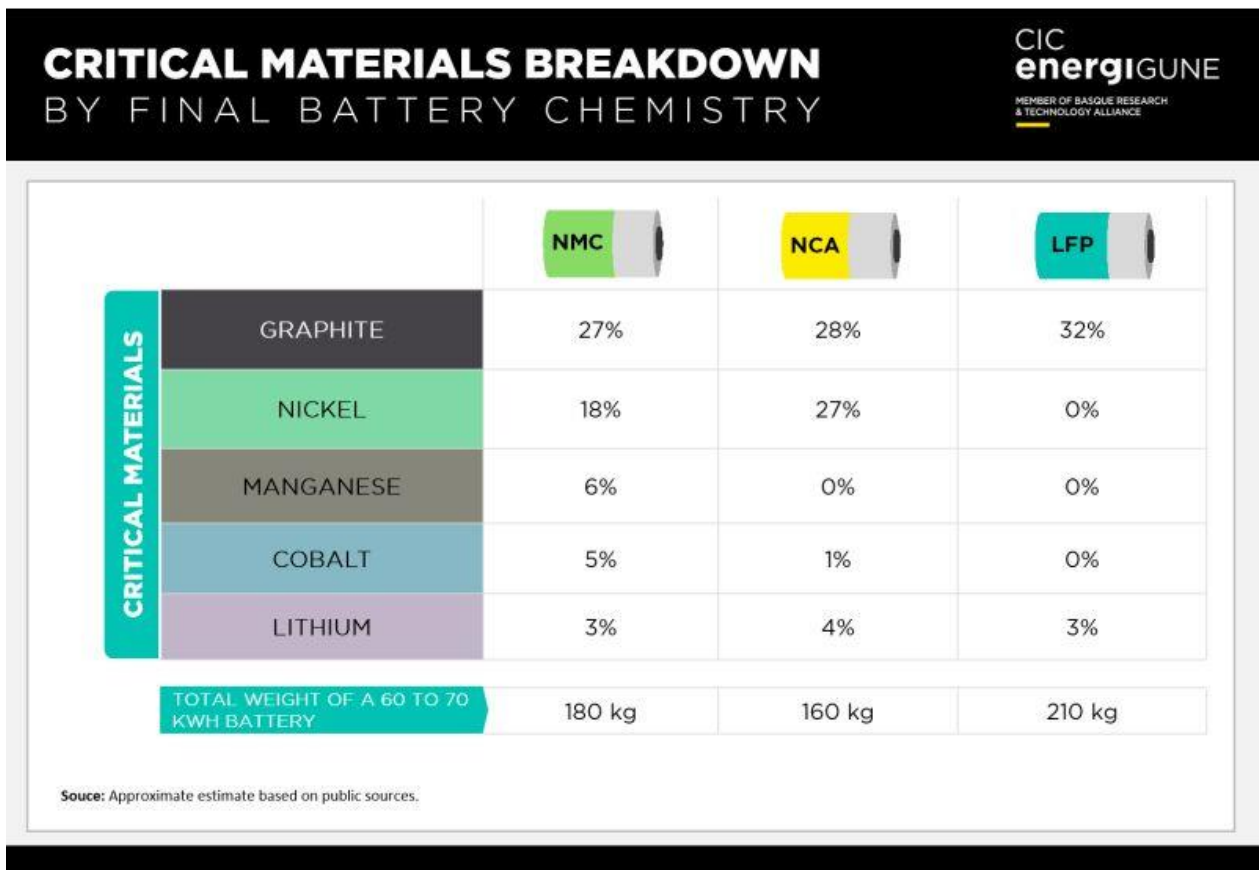
This puts the author of Low Carbon Pulse in mind of the following map-graphic taken from an NETL report.

CORE-CM INITIATIVE



Source: NETL

- **WA publishes Battery and Critical Minerals Prospectus:** On **June 21, 2022**, the Government of Western Australia (Australia's largest state by area), published the [Battery and Critical Minerals Prospectus](#), outlining the investment opportunities in Western Australia given "Western Australia's status as a leading global supplier of battery and critical metals and minerals.
- **ArcelorMittal and RWE – off-shore to on-shore:** On **June 22, 2022**, **RWE** announced that it and **ArcelorMittal** had signed a memorandum of understanding (**MOU**) to work together to develop and to deploy **off-shore wind fields** and **hydrogen facilities** to produce hydrogen for use by **ArcelorMittal** at its iron and steel mills in Germany.
- **Another day, another great summary from CiC energigUNE:** On **June 30, 2022**, the good folk at **CiC energigUNE** explained the use of critical minerals (or, as they have it, critical materials) in the three major existing chemistries that may be present in the average battery, and how they affect the final mass of the battery:



Wind round-up, on-shore and off-shore:

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the development of wind power generation capacity, on-shore and off-shore (fixed bottom and floating).*

- **Ocean Winds seeks approval for 1.6 GW OWF project:** On **June 3, 2022** it was reported widely that **Ocean Winds** (50:50 joint venture between **EDP** and **Engie**) is progressing with the first phase of the consultation process as part of the approval process for its proposed **Réalt na Mara** off-shore wind field project, off the coast of the **Republic of Ireland**. The second phase of the consultation process is expected in Q4 of 2022.
- **Ørsted Changhua County off-shore wind field projects progress:** On **June 8, 2022**, it was reported widely that the **two 750 MW** off-shore wind field projects (**Xufeng-2** and **Xufeng-3**), off **Changhua County, Taiwan**, were progressing as a result of the recommendation for approval of each Environmental Impact Statement (**EIA**) for each project.

Progression in this context means that following approval of the **EIAs** by the **Environmental Protection Agency**, the two projects will be able to participate in the Round 3 of off-shore wind auction that is scheduled to open during August 2022, with the expectation that the results of Round 3 will be announced towards the end of 2022, likely during December 2022.

Previous editions of Low Carbon Pulse have reported that the off-shore wind fields successful in the Round 3 auction process will develop their off-shore wind fields to come on-line between 2026 and 2035, with 15 GW of off-shore wind capacity to come on-line within this period.

By way of reminder:

- **Edition 12** of Low Carbon Pulse reported that:

On **March 18, 2021**, it was reported that **Ørsted** has commenced construction works at the **900 MW Greater Changhua 1 and 2a** off-shore wind fields, with installation works likely within 2021. The off-shore wind fields are located **35 to 60 kilometres** from the coast line of **Changhua County** on Taiwan's west coast. This is the first of Taiwan's off-shore wind field developments, with completion planned for 2022;

- **Edition 17** of Low Carbon Pulse reported that:

On **May 5, 2021**, it was announced that the commencement of the installation of jacket foundations had started on **Ørsted's Greater Changhua** off-shore wind field project, off Taiwan: the project comprises two fields, **Changhua 1 and 2a**, with the fields developed as one project.

- **BP and Equinor combine for hub:** On **June 10, 2022**, it was reported widely that **BP** and **Equinor** are to develop an **Off-shore Wind Innovation Hub** in New York. As reported, the decision to develop the **Innovation Hub** has resulted from a three year partnership between Equinor and the Urban Future Lab, backed by the New York City Economic Development Corporation.

The **Innovation Hub** will provide facilities to allow the development of technologies, and will be located in the vicinity of Sunset Park office of BP and Equinor established for the purposes of the development of their off-shore wind field developments (including **Empire Wind 1 (816 MW)** and **Empire Wind 2 (2 GW)**, and **Beacon Wind 1 (1.2 GW)**).

- **Cirio offshore:**

- **Australia: 2.5 GW off-shore wind field project down-under:** On **June 10, 2022**, it was reported widely that **Corio Generation** (a corporation within the portfolio of the **Green Investment Group (GIG)**) plans to develop a **2.5 GW** off-shore wind field project **22 km** off **Wellington Shire, Gippsland**, in the state of **Victoria**, Australia (**Great Eastern Offshore Wind** project). The development of the **Great Eastern Offshore Wind** project, together with the previously announced **1.5 GW Great Southern Offshore Wind** project, means that **Cirio** has **4 GW** of off-shore wind field capacity planned in Australian waters;

- **Brazil fixed-bottoms - 5 GW off-shore wind project off Brazil:** On **June 13, 2022**, it was reported widely that **Corio Generation** plans to develop **five fixed-bottom** off-shore wind fields off the coast of **Brazil**. The five fixed bottom off-shore wind fields are reported to be at early stage development, having made applications for investigation licences, which are with the **IBAMA** (the Institute for Environment and Natural Resources). It is understood that **Corio** will develop the off-shore wind fields working with **Servtec** (a Brazilian power generation corporation), and the areas in respect of which leases are sought will allow the development of projects having the following spreads of installed capacity: **495 MW to 1.2 GW: Cassino (1.2 GW), Costa Nordeste (1.2 GW), Guarita (1.2 GW), Rio Grande (1.17 GW) and Vitoria (495 MW)**.

- **Shell to be found in the Baltic Sea:** On **June 13, 2022**, Shell [announced](#) that **Amber Baltic Wind Ltd** (a wholly-owned subsidiary of **Shell plc**) had submitted proposals for new off-shore wind locations in the Polish sector of the Baltic Sea, as part of the Polish Government's current tender process.

The current tender process is part of the policy settings of the **Polish Government** to have **11 GW** of installed off-shore wind field capacity **by 2040**, and **28 GW by 2050**.

- **The Netherlands tethers tendering timelines:**

- **Edition 40** of Low Carbon Pulse reported as follows under (**Hollandse Kust West Site bids close**):

"As the close date for the auction approached on May 12, 2022, there was considerable coverage of the fact that the criteria for the assessment of bids for Hollandse Kust (west) VI and Hollandse Kust (west) VII were different, in particular for:

Hollandse Kust (west) VI the criteria are reported as requiring bidders to consider and to address the impact of ecosystems in the North Sea (with a reported 50% weighting in respect of these criteria); and

Hollandse Kust (west) VII the criteria are reported as requiring bidders to consider and to address the integration on the renewable electrical energy generated (and related infrastructure) into the energy system in the Netherlands (again with a reported 50% weighting in respect of these criteria).

At the risk of missing those that bid in the action process (and apologies in advance if anyone is missed), from news reports the following bidders have been reported: **BASF** and **Vattenfall** are reported to have bid jointly in respect of Hollandse Kust (west) VI, and **Vattenfall** is reported to have bid on Hollandse Kust (west) VII; **bp** is reported to have bid for both Hollandse Kust (west) VI and Hollandse Kust (west) VII; **Brookfield** and **SSE Renewables** are reported to have bid for Hollandse Kust (west) VII; **Eneco** and **Shell** are reported to have bid for both Hollandse Kust (west) VI and Hollandse Kust (west) VII; **Ocean Winds** (the **EPD Renewables** and **Engie 50:50** joint venture) is reported to have bid for Hollandse Kust (west) VI; **Ørsted** and **TotalEnergies** are reported to have bid jointly for both Hollandse Kust (west) VI and Hollandse Kust (west) VII; and **RWE** is reported to have submitted bids for both Hollandse Kust (west) VI and Hollandse Kust (west) VII.

- **Edition 40** of Low Carbon Pulse (under **North Sea Countries 65 by 2030 and 150 by 2050**) reported that: "... at the **North Sea Summit, Belgium, Denmark, Germany** and **the Netherlands**, consolidated their collective thinking around the development of off-shore wind field capacity development and Green Hydrogen production, with the **North Sea the Green Power Plant of Europe** – the thinking includes the development of **65 GW of OWF capacity by 2030** and **150 GW of OWF capacity by 2050**.

For these purposes, each of the countries signed the [Esbjerg Declaration](#) (formally, **The Declaration of Energy Ministers on The North Sea as a Green Power Plant for Europe**).

ESBJERG DECLARATION - NORTH SEA OWF TARGETS

Belgium: 8 GW by 2040	Denmark: 35 GW by 2050	Germany: 70 by 2050	The Netherlands: 21 GW by 2030
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- On **June 13, 2022**, [offshorewind.biz](#) reported that the Government of the Netherlands had announced the tendering timelines for **nine off-shore wind field projects** ranging in installed capacity from **700 MW to 2 GW**. The tendering timelines provide for the **nine OWF projects** to come to market "between the second quarter of 2025 and the end of 2027".

Of the **nine areas** identified, **eight** are **within** the **Doordewind, Hollandse Kust (west)** and **Ijmuiden Ver** zones, and one is within the **Ten noorden van de Waddeneilanden** zone.

Aanvullende routekaart windenergie op zee

om te komen tot circa 21 GW rond 2030



Source: Ministry of Economic Affairs and Climate Policy

• **Denmark not tethered by previous targets:**

- On **June 13, 2022**, it was reported widely that the **Danish Government** had announced plans to increase the off-shore wind field capacity of Denmark by 2030: the plan is to increase the capacity by a further **4 GW by 2030**, from **8.8 GW to 12.9 GW**.
- On **June 23, 2022**, [4coffshore.com](https://www.coffshore.com) reported that in response to the scale of commitments to develop up to **65 GW** of off-shore wind field capacity by 2030 under the **Esbjerg Declaration** (see under **By way of reminder**) transmission system operator or TSO, **TenneT** (leading European electricity TSO) intends to develop and to implement a new form of procurement to ensure that the supply chain is able to plan for the scale of the supply task.

For these purposes, **TenneT** intends to contract with key market participants for a period of eight years, providing visibility on the procurement packages and timing that they will come to market.

- **RWE and SGN look to water and wind:** On **June 14, 2022**, renews.biz reported that **RWE** (renewables electrical energy giant) and **SGN** (gas distribution company) signed a memorandum of understanding (**MoU**) under which they will work together to investigate the production of Green Hydrogen for use to satisfy heating demand in businesses and homes in the towns of Campbeltown, Oban, Stornoway, Thurso and Wick in Scotland. The **MoU** contemplates the use of renewable electrical energy generated by the on-shore wind farm capacity of **RWE** to power electrolyzers to produce the Green Hydrogen, the Green Hydrogen produced to be hauled across the gas network of **SGN**.



Source: RWE

- **NZ Super Fund and CIP project NZ wind:** On **June 14, 2022**, 4coffshore.com reported that **NZ Super Fund** and **Copenhagen Infrastructure Partners** or **CIP** are exploring the potential for the development of off-shore wind capacity off Aotearoa, New Zealand, off the South Taranaki coast, to support **1 GW** of off-shore wind field capacity.
- **Ocean Winds fixed on Brazil:** On **June 15, 2022**, it was reported widely that **Ocean Winds** (a 50:50 joint venture of **Engie** and **EDP Renewables**) plans to develop **15 GW.2** of off-shore wind field capacity off Brazil, and that for these purposes it had applied to **IBAMA** for approval to investigate five off-shore wind field areas. As reported, the five areas have potential for **15.2 GW** of installed capacity: **Maral, 2 GW, Tramandaí, 700 MW, Ventos do Atlântico, 5 GW, Ventos do Sul, 6.5 GW, and Vento Tupi, 1 GW.**
- **Eye-catching Wind Catcher:** On **June 15, 2022**, **Wind Catching Systems AS (WCS)** announced that it had raised up to **USD 10 million** to help fund the development of its **Wind Catching System**. **WCS** announced that that the "investment round" of up to **USD 10 million** [was] led by **GM Ventures**", and that **WCS** and **General Motors** had "entered into a strategic agreement for collaboration covering technology development, project execution, offshore wind policy, and the advancement of sustainable applications". Regular readers of Low Carbon Pulse may recall the following reporting:
 - **Edition 19** of Low Carbon Pulse reported as follows:

"**Is it a wind sail, a wind wall, a wind wave – no it is a Wind Catcher System:** On **June 8, 2021** many [news feeds](#) reported on a new floating off-shore wind field project technology, with the scale of the technology presented in comparison to the **Eiffel Tower**, the **Statue of Liberty**, aircraft and cruise ships. The headlines for the **Wind Catcher System** are that it is competitive with fixed-bottom off-shore wind capital costs, and is five times as efficient as a conventional wind turbines.
 - **Edition 26** of Low Carbon Pulse reported as follows:

"As noted in **Edition 19** of Low Carbon Pulse (under **Wind round-up**), larger structures than the **My Mega** are being contemplated, including the **Wind Catching System** or **Windcatcher**. On **August 23, 2021**, the **Wind Catching System** was back in a number of news feeds, it being reported that development is proceeding. At the risk of repeating earlier reporting, the **Windcatcher** comprises 300 metre framework with around 120 turbines. As with the **My Mega**, it might be expected that **Windcatcher** will result in lower electrical energy costs, and as such make off-shore wind more competitive with other sources of electrical energy, or in any event allow an energy cost that will result in a reduction in the level of funding support required from Government."
- **Studying Troll Field floating wind field:** On **June 17, 2022**, it was reported widely that **Equinor** was leading a study, working with **Conocco Phillips, Pectoro, Shell** and **TotalEnergies**, to assess the feasibility of the development and deployment of a **1 GW** off-shore floating wind field project, 65 km off-shore of Bergen, Norway (**Trollwind project**). As contemplated, the **Trollwind project** would generate electrical energy to power the **Troll** and **Oseberg oil fields**, and would provide electrical energy for the Norwegian grid at less than **€0.095 kWh**.

- **On Global Wind Day a reminder of progress in the US:** On **Global Wind Day**, **Aker Offshore Wind** reminded folk that floating off-shore wind field development is going to commence in earnest in California in the fall of 2022, with auction of leases allowing the development of up to **4.5 GW** of off-shore floating wind field capacity. For the purposes of providing both a reminder and a time line, Aker Offshore Wind provides the following graphic:



Floating Offshore Wind in California by 2030



Updated June 2022

- **Copenhagen Infrastructure Partners obtains EBLs:** On **June 20, 2022**, **CIP** announced that it had been granted **Electricity Business Licences** for its three floating off-shore wind field projects offshore of **Ulsan, South Korea**, once installed having **1.5 GW** of capacity.
- **ORE Catapult assessment of floating offshore wind:** On **June 21, 2022**, **ORE Catapult** published a [report](#) on the commercialisation of floating off-shore wind capacity. The report is well-worth a read. In broad terms, the findings of the report (in short form) are best summarised in the following table suggesting the likely progress of off-shore wind floating wind fields:

2022 - 2030	2030 - 2035	2035 - 2050
<ul style="list-style-type: none"> • United Kingdom • Japan • France • South Korea • Taiwan • Norway • United States • China • Portugal • Ireland • Poland • Spain 	<ul style="list-style-type: none"> • Italy • Greece • Canada • Sweden • Vietnam • Philippines • Brazil • Australia • Romania • India 	<ul style="list-style-type: none"> • Colombia • Bulgaria • Morocco • Tunisia • Turkey • Finland • Lithuania • South Africa • New Zealand • Chile • Costa Rica • Kenya

Source: OWC, 2022. As of March 31, 2022

Figure 0-7: Select Floating Offshore Wind Markets by Decade

- **Connection and transmission infrastructure:** In a number of editions of Low Carbon Pulse (and sibling publications) the importance of the development of connection and transmission infrastructure, on-shore and off-shore has been noted.

On **June 22, 2022**, [4coffshore.com](#) reported that **Svenska Kraftnät** (the operator of the grid in Sweden) intends to develop six offshore connection points off the Swedish coast between 2029 and 2035. The connection points will allow renewable electrical energy generated from 10 GW of off-shore wind field capacity to be accommodated into the grid in Sweden.

In Q3 of 2021, **Svenska Kraftnät** commenced preparation of a plan to develop and to expand the off-shore transmission network. As the plan is prepared (and finalised), the capacity at each connection point is expected to be in the range of **1.2 GW** to **2 GW**.

- **A Big Catch:** On **June 27, 2022**, it was reported widely that the **Kellybegs Fisherman's Organisation Ltd** and **Sinbad Marine Services Ltd** had signed a memorandum of understanding with **Hexicon AB** (Swedish headquartered off-shore wind and technology corporation) for the purposes of developing a **2 GW floating off-shore floating wind field** to be located around **50 km off-shore** of **County Donegal, Republic of Ireland**.

Solar and Sustainability (including NZE Waste):

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the development of solar power generation capacity, on-shore (photovoltaic and concentrated) and floating. Also this section covers news items relating to the development of facilities and technologies to process and to recycle **NZE Waste**. Also this section considers the treatment of residual **NZE Waste**.*

- **Plastic waste:**

Clear eyed perspective: In **2021** approximately **400 million metric tonnes** of plastic was produced. Given the spread of estimates of plastic waste arising it is not possible to provide a reasonable estimate.

It is estimated that of the plastic waste that arose, around **11 million metric tonnes** found its way into waterways and oceans in 2021. Of the plastic waste arising globally, it is estimated that less than 10% is recovered and recycled.

There are many reasons for what may be viewed as low levels of recovery and recycling, including the need to develop collection systems to allow increased, and more effective recovery, and the fact that the current technologies (physical and thermal) do not allow the recycling of many forms of plastics.

As has been noted by the author of Low Carbon Pulse in many presentations (over the last 10 years), as the price of hydrocarbons (used to derive and to produce monomers to produce polymers) increases, the opportunity for plastic recovery and recycling increases because the prices of virgin polymers increases.

The challenge is taking the next step, the next step requiring policy settings and funding support from government: the next step is to achieve technology convergence to allow the use of plastic waste as a feedstock to derive and to produce plastic waste derived fuel or to produce polymers that can be used to produce plastics. To take the next step requires the development of scalable petrochemical technology.

- **West Dunbartonshire Council, Scotland, gives green light on plastics-to-hydrogen:** On **June 9, 2022**, [utilityweek.co.uk](https://www.utilityweek.co.uk) reported that West Dunbartonshire Council had approved the development of the UK's second plastics-to-hydrogen (**P-to-H2**) project. The **P-to-H2** project comprises a **13,000 metric tonne** facility that will derive sustainable hydrogen from non-recyclable plastics.

The **P-to-H2** project will use **Powerhouse Energy** technology, and will be developed by **Peel NRE**. The **P-to-H2** is to be located at Rothesay Dock, on the banks of the River Clyde. The **Powerhouse Energy** technology is reported to shred non-recyclable plastic, with the shredded plastic then treated thermally, at high-heat temperatures, with the plastic converting in a gaseous state, with the gases then reformed to derive a synthetic gas comprising **CH₄** and **H₂** (and **CO**).

The **CH₄** is used to generate electrical energy and the **H₂** is used as feed-stock to produce fuel for the mobility sector. **Peel NRE** and **Powerhouse Energy** are reported to plan the development of **11 P-to-H2** projects in the UK.

The development of the **P-to-H2** project on the banks of the River Clyde, follows the approval of the **Peel NRE** Protos energy and resource hub near Ellesmere Port, Cheshire, England.

- **Rio Tinto procuring 4 GW of renewables:** On **June 8, 2022**, **Rio Tinto** [announced](#) that it is seeking proposals to develop large-scale photovoltaic solar and wind in Central and Southern Queensland to power its Boyne smelter, Yarwun alumina refinery, and Queensland Alumina refinery, so as to allow it to achieve "its climate change ambitions and further encourage renewable development and industry in the region".

The load available under the request for proposals is **1.114 GW**, requiring the installation of **4 GW** of photovoltaic solar and wind capacity.

The request for proposals reflects the climate change commitment of Rio Tinto: to halve its Scope 1 and 2 emissions by 2030 compared to 2018.

- **Development and deployment commences on 650 MW on-shore photovoltaic solar farm:** On **June 9, 2022**, it was reported widely that the development and deployment of what will be the largest solar farm in Germany had commenced.

The photovoltaic solar farm is to be developed and deployed on the site of a disused open-cut coal mine, **Witznitz II**, located about **30 kms south of Leipzig**.

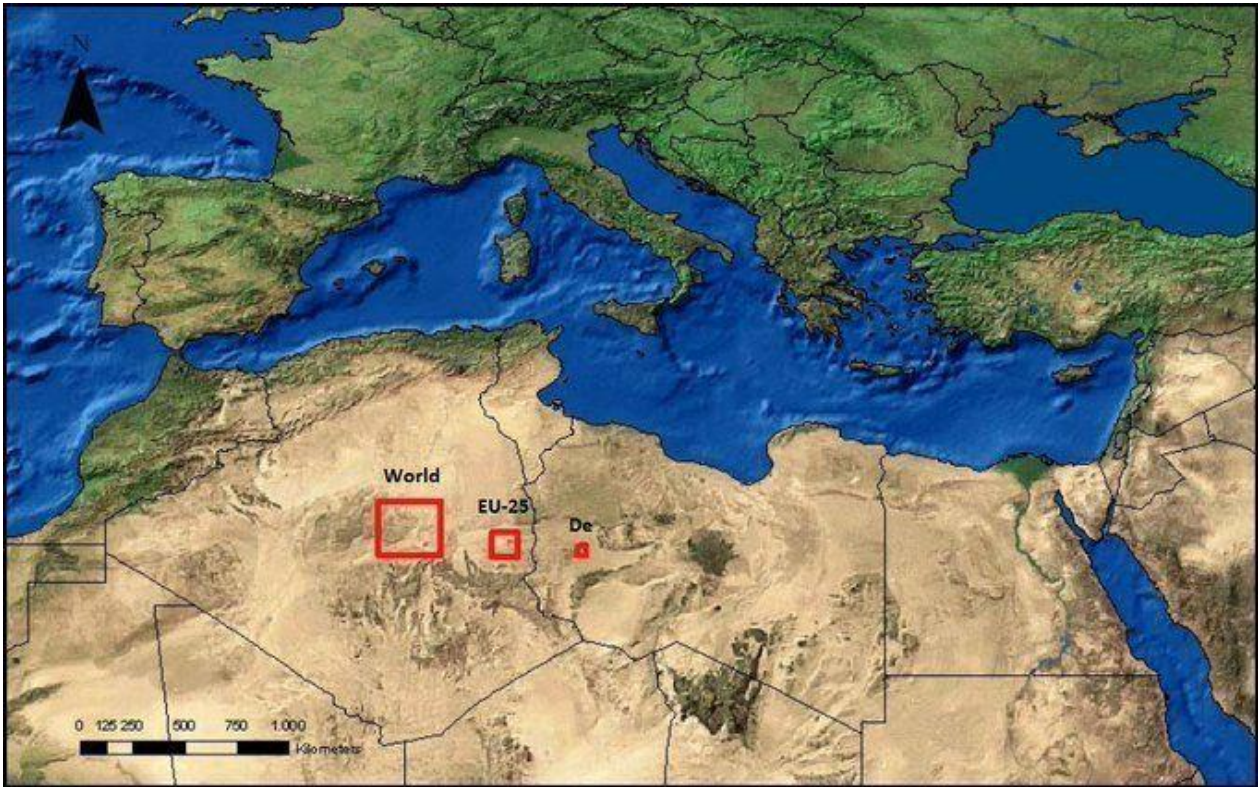
The photovoltaic solar farm (the **Witznitz Energy Park**) will make use of an area that has been little-used in recent times.

- **Prime Infrastructure Holdings plans 3.5 GW photovoltaic solar farm:** On **June 10, 2022**, [pv-magazine-australia](https://www.pv-magazine-australia.com) reported that **Prime Infrastructure Holdings** had announced plans to develop and to deploy a **2.5 GW** to **3.5 GW** photovoltaic solar farm and a **4 to 4.5 GWh BESS**.

As reported, the project is to be undertaken by **Terra Solar** (a joint venture between Prime Infrastructure and photovoltaic solar manufacturer and project developer, Solar Philippines).

As yet there do not appear to be any details available as to cost or location on the project.

- **Visualisation of the area of the world's surface required to be covered by solar panels:** On **June 11, 2022**, the author of Low Carbon Pulse came across the following photo-graphic illustrating the area of land required to be installed with photovoltaic solar facilities to generate sufficient renewable electrical energy for the needs of the **World**, the **EU** and **Germany**.

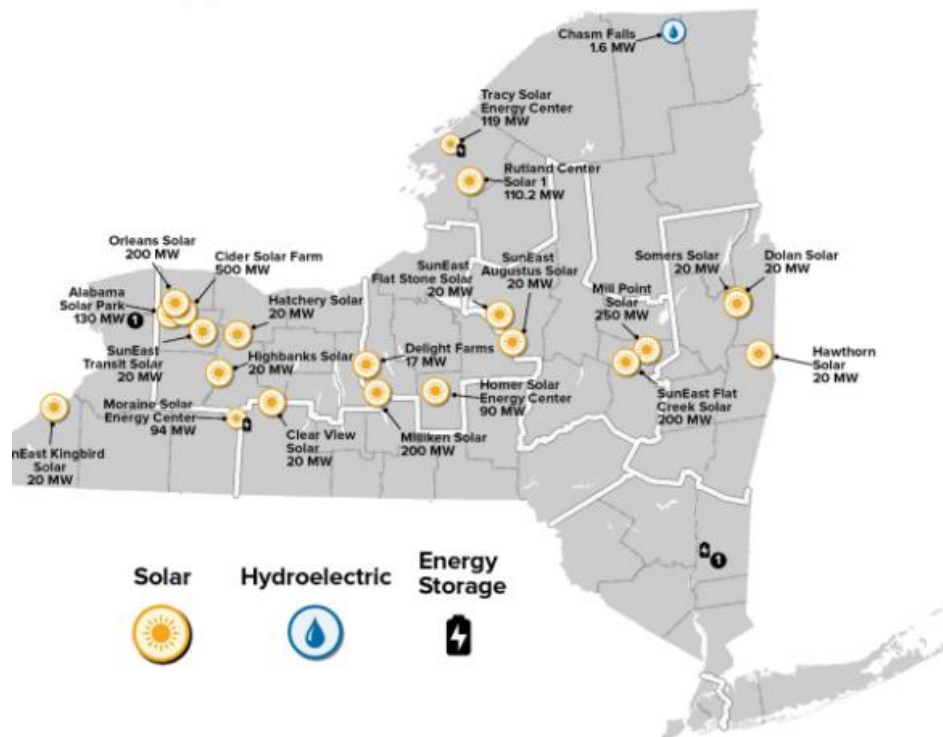


Source: [Sven Wiechert](#)

The following map provides a global view.



- NY awards 2.4 GW of photovoltaic solar and 159 MW of BESS:** On **June 13, 2022**, [energy-storage](#) reported that the US state of New York, New York State Energy Research and Development Authority (**NYSERDA**), had awarded **22** photovoltaic solar projects to install **2.4 GW** of capacity, including six projects with co-located **BESS** having a combined capacity of **159 MW**. The 22 photovoltaic projects will require **USD 2.7 billion** to develop and to deploy. The awards represent New York State's largest-shore-based procurement of renewable energy.



Source: [NYSERDA](#)

Other news outlets have reported that the following corporations were [awarded contracts](#): (1) **EDF Renewables North America** (having **24 GW** of renewable energy projects across North America) was awarded contracts for **three** of its **photovoltaic solar projects** in respect of **1 GW**; (2) **CS Energy** was awarded contracts for **three** of its **photovoltaic solar projects** in respect of **270 MW**; (3) **Boralex** was awarded contracts for **five** of its **photovoltaic solar projects** in respect of **540 MW**; (4) **East Light Partners** was awarded **two** contracts for **photovoltaic solar projects** in respect of **40 MW**; (5) **ConnectGen** was awarded **two** contracts for **photovoltaic solar projects** in respect of **200 MW**; (6) **SunEast Development** was awarded **two** contracts for **photovoltaic solar projects** in respect of **118 MW**; (7) **ReneSola Power** was awarded **one** contract for a **20 MW photovoltaic solar project**; (8) **Borrego Solar** was awarded **one** contract for a **60 MW photovoltaic solar project**; (9) **Cypress Creek Renewables** was awarded **one** contract for a **100 MW photovoltaic solar project**; (10) **Northland Power** was awarded **one** contract for a **100 MW photovoltaic solar project**; (11) **Nexamp** was awarded **one** contract for a **20 MW photovoltaic solar project**.

- **Shell swift to shift:** On **June 13, 2022**, it reported widely that **Shell UK** had [announced](#) plans invest up to **GBP 25 billion** so as to enable it to achieve its "five ambitions to help the UK to net zero". The five ambitions are: (1) to keep the energy flowing, helping strengthen the energy system and more self-reliant; (2) to accelerate the development of low-carbon power and renewable energy sources across the industrial heartlands of the UK; (3) to lead a nationwide roll-out of charging infrastructure to allow the acceleration of the adoption of electric vehicles; (4) to provide more renewable energy to customers; and (5) to invest in the "generation of net zero" to identify and to offer opportunities to the current and future workforce, in a way that ensures that transition is fair and just for all.
- **Duke Energy completes first of 10:** On **June 13, 2022**, [renewableenergyworld](#) reported the **Duke Energy** had completed the **first of 10** community solar projects in Florida, which when all complete will provide 750 MW of photovoltaic solar capacity, as part of the **Clean Energy Connection** community solar program. The first project is the **75 MW Fort Green Renewable Energy Center**.
- **Jinko searches for Keppel:** On **June 13, 2022**, [sbr.com.sg](#) reported that **Jinko Power** is to work with **Keppel Infrastructure Fund Management Pte Ltd** (trustee manager of **Keppel Infrastructure Trust**) to identify up to **1 GW** of photovoltaic solar and **BESS** in which **Keppel** may invest "in key developed markets in Asia Pacific, Europe and the Middle East".
- **Race to Zero:** On **June 15, 2022**, [climatechampions.unfccc.int](#) website reported on the UN backed **Race to Zero** initiative had published [refined criteria](#) following consultation with over 200 experts and civil society groups. The refined criteria take effect from **June 15, 2022**.
High-Level Climate Champions for **COP-26** and **COP-27**, **Mr Nigel Topping** and **Mr Mahmoud Modieldin** stated: "The clarity these criteria provide, together with strengthened data transparency, will help us identify the progress made and gaps remaining. They will clearly show those actors who are truly moving ahead versus those who are trying to find loopholes. We urge all Race to Zero actors to keep stepping up, or risk being removed from the Race".
- **Petronas launches Gentari:** On **June 17, 2022**, it was reported widely that **Petroleum Nasional Berhad (Petronas)** had established a clean energy subsidiary, **Gentari Sdn Bhd**. It is intended that **Gentari** will develop renewable energy, hydrogen and mobility projects, with the aim of developing and deploying **30 to 40 GW** of renewable energy capacity and **1.2 million tonnes** of hydrogen by 2030.
- **BASF to develop battery recycling plant in Germany:** On **June 22, 2022**, [batteryindustry.tech](#) reported that **BASF** (German chemical giant) is to develop a commercial scale **battery recycling black mass plant** in Schwarzheide, Germany: the concept of black mass refers to the first step in the recycling process, deriving metals

used to produce cathode active materials (**CAMs**), including cobalt, lithium, manganese, and nickel. The recycling process to derive **CAMs** is mechanical. In due course, the black mass will be feedstock for a hydrometallurgical refinery that **BASF** plans to build.

The plant is to have capacity to recycle 15,000 metric tonnes of electric vehicle batteries. As reported, the location of the plant is ideal given the presence of cell and EV manufacturers.

- **24 bidders approved or 2 GW auction:** On **June 22, 2022**, [pv-magazine.com](https://www.pv-magazine.com) reported that the **Green Energy Auction Bids Evaluation and Awards Committee** of the Philippines **Department of Energy (DOE)** had approved **24 bidders** to compete in an auction to allocate **2 GW** of capacity. As reported, of the **24 bidders, eight** are **photovoltaic solar**, **eight** are **wind**, **seven** are **run-of-river hydroelectric**, and **one** is **biomass**.
The outcome of the auction process was announced on **June 27, 2022**, (see <https://www.pv-magazine.com/2022/06/27/philippines-allocates-1-57-gw-of-solar-in-2-gw-renewables-auction/>). In short, the Green Energy Auction Bids Evaluation and Awards Committee published details of 19 bidders successful in their bids, allocating **1.966 GW** of renewable energy among them, with around **1.490 GW** of **photovoltaic solar**, **374 MW** of **wind**, **120 MW** of **hydroelectric** and **3.5 MW** of **biomass**.
- **Sun Cable investment ready:** On **June 24, 2022**, **Sun Cable** [announced](#) that **Infrastructure Australia** (independent statutory body providing research and advice to government and industry on investment in Australian infrastructure) had endorsed its **USD 30 billion** project (see **Editions 3, 13, 26, 28, 32** and **39** of Low Carbon Pulse) as **investment ready**, among other things, providing an opportunity for **Sun Cable** to access funding from the **Clean Energy Finance Corporation** and the **Northern Australia Infrastructure Facility**.
- **EMC first renewable energy import:** On **June 28, 2022**, the **Energy Market Company** (independent market operator of Singapore's wholesale electricity market) announced the import of renewable electrical energy into the **National Electricity Market of Singapore**, under a trial. The trial is stated to involve the import of up to **100 MW** of **renewable electrical energy** from a **hydroelectric source** in **Laos**, imported into Singapore through Thailand and Malaysia.
- **Live link electricity map:** Attached is a [link](#) to a live 24/7 **CO₂** emissions map showing **CO₂** emissions arising from electricity globally.

Land Mobility / Transport:

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the development and deployment of land vehicles, buses and coaches, cars, industrial vehicles and trucks, and trains.*

• Buses and coaches:

- **Melbourne to run hydrogen buses:** On **June 2, 2022**, it was reported widely that from March 2023 the State of Victoria, Australia, will trial the use of two hydrogen powered and propelled buses. As reported, **Transit Systems** will operate the buses, which are to be trialled on 15 school bus routes, and 26 other routes in the western suburbs of Melbourne. In addition, nine battery electric vehicles will commence operation at the same time, adding to the 41 battery electric buses already in operation.
- **Van Hool launches zero-emission vehicles:** On **June 10, 2022**, hydrogen-central.com reported that **Van Hool** (Belgian bus manufacturer of buses, coaches and industrial vehicles) has presented a number of "100% zero-emission buses".
As reported, the **Van Hool A12 Battery Electric** (in 12, 13, 18 and 24 metre models) is to be powered and propelled exclusively by zero-emission powertrains: battery-electric technology, fuel cell technology and trolley (i.e., overhead). It is understood that Van Hool had 13 orders for a total of 162 buses before it presented its 100% zero-emission buses.
- **IVECO to recommence production of buses in Italy:** On **June 21, 2020**, fuelcellworks.com reported that **IVECO** intends to recommence the production of buses, including using battery electric and fuel-cell technologies to manufacture battery electric, and fuel-cell electric buses.

By way of a reminder:

- **Edition 26** of Low Carbon Pulse (under **H2Accelerate**) reported that: "On **August 24, 2021**, **H2Accelerate** (established by **Daimler, IVECO, Volvo Group, OMV, Shell** and **TotalEnergies**), outlined its expectations in a publication titled [Expectations for the fuel truck market \(Expectations Paper\)](#)". The **Expectations Paper** outlines three phases for development of **FCEVs** and concomitant support:
 - 1. Learning and Development:** with this phase having commenced and to continue until 2025;
 - 2. Industrial Scale up:** this phase will commence from 2025 and continue until 2028, and will involve the deployment of thousands of **FCT** heavy goods vehicles and trucks, with refuelling infrastructure to continue to develop, critically along key transport corridors; and
 - 3. Sustainable Growth:** the third phase from 2028 and continuing thereafter will become self-sustaining as economies of scale arise and are maintained across each aspect of the supply and value chain.

Until the **Sustainable Growth Phase**, **H2Accelerate** expects public funding support to be required, but the need for it to decline as economies of scale are realised on a sustained basis.

Spokesperson for **H2Accelerate**, Mr Ben Madden, said: "It has never been clearer that actions to enable the decarbonisation of road freight must be set in motion immediately if climate targets are to be achieved. The latest whitepaper from ... H2Accelerate ... demonstrates the commitment from participants to invest in scaling up this vital sector, and support policymakers to take the necessary steps to catalyse these investments".

As noted in previous editions of Low Carbon Pulse, key participants in the freight industry are taking the lead in the development of technology and infrastructure. (See **Editions 18, 19**, and **22** of Low Carbon Pulse for illustrative examples.)"

- **Edition 27** of Low Carbon Pulse (under **IVECO and Nikola**) reported that: "Previous editions of Low Carbon Pulse reported that **IVECO** was committed to the development of **FACT** trucks. On **September 16, 2021, IVECO and Nikola** (leading fuel cell technology corporation) announced the development of a new **FACT** truck manufacturing facility in **Ulm, Germany**. The first **FACT** truck to be manufactured at the Ulm facility will be the **Nikola Tre battery-electric and FACT** powered and propelled truck, based on the **IVECO S-Way** track and incorporating **Bosch-designed components**. Earlier in September, Nikola agreed a licencing agreement with Bosch".
- **Cars** (including taxis and air-taxis, and fast cars and racing cars!):
 - **Have the cars been drinking?:** On **June 10, 2022**, hydrogen-central.com reported that **TotalEnergies** deployed a hydrogen refuelling station at the **Le Mans, 24-hour** race. In addition, it was reported that the 62 cars competing in the **90th Le Mans 24-hour race** (June 11 and 12, 2022) were powered and propelled by 100% renewable fuel produced and supplied by **TotalEnergies – Excellium Racing 100**. **Excellium Racing 100** is derived and produced from wine residues (grape marcs and lees).
 - **Overair Funded:** On **June 14, 2022**, fuelcellworks.com reported that **Hanwha Group** (including Hanwha Aerospace and Hanwha Systems) had provided **USD 145 million** in funding to Overair for the development of the electric vertical and landing (**eVTOL**) **Butterfly**. As reported, the **Butterfly** will take (vertical) flight in the second half of 2023.
 - **Ferrari to go electric:**
 - On **June 17, 2022**, [The Financial Times](https://www.ft.com/content/2022-06-17/ferrari-electric) reported that **Ferrari** will power and propel 40% of its vehicles using battery electric technology by 2030, and 40% of its vehicles using hybrid technology by 2030.
 - On **June 23, 2022**, it was reported widely that **Ferrari** is work with **Bloom Energy** to decarbonise its motor vehicle manufacturing plant at **Maranello, Italy**.
- **Battery, Fuel Cell and ICE Technology:**
 - **Recharge will driving:** On **June 1, 2022**, techspot.com reported that **Electreon** (a corporation headquartered in Israel) had announced that it is planning the development and deployment a **wireless-charging** pilot road project in Detroit, Michigan, US.
 - **Cummins Inc zero-emissions for Komatsu:** On **June 28, 2022**, **Cummins Inc** (global technology leader in power) announced that it was to work with **Komatsu Ltd** (global construction and mining industry equipment provider) under a memorandum of understanding to develop zero-emissions haulage equipment.
 - **Hyundai Doosan ICE:** On **June 29, 2022**, it was reported widely that **Hyundai Doosan Infracore** had commenced development of a **hydrogen-fired engine** for use in **buses, commercial vehicles and construction machinery and vehicles**, and **heavy goods vehicles / trucks**. The development of the hydrogen-fired engine is part of a national project promoted and sponsored by the **Ministry of Trade, Industry and Energy** in the **ROK**.
- **Industrial Vehicles and Trucks:**
 - **JCB parades first hydrogen digger:** During the **Queen's 70th Jubilee Week** (during the first week of June), it was reported widely that the **JCB backhoe loader** had been introduced to the world (in one of the parades held to mark the Jubilee). As reported, the **JCB backhoe loader** is the first digger to be powered and propelled using hydrogen.
 - **Volvo CE tests first hydrogen articulated hauler:** On **June 13, 2022**, it was reported widely that **Volvo Construction Equipment (Volvo CE)** had commenced testing of a prototype articulated hauler – the **Volvo HXO4**. Head of Advanced Engineering Programs, at **Volvo CE, Ms Carolina Diez Ferrer** stated: "*Being the inventors of the world's first articulated hauler more than 55 years ago, we are happy and proud to again drive change with this fuel cell hauler concept.*" As reported, funding support has been provided by FFI (with the Swedish Energy Agency, the Swedish Innovation Agency, and the Swedish Transport Agency).
 - **Amogy Ammonia tractor:** On **June 9, 2022**, the **Ammonia Energy Association** [announced](https://www.ammoniaenergyassociation.com/news/amogy-announces-successful-testing-of-ammonia-powered-tractor) that **Amogy** had demonstrated successfully a new ammonia powered and propelled tractor in Stony Brook, New York: a **100 KW ammonia-to-power system** having been integrated successfully into a John Deere mid-sized standard tractor.
 - **Volvo testing fuel cell technology trucks:** On **June 20, 2022**, it was reported widely the **Volvo Trucks** is testing trucks powered and propelled by hydrogen fuel cells. As reported, the range of the Volvo Trucks using fuel-cells is up to **1,000 kms (or 620 miles)**, and having the ability to refuel in 15 minutes.

As reported in **Edition 17** of Low Carbon Pulse, in **March 2021, Daimler Trucks and Volvo Trucks** established a joint venture:

"**Volvo and Daimler back-into FCEV:** In the context of closer ties between two of the world's largest truck makers, there appears to be a complete meeting of minds: by the end of the current decade, **FCEV** will start to displace diesel as the preferred power and propulsion for heavy goods vehicles / trucks. **Volvo** anticipates that by the end of the decade half of its European sales will be of **BEVs** and **FCEVs**: the truck maker anticipates a 50 /50 split between the two technologies. Both **Volvo** and **Daimler** are aiming to be net-zero by 2040. **Volvo** and **Daimler** have established a joint venture, **Cellcentric**, to produce fuel cells (**FCs**). The production of **FCs** is expected to commence in 2025.

This transition is required, indeed the transition is likely to be accelerated, as policy settings respond to the realisation that the world carbon budget needs to anticipate the growth in road freight transport (anticipated to double globally by 2050), and to mandate transition to **BEVs** and **FCEVs**."

 - **Hydrogen key for heavy-duty long distance transportation:** On **June 23, 2022**, [Rethink Energy](https://www.rethinkenergy.com/publications/heavy-duty-transport-transition-will-rely-more-on-hydrogen-than-batteries) published [Heavy duty transport transition WILL rely more on hydrogen than batteries](https://www.rethinkenergy.com/publications/heavy-duty-transport-transition-will-rely-more-on-hydrogen-than-batteries). At 20 pages, the publication is an easy, and thought provoking, read.

- **Recharging and refuelling infrastructure:**

- **Portable hydrogen cartridge:** On **June 2, 2022**, **Toyota Motor Corporation**, and its subsidiary **Woven Planet Holdings**, [announced](#) the development of a prototype hydrogen cartridge for use in a number of applications.
- **CLARA and Hydrogen Fuels provide clear hyway:** On **June 22, 2022**, it was reported widely that **CLARA Energy** and **Hydrogen Fuels Australia** are to work together to develop and to deploy **up to five hydrogen refuelling stations** along the Hulme Highway, the main highway between Australia's two most populous cities, Melbourne and Sydney. As reported, the cost of the development and deployment will be around **AUD 600 million**.
- **Liquid hydrogen refuelling station:** On **June 27, 2022**, it was reported widely that a liquid hydrogen refuelling station had been installed at the **Daimler Truck** testing centre in Wörth am Rhein, Germany. This follows the recent liquid hydrogen refuelling of a Daimler Truck. The refuelled Daimler Truck test drive was joined by Minister for Economic Affairs of Rhineland-Palatinate, Ms Daniela Schmitt.

While noted in previous editions of Low Carbon Pulse (and in sibling publications), it is worth a reminder that hydrogen is in its liquid state at **minus 253°C**, and as such the refuelling of liquid hydrogen requires cryogenic tanks and delivery system, and the hydrogen fuel cell vehicle being refuelled requires cryogenic receiving and fuel tanks, with insulation to avoid active cooling of the liquid hydrogen.

As noted in previous editions of Low Carbon Pulse (and sibling publications), liquid hydrogen has a higher energy density compared to gaseous hydrogen. The use of liquid hydrogen increases significantly the range of a truck using liquid hydrogen, stated to be up to 1,000 km by Daimler Trucks.

- **Trains:**

- **Berlin-Brandenburg lines go hydrogen:** On **June 27 and 28, 2022**, it was reported widely that **Siemens Mobility** had contracted with **Niederbarnimer Eisenbahn (NEB)** to supply **seven** of its **two-car hydrogen** powered and propelled **Mireo Plus H trains** for a line in the region of Berlin-Brandenburg, Germany. As reported, Siemens is to deliver the trains for Q3 2024. The **Mireo Plus H trains** will replace diesel trains.

By way of reminder:

- **Edition 21** of Low Carbon Pulse reported:

On **July 1, 2021**, it was announced that **Siemens Mobility** is testing its **Mireo Plus H train** using **LOHC** technology, working with **Helmholtz Institute Erlangen-Nuremberg**. Many countries have high levels of electrification across their rail networks. High levels of electrification allow decarbonisation by the completion of electrification and development, and use, of renewable electrical energy, and on some part of the rail network to use **BET** or **FCT** or both. In countries with lower and low levels of electrification (in the US less than 1% of rail miles are electrified), it is likely that **BET** and **FCT** will be used.

- **Edition 22** of Low Carbon Pulse reported:

For some time, Ballard Power Systems (**BPS**) has been making progress across a number of sectors. On **July 15, 2021**, it was reported widely that **BPS** is to supply 200 kw fuel cell modules under arrangement with **Siemens Mobility GmbH** to power a two car **Mireo Plus H** passenger train trials in **Bavaria, Germany** (one of the hydrogen hot spots in the **EU**). The fuel cell modules are located on the roof of the passenger train, to power and propel the train with electric battery technology located underneath the floor of the train. It is reported that that trials will start in 2022. The **Mireo Plus H** passenger train is designed for use on non-electrified lines at speeds of up to 160 kph.

- **Edition 37** of Low Carbon Pulse reported:

On **March 16, 2022**, it was reported widely that the Siemens Mobility and Bayerische Regiobahn had signed a lease of a two car hydrogen-powered Mireo Plus trainset, developed by Siemens Mobility. The Mireo Plus trainset is to be tested on the Augsburg-Füssen route, starting in mid-2023.

- **Underground goes green:** On **June 28, 2022**, it was reported widely that the **Mayor of London, Mr Sadiq Khan**, got rolling the procurement process to procure green electrical energy to power and to propel the **London Underground** system. The procurement process will result in 10% of electrical energy to be supplied from renewable energy sources to Transport for London, with the long-term intention to move to 100%.

Ports Progress and Shipping Forecast:

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the development and deployment of production and storage capacity, and infrastructure, at ports for **E-Fuels / Future Fuels** (including **Hydrogen Hubs**) and to capture and to store or to use carbon, or both (including **Carbon Clusters**), and the connection of port infrastructure to the hinterland.*

Also this section considers news items that relate to the development of infrastructure at ports, including to allow the development of off-shore wind fields.

- **Ferries and other craft (including tugs):**

- **Approval in Principle (AiP) for H2 Ocean:** On **June 3, 2022**, it was reported widely that leading international shipping classification society, **Lloyds Register**, had granted **AiP** in respect of the design of the **H2 Ocean**, a harbour cruise vessel powered and propelled by fuel cell technology and battery electric technology.

As reported, the **H2 Ocean** is being developed by leading corporations including **Ballard Power Systems, Inc**, **Canadian Hydrogen and Fuel Cell Association**, **Canal Marine & Industrial Inc**, **Capilano Maritime Design Ltd**, **Fairweather Cruises**, **HTEC**, the **University of British Columbia**, and **Lloyds Register**.

- **Launch of hydrogen-powered vessel concept:** On **June 13, 2022**, it was reported widely that **DNV**, **Ektank AB**, **Shell Shipping and Maritime**, and **TECO 2000** had launched the **Hy-Ektobank**. The concept manifest by the **Hy-Ektobank** is that existing **Ektank** vessels will be retrofitted with fuel cell technology to power and to propel them, using compressed and liquified hydrogen. The **Hy-Ektobank** is intended to allow **Ektank** to reduce its **GHG** emission footprint by **55% by 2030**, and to achieve **net-zero by 2050**.

- **EV Ellen poster ferry:** On **June 20, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **EV Ellen** had set a new world record during the International Energy Agency 7th Annual Global Conference on Energy Efficiency held in **Sønderborg, Denmark**. EV Ellen travelled 92 kms (or 50 nautical miles) on a single charge of its battery. The **EV Ellen** has been operating since 2019, using **Danfoss' Editron** electric drivetrains and propulsion motor.
- **Sparky the electric tug:** On **June 21, 2022**, it was reported widely that the **Port of Auckland, New Zealand**, had received **Sparky** (a name chosen by the good folk of New Zealand), the electric tug (e-tug in some reporting). Sparky is the first **Damen RSD-E Tug 251**, having a 70 tonne bollard pull, and **2,240 batteries** producing **2,784 KWh** of power.
- **MV Hydrogen one hydrogen tug:** On **June 22, 2022**, [news.cision.com](https://www.news.cision.com) reported on the development of **MV / Hydrogen One** being developed by US-based **Maritime Partners LLC**, with **Maritime Partners** placing orders with **PowerCell Sweden AB** (heading technology corporation head-quartered in Sweden) for its PowerCellution Marine System 200 fuel cells. As reported, the **MV / Hydrogen One** is to be commissioned in 2023, and will be the first methanol to hydrogen fuel-cell technology towboat (aka tug boat).
- **Green Ports (including infrastructure):**
 - **Port of Rotterdam:** The **Port of Rotterdam Authority (PORA)** has posted [Hydrogen in Rotterdam](#), providing an update on the initiatives and projects underway at the **Port of Rotterdam**, the Netherlands, and underlining the role of Port as an international hub for hydrogen import and production, and its key role in the value chain, including distribution to allow application across the northern Europe. The following map-graphic provides a snap shot.



Source: Port of Rotterdam

See [Editions 17, 20, 23, 27, 39](#) and [40](#) for previous news items and reports on the Port of Rotterdam and PORA.

- **Ports need to be supercharged:** On **June 24, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that the UK ports sector has called on the UK Government "to supercharge the delivery of energy network infrastructure to ports with new research and a transformational funding programme". As reported: "Energy connectivity is a key enabler for ports if they are to act as hubs for the decarbonisation of transport on land and water".
- **Stockholm Norvik Port development:** On **June 30, 2022**, it was reported widely that **CBM.TECH** and **Ports of Stockholm** are to work together to develop a hydrogen refuelling station in the vicinity of the **Norvik Port**. The refuelling station will supply hydrogen to fuel cell powered and propelled vehicles deployed at **Norvik Port**.
- **Green Freeports:**
 - **Freeports in Scotland:** [Edition 35](#) of Low Carbon Pulse reported (under **Green Free Ports**) that: "... two Green Freeports are to be established in Scotland. Each Green Freeport will offer incentives to investors (including tax incentives). Low Carbon Pulse will cover the process and outcome of the tendering and bidding process as it develops"
The development of two special economic zones (Freeports) is proceeding under arrangements agreed by the Government of Scotland and the Government of the UK.
 - **Bids on the way:** As reported in [Edition 40](#) of the Low Carbon Pulse, the two Freeports will benefit from lower tariffs and tax incentives within defined precincts of airports, seaports and rail terminals.
 - **Bids in:** As reported widely, that bids were received on **June 20, 2022**, from the following (in alphabetical order): **Clyde Green Freeport**, Opportunity **Cromarty Firth**, **Firth of Forth Green Freeport**, **Orkney Green Freeport**, and North East Scotland Green Freeport (comprising **Port of Aberdeen** and **Aberdeen International Airport** and the **Peterhead Port Authority**).
Future editions of Low Carbon Pulse will report on the progress of the process, and the two successful bidders.

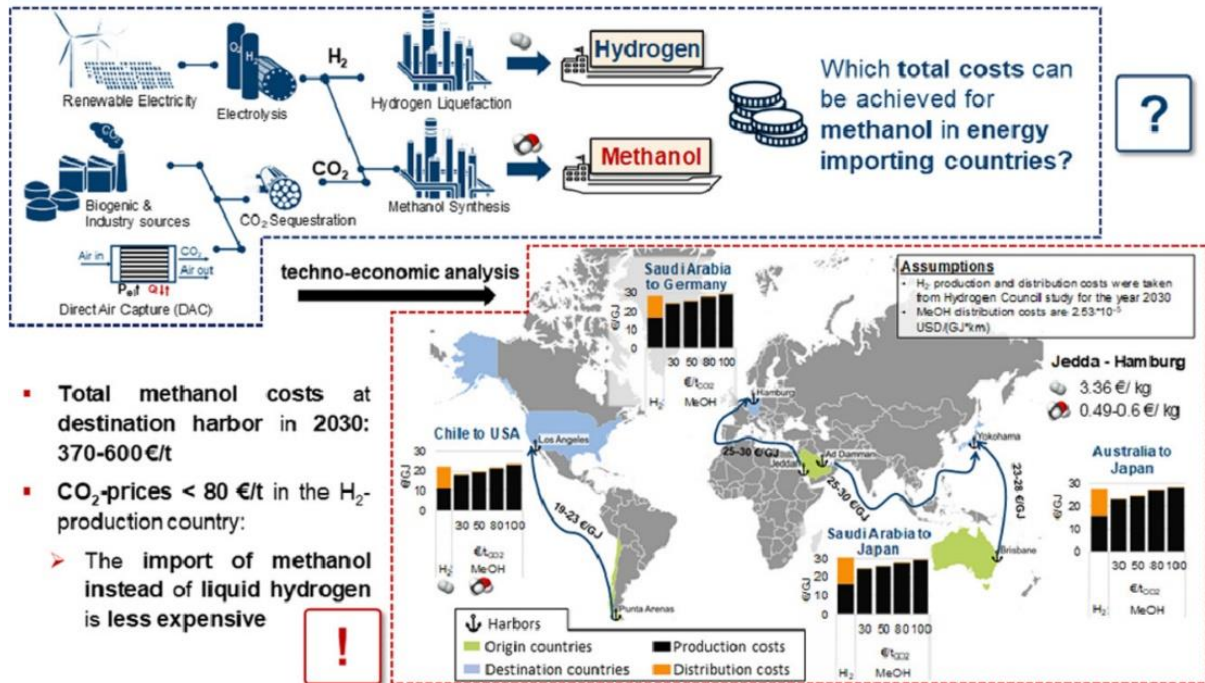
- **Green Shipping:**

- **Ocean Yield orders methanol-ready box-ship:** On **June 13, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Ocean Yield AS** (Norwegian ship-owning corporation) is to order a **5,500 TEU box-ship** from **HJ Shipbuilding & Construction** (formerly Hanjin Heavy Industries & Construction).

The **box-ship** is designed to enable it to convert to **dual-fuel** operation, allowing the use of methanol.

Methanol as a Renewable Energy Carrier: An Assessment of Production and Transportation Costs for Selected Global Locations

F. Schorn, J. L. Breuer, R. C. Samsun, T. Schnorbus, B. Heuser, R. Peters, D. Stolten



- **LMG Marin AS green ammonia carrier:** On **June 13, 2022**, **Sembcorp Marine Ltd** [announced](https://www.sembcorpmarine.com) that its wholly-owned subsidiary, **LMG Marin AS**, working with **Grieg Edge** and **Wärtsilä** had been awarded **Approval in Principle (AIP)** for the design of a tanker (**MS Green Ammonia**) that is powered and propelled by **Green Ammonia**. The **AIP** was awarded by **DNV – Maritime (Den Norske Veritas)**. As announced, the **AIP** is in respect of "the world's first green ammonia-fuelled tanker".

The **MS Green Ammonia** is intended to form part of the **Berlevåg** project in northern Norway, which involves a number of Norwegian corporations producing Green Ammonia from Green Hydrogen feedstock produced from electrolyzers powered by renewable electrical energy sourced from the Raggovidda wind farm.

- **Acta Marine in the act:** On **June 14, 2022**, [4coffshore.com](https://www.4coffshore.com) reported that **Acta Marine** had ordered two next generation MDO / HVO powered and propelled DP2 methanol fuelled construction support operating vessels (CSOVs) from Turkish shipyard Tersan.
- **MANNED up:** On **June 17, 2022**, [hydrogen-central.com](https://www.hydrogen-central.com) reported that dual fuel **MAN Engines** had been installed on a work boat: the **MAN Engines** are **V-12** marine diesel engines (**MAN D2862 LE448**) that have been supplemented with a hydrogen injection system by **CMB.TECH** (see **Edition 40** of Low Carbon Pulse).
- **Howden E-compression:** On **June 17, 2022**, [h2-view.com](https://www.h2-view.com) reported that **Howden** (leading compression engineering corporation) had signed a contract with **European Energy** to provide hydrogen compressors to allow **European Energy** to deliver compressed Green Hydrogen as feedstock for the production of **E-Methanol** for use in maritime transportation.

As reported in previous editions of Low Carbon Pulse, **European Energy** is to supply **E-Methanol** to **A.P. Moller – Maersk** to its dual fuel container vessels.

- **Proman Stena Bulk takes delivery of methanol fuelled tanker:** On **June 20, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Proman Stena Bulk** had taken delivery of the **first of six** 49,990 dwt **methanol-powered-and-propelled dual-fuel medium-range tankers** – the **Stena Pro Patria**. Having been launched in late 2021, the **Stena Pro Patria** is preparing for commercial operation.
- **ESL Shipping to use Neste co-processed marine fuel:** On **June 20, 2022**, **Neste** announced that **ESL Shipping** (shipping corporation headquartered in Finland and leading carrier of dry bulk in the Baltic and Nordic area) is to use **Neste Marine™ 0.1 Co-processed** marine fuel to power and to propel ESL shipping vessels in Finland and Sweden.

As announced by Neste: "The ISCC PLUS certified marine fuel enables up to 80% reduced greenhouse gas emissions over the life cycle compared to fossil fuels ...".

- **WindWings flying:**

- **Mitsubishi Corporation to sail:** On **June 21, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Mitsubishi Corporation** intends to install **Two WindWings** on the **Pyxis Ocean**, a 80,962 dwt **bulk carrier**.

BAR Technologies has developed the **WindWings** technology, and Yara Marine will install the **WindWings** on the **Pyxis Ocean**. The EU has provided funding for one of the WindWings under the [EU Horizon 2020](#) initiative.

- **Berge Bulk Berge Olympus to sail:** On **June 29, 2022**, it was reported widely that **Berge Bulk** (leading dry bulk shipping corporation) is to equip its Newcastlemax bulk carrier, the **210,000 DWT Berge Olympus**, with four **BAR Technologies WindWings**.



- **SeaShuttle on the drawing board:** On **June 23, 2021**, it was reported widely that **Enova** (Norwegian energy and climate technology company, operating under the Ministry of Climate and Environment) had provided funding support for the development of two fuel-cell technology hydrogen powered and propelled **500 TEU containerships** to be remotely controlled and autonomous ready. The two containership will operate between Oslo Fjord and the Port of Rotterdam. As reported, the main power and propulsion will be hydrogen fuelled, with diesel as back-up.

By way of reminder: Enova provided funding support as follows:

- **Edition 34** of Low Carbon Pulse (under **Yara and Linde contract**) reported that: "Previous editions of Low Carbon Pulse have covered various aspects of the ammonia production facility of Yara (leading fertiliser producer) at Herøya, Porsgrunn, Norway. Most recently, **Edition 33** of Low Carbon Pulse covered the award of NOK 283 million in funding support from the Norwegian Government, through Government agency Enova".

- **Edition 33** of Low Carbon Pulse (under **First, Polaris to progress, now Barents Blue**) reported that:

"**Edition 32** of Low Carbon Pulse reported that on December 10, 2021, it was announced that Equinor ASA, Horisont Energy AS, and Vår Energi had entered into an agreement to collaborate on the development for the carbon transportation and storage project, Polaris off the coast of Northern Norway (see **Editions 25** and **27** of Low Carbon Pulse).

The Polaris storage project is expected to have **CO₂** storage capacity of 100 million tonnes, or stated another way, twice the mass of **GHG** emissions arising from activities in Norway each year. As noted in previous editions of Low Carbon Pulse, the Polaris storage project is key to the development of the **Barents Blue** project in Finnmark – Europe's first world-scale carbon neutral ammonia production plant.

By way of reminder, **Edition 27** of Low Carbon Pulse reported that on September 13, 2021, Horisont Energi announced that it had made an application for a licence to establish the Polaris **CO₂** storage facility off the coast of Finnmark. It was stated that the Horisont Energi application was intended to allow the storage of **CO₂** arising from the production of Blue Hydrogen at the **Barents Blue** project (to produce Blue Hydrogen and Blue Ammonia). **Edition 23** of Low Carbon Pulse reported that Horisont Energi, Equinor and Vår Energi had entered into a cooperation agreement to develop **Barents Blue**, and the development of the Polaris **CO₂** project has long been an integral part of the thinking around the development of **Barents Blue**.

On December 17, 2021, [highnorthnews.com](#) reported that **Barents Blue** was one of three major hydrogen projects chosen to receive NOK 1 billion in support from the Norwegian Government, with **Barents Blue** to receive up to NOK 482 million. The CEO of Horisont Energi, Mr Bjørgulf Haukelidsæter Eidesen is reported to have said that: "This is a big day for the Barents Blue project". It was indeed a big day: in addition to the Norwegian Government funding, the **Barents Blue Ammonia Plan** will be award Important Projects of Common European Interest (**IPCEI**) status.

The other two major hydrogen projects are Tizir Titanium & Iron (**TTI**) in Tyssedal (see **Edition 21** of Low Carbon Pulse) and Yara International (see **Edition 29** of Low Carbon Pulse) receiving NOK 261 million and NOK 283 million respectively."

- **ENOVA supports hydrogen and ammonia ecosystem:** On **June 24, 2022**, it was reported widely that **Enova** is to support **five hydrogen production facilities** along the coast of Norway and **seven hydrogen and ammonia** powered and propelled **vessels**.
- **Roll-on:** On **June 27, 2022**, [offshore-energy.biz](#) reported that **Knud E. Hansen** (Danish navel architecture and design firm) and **Wallenius Marine** (Swedish ship management and design corporation) had signed a memorandum of agreement for **Knud E. Hansen** to join the team designing the **world's first wind-powered roll-on/roll-off (RoRo) 7,000 CEU** vessel.
- **The cost of Green Hydrogen and Green Hydrogen-based fuels:** On **June 28, 2022**, [offshore-energy.biz](#) provided snippets from a report entitled [Cost of clean shipping is negligible](#). As reported, powering and

propelling shipping using Green Hydrogen and Green Hydrogen-based fuels would add less than €0.10 to the price of a pair of pumps / training shoes / sneakers (whatever your lingua franca) and up to €8 for a refrigerator.

The report is helpful, moving thinking from the conceptual / drawing board to the practical real world.

- **Decarbonising the maritime sector:**

- **Coordinated action needed across the maritime sector:** On **June 8, 2022**, unctad.org posted an article [Decarbonising the maritime sector: Mobilising coordinated action in the industry using an eco-systems approach](#). The article starts with facts and stats that are known: the marine industry emitted about **1.2 gigatonnes of CO₂-e** in 2020, equivalent to about 3% of global **GHG** emissions. (It should be noted that the stated mass of **GHG** emissions arising from the maritime sector is reported as low as **940 million tonnes of CO₂-e**.) Because the maritime sector is cross-border, reductions in **GHG** emissions are not addressed in nationally determined contributions of countries under the **Paris Agreement**.

While the **International Maritime Organisation** has challenged the maritime sector to reduce **GHG** emissions, the rate of **GHG** emission reductions is not at the required levels. The article identifies the need to align efforts across **three value chains** as follows:

(i) the **fuel chain** - which encompasses the **well-to-wake** fuel value chain (i.e., exploration, transportation to the point of processing, processing, and transportation to the point of delivery, from the point of delivery to the point of use);

(ii) the **shipbuilding chain** - which encompasses ship design, procurement, including assembly and construction, post-build maintenance and refitting, and end-of-life-recycling ; and

(iii) the **operations chain** - which encompasses the operation of ships travelling between ports and making port visits.

For those familiar with the maritime sector, the article provides a helpful summary, and further emphasis of the need for action to be taken, urgently.

- **Green Shipping Corridors:** On **June 10, 2022**, offshore-energy.biz reported that the **Port of Long Beach** (California) or **POLB** had joined the **Shanghai-Los Angeles Green Shipping Corridor**.

As regular readers of Low Carbon Pulse will recall, the **Shanghai-Los Angeles Green Shipping Corridor** was announced in **January 2022** by the **C40 Cities**. Green Shipping Corridors are an important initiative intended to decarbonise shipping corridors around the world.

The **C40 Cities** is a network of cities around the world that are committed to working together to take action needed to address climate change, so as to create an environment in which everyone, everywhere, can thrive.

The key action involves the development of a **Green Shipping Corridor Implementation Plan** by the end of 2022.

The key decarbonisation goals include the phasing in of low, ultra-low, and zero-carbon fuelled ships, the development of best management practices to reduce **GHG** emissions and to improve the efficiency of ships, and reducing **GHG** emissions from ports and improving air quality.

By way of reminder:

- **Edition 30** of Low Carbon Pulse reported on Green Shipping Corridors as follows:

"**Clydebank Declaration:** On November 10, 2021, the [Clydebank Declaration](#) was agreed at **COP-26**. The **Clydebank Declaration** emphasises the importance of limiting "the increase in global average temperature to **1.5°C** above pre-industrial levels", expressed great concern that if "no further action is taken, international shipping emissions are expected to represent 90% to 130% of 2008 emissions levels by 2050", and recognised that "a rapid transition in the coming decade to clean maritime fuels, zero-emission vessels, alternative propulsion systems, and the global availability of landside infrastructure to support these, is imperative for the transition to clean shipping".

In addition the signatories to the **Clydebank Declaration** committed facilitate the development of **Green Shipping Corridors**, with at least six **Green Shipping Corridors** by "the middle of this decade ... [and] many more corridors ... by 2030". A **Green Shipping Corridor** is a route between two or more ports that are "zero-emission maritime routes".

The signatories to the **Clydebank Declaration** are: Australia, Belgium, Canada, Chile, Denmark, Fiji, Finland, France, Germany, Republic of Ireland, Italy, Japan, Republic of the Marshall Islands, Morocco, the Netherlands, Norway, Spain, Sweden the UK, and the US.

- **Edition 34** of Low Carbon Pulse reported the Los Angeles and Shanghai Green Corridor as follows:

"On January 28, 2022, or thereabouts, it was reported widely that the Port of Los Angeles, the Port of Shanghai and **C40 Cities** (a global network of mayors taking action to confront climate change), are to create the first transpacific Green Shipping Corridor between the US and the **PRC**.

It is difficult to overstate the significance of the establishment of the first transpacific Green Shipping Corridor between the US and the **PRC**. The US and the **PRC** have the largest bilateral trading relationship globally, and the ports of Los Angeles and the Shanghai are key gateways to the seaborne trade, which accounts for the vast majority of trade."

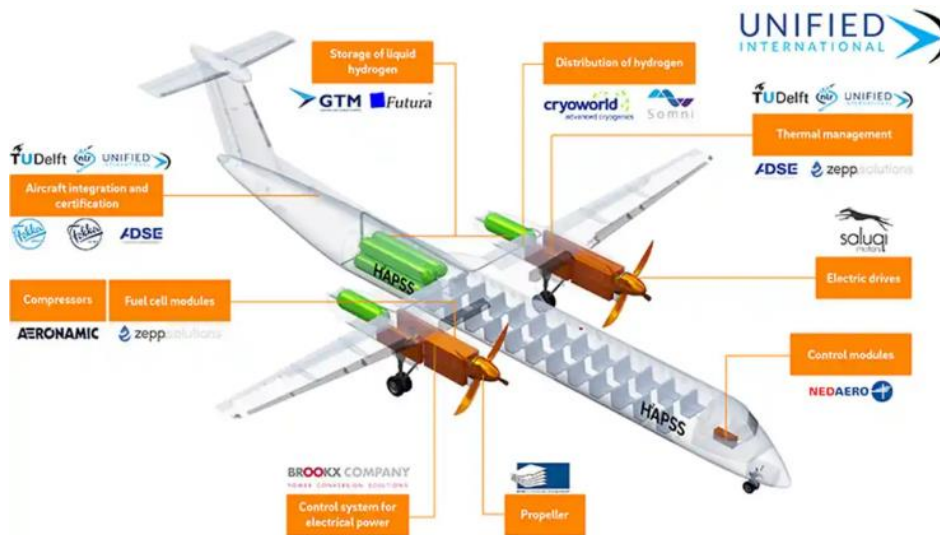
- **CO₂ carrier capacity:** On **June 16, 2022**, [Reuters](https://reuters.com) reported that **Shell** (leading global international energy corporation) intends to develop **CO₂ carriers** with **12,000 m³** capacity, moving to **36,000, 40,000 and 70,000 m³**. Along with **Equinor** and **TotalEnergies**, **Shell** is developing the Northern Lights project (as part of the Longship project), on the continental shelf of Norway. The **CO₂** carriers being built for the Northern Lights project have capacity of **7,500 m³**. As noted in previous editions of Low Carbon Pulse, carriers need to be designed and then developed to carry greater mass of **ammonia, CO₂, hydrogen** and hydrogen-based fuels. The design and development of carriers able to carry Future Fuels will be one of the key factors to the development of the market Future Fuels.

- **Vessel Emission Reductions:** On **June 28, 2022**, Maersk McKinney Moller Center for Zero Carbon Shipping published [Determining the impact and role of onboard vessel emissions reduction](#). The publication is a helpful reminder that while **CO₂** is the focus of **GHG** emission reductions in the shipping sector, the other two well-mixed **GHG's**, **CH₄** and **N₂O**, need to be a focus too, not least because their global warming potential is considerable greater than **CO₂** by metric tonne equivalence. This reminder is placed along side the **four fuel pathways** identified by the Center: **ammonia**, **methane**, **methanol** and **bio-oils**. The publication is well-worth a read.

Airports and Aviation:

*This section considers news items that have arisen within the news cycle of this **Edition 41** of Low Carbon Pulse relating to the development and deployment of technology at airports and in the aviation sector to decarbonise the airports and the aviation industry.*

- **Neste:**
 - **Some facts and stats:** Various editions of Low Carbon Pulse have covered the use of sustainable aviation fuel or synthetic sustainable fuel (**SAF**), including coverage of **Neste** as the leading producer of **SAF**. **Neste** has published something of a [fact sheet](#) on **SAF**. The fact sheet is well-worth a read. The most telling facts for the author of Low Carbon Pulse are as follows: "More than 370,00 commercial flights have used **SAF** since 2016; more than 40 airlines and 13 major airports already use and supply **SAF**".
 - **Neste** continues to develop its capacity to produce **SAF**: currently **Neste** has annual production capacity of **100,000 tonnes** (around 34 million gallons), progressing to annual production capacity of **1.5 million tonnes** (around 515 gallons) by the end of 2022, progressing to **5.5 million tonnes** by the end of 2023.
 - **Some news:**
 - On **June 15, 2022**, **Neste** [announced](#) that it had made its first delivery of **SAF** in New York, delivering **SAF** using the existing aviation fuel pipeline systems to **LaGuardia Airport**, working with **Delta Air Lines**, and **Buckeye Partners, Colonial Pipeline Company** and the **Port Authority of New York**.
 - On **June 15, 2022**, [Airbus Corporate Helicopters](#) reported that **Helsinki Citycopter** is to start replacing aviation fuels produced from hydrocarbons with **Neste MYSustainable Aviation Fuel** in its new **ACH130s**.
 - **Sustainable Aviation Fuel Grand Challenge:** On **June 6, 2022**, [LanzaJet](#) posted an article stating that **Southwest Airlines** is to co-invest in the **SAFFire renewables project**, which is developing technology devised in the ever-active **National Renewable Energy Laboratory (NREL)** to convert corn stover into ethanol as feedstock for the derivation / production of **SAF** at the **Freedom Pines Fuels** facility of **LanzaJet**.
 - **Airbus and Kansai Airports look to deploy hydrogen:** On **June 10, 2022**, it was reported widely that **Airbus Industries** and **Kansai Airports** had signed a memorandum of understanding (**MOU**) under which they are to assess the use of hydrogen at three airports owned and operated by **Kansai Airports – Kansai International Airport, Kobe Airport** and **Osaka International Airport**.
As reported, the **MOU** provides for **Airbus** and **Kansai** to work together to develop a roadmap, with the roadmap to report on the assessment undertaken, including the challenges and to develop a plan to advocate for the development of hydrogen infrastructure.
As might be expected, **Airbus** will provide aviation information (including in respect of aircraft characteristics, energy use, and hydrogen powered and propelled aircraft), and **Kansai** will provide information as to the facilities and infrastructure required at airports (air and landside) desirable and necessary to support and to supply hydrogen powered and propelled aircraft.
By way of reminder: **Edition 28** of Low Carbon Pulse reported (under **Airbus, Air Liquide** and **VINCI Airports H2 Airport**) that:
"On **September 21, 2021**, **Airbus, Air Liquide** and **VINCI Airports** announced plans to develop a pilot project at the **Lyon-Saint Exupery** airport. As noted in previous editions of Low Carbon Pulse, hydrogen has considerable potential airside and landside, and airborne.
The planned pilot project is understood to involve the development and deployment of hydrogen storage and delivery systems. If the pilot project proves feasible, **VINCI Airports** across Europe are likely to adopt the storage and delivery systems overtime".
- **ATR, Braathens and Neste teaming for first 100% SAF flight:** On **June 13, 2022**, [atr-aircraft.com](#) published an article outlining that an historical flight will take place shortly in Sweden – the **first 100% SAF flight for a commercial aircraft**.
The **propulsion system** is provided by **ATR**, the **SAF** is provided by **Neste** and the commercial aircraft by **Braathens Regional Airlines**.
On **June 21, 2022**, **ATR, Braathens** and **Neste** each [announced](#) that on **June 21, 2022**, the first **100% SAF** commercial flight had taken place in Sweden, using **Neste MY Sustainable Aviation Fuel**.
- **The Netherlands committed to first hydrogen flights to the London by 2028:** On **June 13, 2022**, [fuelcellworks.com](#) reported that a consortium of **17 Dutch corporations** and **organisations** (with funding support from the Dutch Government) are committed to the first hydrogen flight by a medium- sized passenger aircraft from **Rotterdam**, the Netherlands, **to London**, England (around 750 kms) **by 2028**.
The current thinking is that The medium-sized passenger aircraft will be turbo-propeller aircraft, retrofitted with hydrogen to be stored in the tail, rather in the wings of the aircraft, i.e., the tail of the aircraft will house the Hydrogen Aircraft Powertrain and Storage System (**HAPSS**).



- **GHG emissions from aircraft must peak by 2025:** On **June 15, 2022**, the **International Council on Clean Temperature (ICCT)** published [Vision 2050: Aligning Aviation with the Paris Agreement \(Vision 2050\)](#). The **ICCT** publication assesses the progress that needs to be made to ensure that the aviation sector achieves **GHG** emission reductions consistent with the **Paris Agreement**.

For these purposes, the **ICCT** provides **three** scenarios: **Action** consistent with achieving a **2°C** increase in average global temperatures compared to pre-industrial times, **Transformation** consistent with achieving a **1.75°C** increase, and **Breakthrough** consistent with achieving a **1.5°C** increase.

Vision 2050 is excellent and well-worth a read, providing an excellent analysis of what needs to be done to achieve alignment with the **Paris Agreement**, and in doing so makes a point that is dear to the heart of the author:

"On average, the [well-to-wake] emissions [arising from aviation fuel] are 21% higher than the CO₂ emitted directly from aircraft engines [on oxidation / use]". As noted in previous editions of *Low Carbon Pulse*, and sibling publications of *Low Carbon Pulse*, accuracy and transparency is required in reporting of **GHG** emissions from "well-to-wake".

Vision 2050 aligns with the next two news items, and is timely, with the member states of **ICAO (International Civil Aviation Organisation)** meeting in July 2022 to assess and, hopefully, to settle on, **GHG** emission goals for the international aviation sector.

- **Jacob's Ladder:** On **June 15, 2022**, **Jacobs Engineering** (American international technical professional services firm) published [Airports as Catalysts for Decarbonisation](#). The **Jacobs** publication complements the **Aerospace Technology** and **FlyZero** publication [Hydrogen Infrastructure and Operation, Airports, Airlines and Aerospace](#) reported on in **Edition 37** of *Low Carbon Pulse*.

As noted in previous editions of *Low Carbon Pulse*, for airports to be able to provide hydrogen for aircraft, infrastructure needs to be developed and deployed well ahead of wide-scale use of hydrogen by the aviation industry.

The **Jacobs** publication adds considerable meat to these bones, providing three scenarios, very much following the scenarios considered in the **FlyZero report** the three scenarios being: delivery of hydrogen in liquid form by truck from a hydrogen production facility in the hinterland of the airport, delivery of hydrogen in compressed gaseous form by pipeline to the airport, with liquefaction at the airport, and delivery of hydrogen in liquid form from a hydrogen production facility at the airport.

- **Air Liquide and Groupe ADP shared aviation visions:** On **June 15, 2022**, it was reported widely that **Air Liquide** and **Groupe ADP** had entered into a joint venture to work together to combine the expertise and know-how of **Air Liquide** in respect of hydrogen with that of **Groupe ADP** in respect of airport infrastructure development and deployment and operations.

The shared vision arises from the work that **Air Liquide** and **Groupe ADP** have done with **Airbus Industries** (see **Edition 20** of *Low Carbon Pulse*) in assessing the role of hydrogen in the aviation and airport sector, in particular in regional flights that account for a large proportion of air-traffic.

- **Bristling with promise:** On **June 21, 2022**, [hydrogen-central.com](#) reported that a hydrogen consortium had been established to develop hydrogen infrastructure. The consortium is reported to consist of **Airbus Industries, Bristol Airport, Bristol Port, Costain, Easyjet, GKN Aerospace, Hymamics, Wales and West Utilities** and **Wood (Hydrogen South West consortium)**. One of the pilot projects is establishing a hydrogen port at Bristol Port: the hydrogen port would receive and store hydrogen and hydrogen-based fuels, and other Future Fuels, and develop hydrogen production facilities.
- **ExxonMobil to produce SAF:** On **June 21, 2022**, [fuelsandlubes.com](#) reported that **ExxonMobil** intends to manufacture **SAF** from **renewable methanol**. The **renewable methanol** feedstock is derived from the gasification of biomass and waste, and "lower-carbon" hydrogen, and then compounded with **CO₂** that has been captured, with the **renewable methanol** then synthesised to produce **SAF**. As reported, the **ExxonMobil** technology is able to produce **SAF** from other renewable bio-feedstock, including animal fats and cooking oils, and vegetable oils.
- **Blockchain for SAF:** On **June 22, 2022**, **Shell** announced that it had launched **Avelia** powered by blockchain: **Avelia** is stated "to track the journey of SAF from the production entry into the fuel network, and environmental attributes of SAF are then allocated to both airlines and business customer respectively".

- **Airbus and Linde global MOU:** On **June 24, 2022**, **Linde** (one of the Big Three industrial gases giants globally, the other two being Air Liquide and Air Products) [announced](#) that it and **Airbus** had signed a memorandum of understanding (**MOU**) to work on the development of hydrogen infrastructure at airports globally, covering working together to establish global supply chains for hydrogen, from production to storage at airports, including the integration of refuelling into ground handling operations.
- **Can Biofuels Really Fly:** On **June 23, 2022**, [science.org](https://www.science.org) published an [article](#) on the use of biomass to produce biofuels for use to power and to propel aircraft. The article provides a useful check-in on the state of play.

Reference Materials:

The purposes of this Reference Material section is keep live, reference material that readers may find most useful on an ongoing basis without the need to search for that material:

- **Background on electrolyzers:**

At the moment around 61% of electrolyzers use **AE** technology and around 30% use **PEM** technology.

ANATOMY OF AN ELECTROLYSER

Alkaline electrolyzers (**AE**) produce H₂ using a liquid electrolyte, using nickel electrodes and stainless steel for the stack.

Polymer Electrolyte Membrane or Proton-Exchange Membrane (**PEM**) electrolyzers operate in an acidic environment, using iridium coated anodes and platinum coated cathodes, both the anode and cathode are made from titanium.

AEs and **PEMs** have similar electrical energy efficiency, with the consumption of electrical energy being almost the same. PEM's operate at a higher electrical current, and as such are more productive per unit of stack mass.

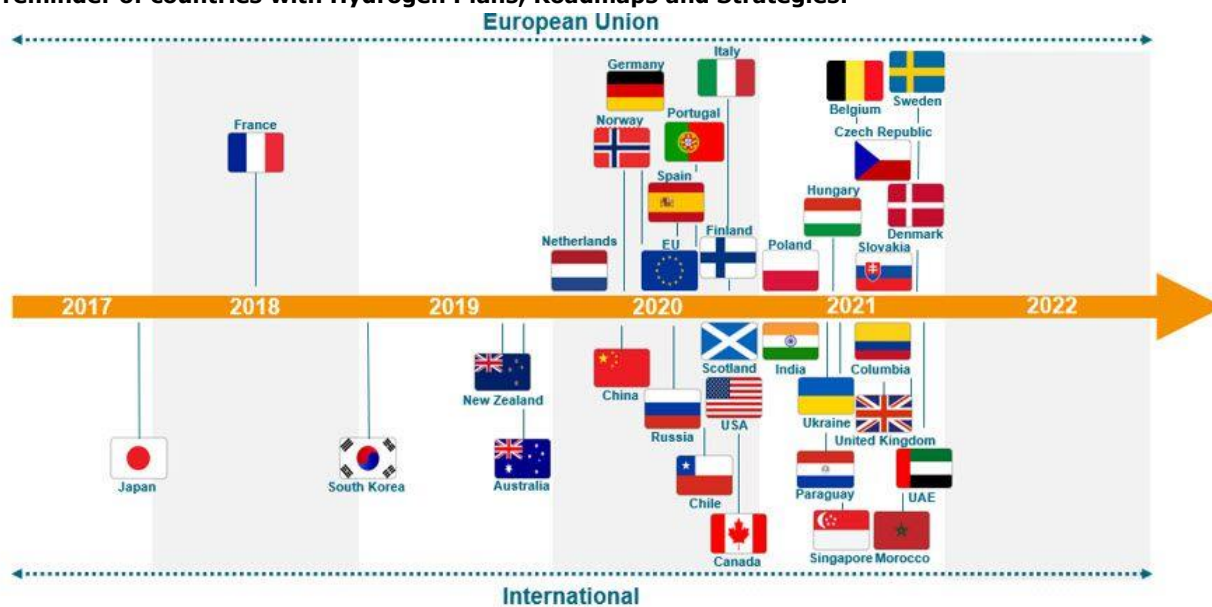
In addition to **AE** and **PEM** electrolyser technologies, there are what may be regarded as emerging technologies of anion exchange membranes (**AEM**) and solid oxide electrolysis cells (**SOEC**). It is fair to say that **SOEC** electrolyzers are emerging more quickly, and more developed, than **AEM**.

SOLID OXIDE ELECTROLYSER CELLS (SOECS)

SOECs operate at high temperatures and with high electrical efficiencies of 79-84% (LHV), and require a heat source to produce steam. Therefore if **SOEC** hydrogen were used to produce synthetic hydrocarbons (power to liquid and power to gas) it would be possible to recover waste heat from the synthesis processes to produce steam for further **SOEC** electrolysis. Nuclear power, solar thermal and geothermal heat systems, as well as industrial waste heat, could provide heat sources for **SOECs**.

SOEC electrolyzers can be operated in reverse mode as fuel cells, to convert hydrogen back into electrical energy (again, distinct from **AE** and **PEM**.) Combined with hydrogen energy storage systems (**HESS**), **SOECs** can provide balancing services to grids, increasing the overall use of the **SOEC**. **SOEC** can be used for co-electrolysis of steam and **CO**₂ so as to create a synthetic gas mix comprising **CO** and **H**₂ for conversion into synthetic fuel.

- **A reminder of countries with Hydrogen Plans, Roadmaps and Strategies:**



- **S&P Global Platts – Atlas of Energy Transition:** On **February 22, 2022**, S&P Global Platts published its [Hydrogen Price Wall](#), mapping hydrogen prices across means of production and regions of use. The [Hydrogen Price Wall](#) is to be found in the updated [Atlas of Energy Transition](#).

While Low Carbon Pulse does not report on the cost or price of hydrogen, the S&P Global Platts [Hydrogen Price Wall](#) (as part of the [Atlas of Energy Transition](#)) provides a helpful point of reference.

Click [here](#) and [here](#) for the sibling publications of Low Carbon Pulse, the **Shift to Hydrogen (S2H2): Elemental Change** series and [here](#) for the first feature in the **Hydrogen for Industry (H24I)** features.

- **A reminder:** On **March 26, 2022**, the author of Low Carbon Pulse came across the following simple reminder of the nomenclature of carbon neutrality and net zero:

Low Carbon Pulse - Edition 42

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 42** of **Low Carbon Pulse** – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Friday July 1, 2022** to **Sunday July 10, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering the period from October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering the period from October 7, 2021 to March 31, 2022), and [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39, 40** and **41** covering **April, May** and **June, 2022**).

Welcome to the weekly news-cycle Low Carbon Pulse:

As foreshadowed in recent editions of Low Carbon Pulse, during July 2022 we are trialling a weekly news-cycle for Low Carbon Pulse. As regular readers of Low Carbon Pulse will know, for the last three months (April, May and June 2022) we have trialled a monthly news-cycle, having previously applied a two week news-cycle. Both the monthly and two weekly news-cycles resulted in long publications, not ideal for those seeking a "quick-read". It is hoped that the weekly news-cycle will provide the right balance / length (between 8,000 and 10,000 words, and 12 to 15 pages in length).

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced. Our condolences to the family and friends, and the people of Japan, for the cruel and untimely loss of Mr Shinzo Abe.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

- **Taxonomy Delegated Act to go live on January 1, 2023:** On the basis that neither the European Council nor the European Parliament objected to the [Taxonomy Complementary Climate Delegated Act](#) by July 11, 2022, the **Taxonomy Delegated Act** will enter into force on January 1, 2023. The [Taxonomy Complementary Climate Delegated Act](#) provides the [EU Taxonomy](#) for what constitute **sustainable** activities. The action plan for financing sustainable growth noted the need for a clear definition of **sustainable** in the context of prescribed activities, being activities eligible for funding support under the **Green Deal**. Attached is the link to the first [Taxonomy Climate Delegated Act](#) that was published on December 2021 and has been applicable since January 2022.

One of the matters debated from late 2021 to July 11, 2022 was the inclusion of **natural gas** and **nuclear energy** as sustainable, and the funding that accompanies green energy transition. The [EU Taxonomy](#) includes **natural gas** and **nuclear** activities as eligible for funding support in certain circumstances.

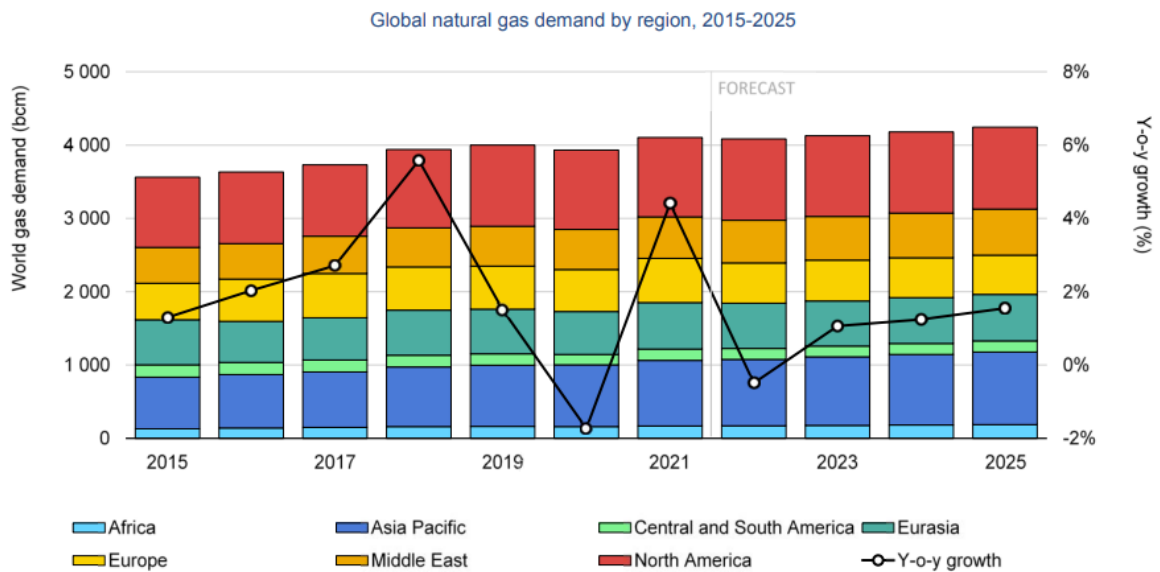
By way of background: The **EU Taxonomy** is a classification system, establishing a list of environmentally sustainable activities, providing corporations, financiers and policy makers with clear definitions as to activities that are environmentally sustainable. The [Taxonomy Regulation](#) entered into force on **July 12, 2020**, establishing that basis for the **EU Taxonomy**, and in this context stating four overarching conditions that an activity has to achieve to be treated as environmentally sustainable. Under the [Taxonomy Regulation](#) the **European Commission (EC)** was responsible for the development of the **EU Taxonomy**.

- **Nature Based Solutions:** During the first week of July, the author of Low Carbon Pulse read the **European Commission** publication [The Vital Role of Nature-Based Solutions In a Nature Positive World](#), which was released by the **Directorate-General for Research and Innovation**. The publication is an excellent primer for **Nature-Based Solutions (NBS)** and **Nature-Based Enterprises (NBE)**. It is hoped the resources and time are devoted to the development of the thinking in the publication in the near term.
- **International Energy Agency (IEA) publications:**
 - On **July 5, 2022**, the **IEA** published its [Gas Market Report Q3-2022](#). The publication is excellent, providing a good sense of the multi-faceted dimensions of current global gas markets. The headline is that natural gas demand is expected to decline in 2022, and to remain subdued through 2025. The pursuit of LNG by Europe is likely to result in prolonged tighter markets. Faster development and implementation of clean energy transition policy settings in mature gas markets would ease price pressure, and help emerging market access to natural gas suppliers that will allow them to achieve near to medium term improvements in carbon intensity and air quality.

Gas Market Report Q3 2022

Gas 2022

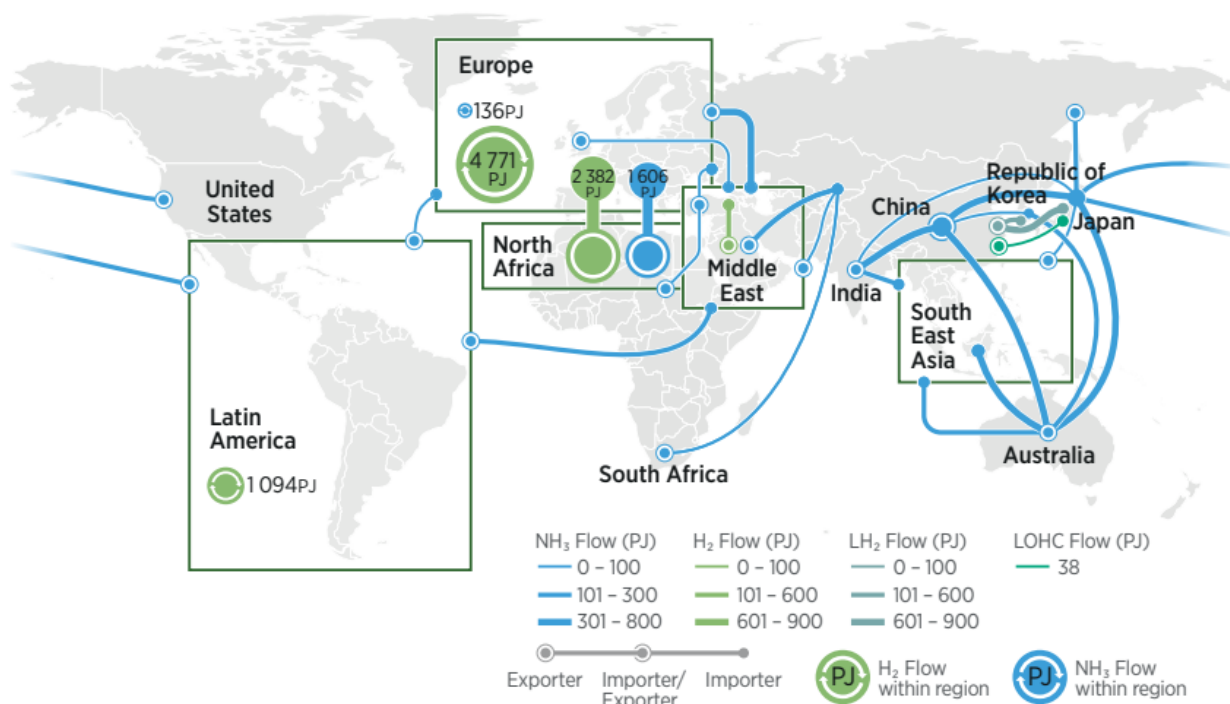
Global gas demand growth dips in 2022 after a strong 2021, with a modest increase expected in the following years



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- On **July 6, 2022**, the **IEA** published its [Solar PV Global Supply Chains \(An IEA Special Report\)](#). The publication is excellent, providing an **A-to-Z** guide to the photovoltaic solar supply industry, and policy setting recommendations. The key forward looking findings from the publication include:
 1. the need to diversify photovoltaic solar supply chains to ensure that the energy transition progress at the rate required to progress to **NZE**; and
 2. Government policy settings are critical to ensuring that diversified and secure photovoltaic solar supply chains are realised.
As usual with the **IEA**, recommendations are made:
 - (a) diversify raw material supplies, and manufacturing capacity;
 - (b) de-risk investment, in particular in the development of manufacturing capacity;
 - (c) ensure environmental and social sustainability;
 - (d) continue to foster innovation; and
 - (e) develop and strengthen recycling capabilities.
All of these recommendations are sound and of broad application to most, if not all, countries.
- **International Renewable Energy Agency (IRENA) publications:**
 - On **July 8, 2022**, **IRENA** published [Global Hydrogen Trade to Meet the 1.5°C Climate Goal – Part I – Trade Outlook for 2050 and Way forward](#). (**Edition 40** of Low Carbon Pulse included links and a brief analysis of **Parts I** and **II**: links to those publications are included for ease of reference.) The following infographic includes a summary of the suggested trade activity by 2050. The publication is excellent.

FIGURE 0.1. Global hydrogen trade flows under *Optimistic* technology assumptions in 2050



Source: [IRENA](#)

One of the key findings from the publication is that international trade in hydrogen and ammonia will amount for about 25% of the total mass of hydrogen and ammonia produced.

"To make trade cost-effective, the cost of producing green hydrogen must be sufficiently less expensive in the exporting region than in the importing region to compensate for the transport cost. This cost differential will become larger as the scale of projects increases and technology develops to reduce transport costs".

The report goes on to make the more telling point:

"As the operating cost of renewables are very low, having a low weighted average cost of capital (WACC) is critical to the cost-effectiveness of trade. Absolute levels of country differences in WACC both significantly affect the trade outlook and determine whether a country becomes an exporter or an importer. If WACC remains roughly as it is today, countries that have good-quality resources [i.e., renewable energy resources] and low WACC would become the largest green hydrogen exporters and would be responsible collectively for almost 40% of the global trade".

- On **July 8, 2022**, [IRENA](#) published [China's route to carbon neutrality: Perspectives and the role of renewables](#). The publication takes as its starting point the announcement by **President Xi Jinping** (in September 2020 (see [Edition 1](#) of Low Carbon Pulse)) at the 75th Session of the United Nations General Assembly that the **PRC** would aim to achieve peak **GHG** emissions before 2030.

The publication notes that for the **PRC** to peak before 2030 (and achieve its **NZE** goal by 2060), it will have to **maximise** the development and deployment of **renewable-based power** generation. This maximisation needs to be **combined** with direct and indirect **electrification** of **end-use sectors** (critically, the building, industrial and transport sectors), supplemented by the **sustainable use of bioenergy, hydrogen and synthetic fuels**. This is a common theme, not specific to the **PRC**. Under the **PRC and Russia** section (at [page 5](#) below) the 13 recommendations of the publication are outlined.

Climate change reported and explained:

CO₂ levels: Recent editions of Low Carbon Pulse have reported on the elevated levels of **CO₂** in the atmosphere, in particular it was reported that:

"On **May 14, 2022** it was reported widely that a new daily record of **421.37 ppm** had been recorded by the **Scripps Institution of Oceanography** at the **University of California, San Diego**, with similar record levels confirmed by the US **National Oceanic & Atmospheric Administration (NOAA)** of **421 ppm**".

As reported in **Forbes**, in May 2022 the **CO₂** measured at **NOAA's** Mauna Loa Atmospheric Baseline Observatory (Hawaii) peaked at **420.99 ppm**, consistent with the **420 ppm** reported in [Edition 40](#).

During **June 2022**, the levels of **CO₂** in the atmosphere were at a slightly lower level than the peak of May. As explained in [Edition 40](#) of Low Carbon Pulse, **CO₂** levels tend to peak during April and May each year as a result of increased decomposition of vegetation.

The underlying trend however remains upwards, and increasingly so.

Middle East including GCC Countries:

- **UAE approves circular economy policies:** On **July 3, 2022**, thenationalnews.com reported that the **UAE** had approved 22 policies intended to accelerate the transition of the **UAE** to a circular economy. The 22 policies focus on the food, infrastructure, manufacturing and transport sectors.
- **73 GW of renewable projects planned across MENA:** On **July 3, 2022**, renewablesnow.com reported on the current planned development of renewable electrical energy projects across **MENA**.

Capacity in MW	Wind operating capacity	Wind prospective capacity	Solar operating capacity	Solar prospective capacity
Oman	50	0	130	15,300
Morocco	1,165	963	702	13,430
Algeria	10	5,030	434	4,982
Kuwait	10	132	20	9,500
Iraq	0	0	0	5,755
Saudi Arabia	400	500	376	4,590
UAE	0	30	2,600	3,970
Egypt	1,641	2,350	1,882	904

Source: renewablesnow.com

- **DEWA increases photovoltaic capacity:** On **July 5, 2022**, it was reported widely that the **Dubai Electricity and Water Authority (DEWA)** had installed **100 MW** of **additional photovoltaic solar** capacity at the **5 GW Mohammed bin Rasid Al Maktoum Solar Park** as part of the fifth phase of the development of the project. The project comprises both photovoltaic solar and concentrated solar power.

Africa:

- **Gabon to create 187 million carbon credits:** On **July 1, 2022**, bloomberg.com reported that **Gabon** (the second-most forested nation after Suriname) intends to create **187 million carbon credits**, almost half of which may be sold in voluntary carbon markets. As reported, the creation of **187 million carbon credits** (representing **187 million metric tonnes** of **CO₂-e** emissions) would be the largest single creation of carbon credits to date. It is understood that the Government of Gabon is working with United Nations Framework Convention on Climate Change's **REDD+** mechanism to create the carbon credits.
- **Djibouti a thing of beauty for FFI:** On **July 5, 2022**, **Fortescue Future Industries (FFI)** announced that it had signed a **Framework Agreement** with the **Government of the Republic of Djibouti** to undertake studies to assess the prospects for the development of Green Hydrogen production capacity. As noted by **FFI**, **Djibouti** has excellent geothermal, photovoltaic solar and wind renewable resources, and good access to ports to allow the development of Green Hydrogen production facilities (and associated renewable electrical energy generation facilities), and to export the Green Hydrogen produced.

India and Indonesia:

- **Tata Power and Government of Tamil Nadu do well:** On **July 4, 2022**, pv-magazine-india reported that **Tata Power** (leading Indian integrated power corporation) and the Government of the **state of Tamil Nadu** had signed a memorandum of understanding to invest **USD 380 million** to develop a **4 GW photovoltaic giga-factory**. The giga-factory will integrate mono-**PERC** (passivated emitter and rear contact) bifacial technology with future n-type technology of **TOPCON** (tunnel oxide passivated contacts), and will produce high-wattage modules.
- **Websol to produce PERCs and TOPCONs:** On **July 4, 2022**, it was reported widely that **Websol Energy Systems Limited** (leading manufacturer of photovoltaic cells and modules) had announced plans to develop a **1.8 GW** giga-factory manufacturing **PERCs** and **TOPCONs**.
- **First grid-scale storage tenders:** On **July 4, 2022**, pv-magazine-india reported that **NTPC Limited** (state-run power producer, and India's largest energy corporation) and **Solar Energy Corporation of India Limited** or **SECI** (state-owned renewable energy corporation) are to procure **500 MW / 3,000 MWh** and **500 MW / 1,000 MWh** of **BESS** respectively, which on procurement and installation will be added to the 1 GW / 4 GWh of current **BESS**.

This may be regarded as a great start of the development and deployment of **BESS** across India with the Central Electricity Authority of India predicting that India will have to develop and to deploy 27 GW / 108 GWh of grid-scale **BESS** and around 10.1 GW of pumped hydro-electric pumped storage (**PHES**) within the current decade to meet its non-fossil fuel goals for 2030.

- **Ministry of Steel seeks time-bound action plans:** On **July 4, 2022**, [The Economic Times](#) reported (under **Govt directs steel industry to draw time-bound action plan to lower CO2 emissions**) that the Government of India Ministry of Steel had asked stakeholders to develop time-bound action plans to reduce **GHG** emissions arising from the iron and steel industry.

The Economic Times notes that the iron and steel industry in India is responsible for 12% of the total **GHG** emissions arising across India, and the Minister of Steel, Ram Chandra Prasad Singh is seeking commitments from the iron and steel industry consistent with the nationally determined contribution of India under the **Paris Agreement**.

As might be expected, the use of green hydrogen and the use of CCS and CCUS technologies are being considered and discussed as the means to reduce **GHG** emissions arising from the iron and steel industry.

- **ACME Group announces Green Hydrogen production facility:** On **July 5, 2022**, **ACME Group** [announced](#) plans to develop further **Green Hydrogen** and **Green Ammonia** production capacity in India with the development of a **USD 6.6 billion Green Hydrogen** and **Green Ammonia** production facility in the state of **Tamil Nadu**. (This follows the announcement in June to develop **USD 6.7 billion** production facilities in the state of **Karnataka**.)
ACME Group has stated that it has signed an agreement with the Government of the state of **Tamil Nadu** for these purposes. As announced, the Green Hydrogen and Green Ammonia production facility will comprise **1.5 GW of electrolyser capacity**, and will be able to produce up to **1.1 million metric tonnes** of Green Ammonia a year.
- **NTPC Renewable Energy Ltd (NTPCREL) and Gujarat Alkalies and Chemicals Limited (GACL) team:** On **July 6, 2022**, it was reported that **NTPCREL** and **GACL** had signed a memorandum of understanding providing a basis for them to work together on Green Hydrogen and Green Ammonia and Methanol and renewable energy projects, including development of a production facility for captive / own-use by **GACL** at its Dahej and Vadorara complexes.
- **India Hydrogen Alliance- June 2022:** Attached is the link to the June edition of the [India H2 Monitor – June 2022](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link to, rather than to repeat the content of, the **India H2 Monitor**.

Japan and Republic of Korea (ROK):

- **Hanwha out and about:** On **July 1, 2022**, **Hanwha** [announced](#) the establishment of **Q Energy**. Based in Berlin, Germany, **Q Energy** business comprises photovoltaic solar and wind farm and field development, with **Q Energy** to play a role along the entire supply / value chain as a technology provider, a developer, and as an EPC and O&M contractor. As announced, **Q Energy** intends to participate beyond its well-recognised strength in photovoltaic solar, including on off-shore wind field developments and hydrogen production.
- **K-Hydrogen Council establishes fund for the hydrogen industry:** On **July 8, 2022**, [hydrogen-central.com](#) reported that at the **Korea H2 Business Summit**, the **K-Hydrogen Council** established a fund to promote the hydrogen industry. The fund was established with **₩ 500 billion** (USD 380 million).
As reported, the hydrogen fund "will establish domestic and overseas hydrogen production, distribution and storage infrastructure and make investments to develop core hydrogen technology".
By way of reminder: **Edition 19** reported that: "On June 10, 2021, Hyundai, Hyosung, and POSCO announced the launch of an industry wide body - the Korean Hydrogen Council. The Council will be launched officially in September 2021 as the K-Hydrogen Council. The Chair of Hyundai Motor Group, Mr Chung Euisun, stated that the goal of the K-Hydrogen Council is "to foster the widespread use of clean energy across industries and advance a hydrogen-based society".

PRC and Russia:

- **PRC and IRENA - [China's route to carbon neutrality: Perspectives and the role of renewables](#):** As noted above, on **July 8, 2022**, as part of the strategic partnership between **IRENA** and the **PRC**, **IRENA** published [China's route to carbon neutrality: Perspectives and the role of renewables](#).

The publication contains a **13-Point Plan** for the **PRC** (being 13 recommendations for the PRC to consider and to explore), as the largest producer and consumer of energy, to reach **peak emissions by 2030**, and **NZE by 2060**.

The **13-Point Plan** makes the following recommendations:

1. Developing and implementing an integrated long-term energy plan; **2.** Maintaining energy efficiency improvements as a priority; **3.** Accelerating the phase-down of coal consumption; **4.** Accelerating the transition toward renewable power; **5.** Reforming power networks; **6.** Increasing the electrification of the end-use sector; **7.** Expanding the direct use of renewables, particularly biomass for energy purposes; **8.** Scaling up the production and use of hydrogen and synthetic fuels; **9.** Supporting cities as champions of low carbon living; **10.** Continuing progress in light-duty transport and broadening to heavy-duty and long-haul modes; **11.** Laying the groundwork for industrial sectors to achieve net-zero emissions; **12.** Continuing to support technology RD&D and broader systemic innovation; and **13.** Deepening global engagement.

These recommendations (and sub-recommendations) are to be found on **pages 7 to 16** of the publication, and, along with the rest of the publication, are well-worth a read.

We have included for completeness an earlier **IRENA** report on the **PRC: [Net-Zero Pathways for Cities: The Case Study of Wuzhong District, Suzhou, China](#)**.

- **BEVS in PRC:** On **July 5, 2022**, **S&P Global Commodity Insights** published an info-graphic detailing the dynamics of the development of the battery electric vehicle market in the **PRC**.

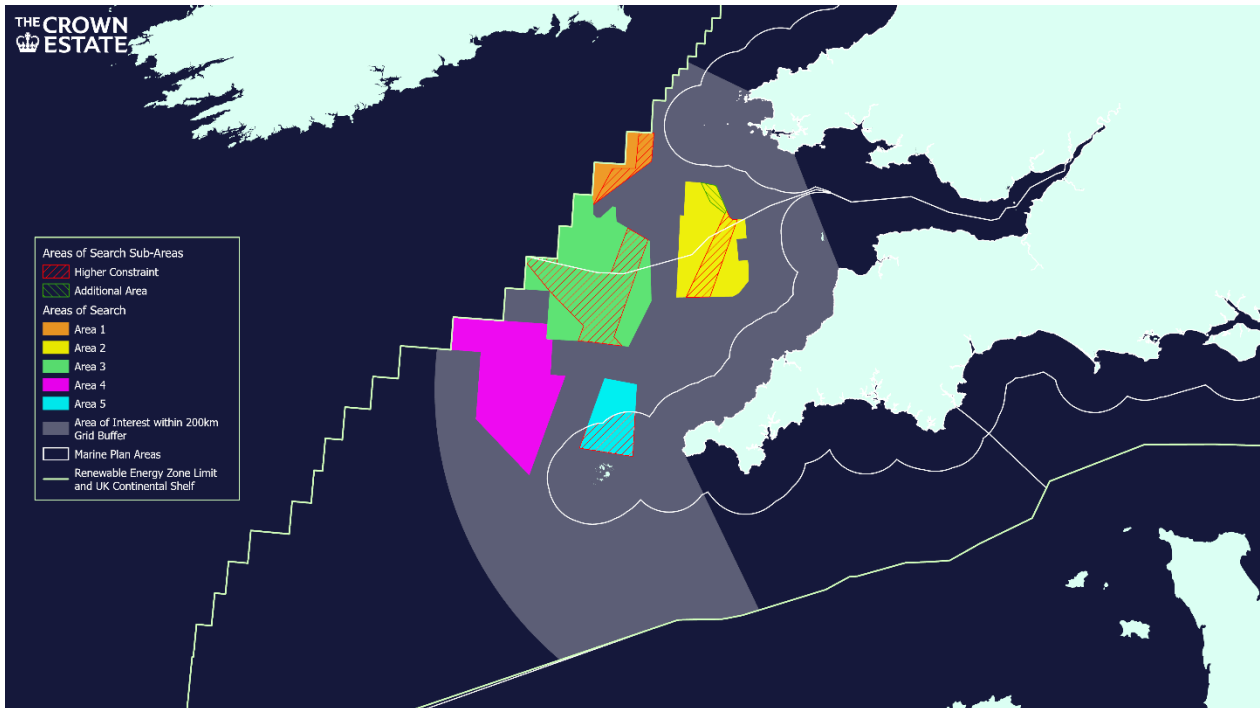
We have included a [link](#) to the info-graphic. In passing, it is noted that the info-graphic tends to indicate that the **PRC** is ahead of the recommendations outlined above.

Europe and UK:

- **The Crown Estate announces Celtic Sea Floating Off-shore Wind areas:** On July 5, 2022, The Crown Estate [announced](#) that it had identified five **Areas of Search**, being "areas of potential opportunity that have been highlighted".

The next step in **The Crown Estate** process is to undertake further stakeholder engagement and technical analysis, and Plan-level Habitats Regulations Assessment (**HRA**) will start, bringing forward the **HRA** process before auction in 2023: this will narrow down the Areas of Search into more defined Project Development Areas.

The Crown Estate notes that bringing forward the **HRA** process will accelerate development timelines and reduce risk for developers. It is expected that up to **4 GW** of Project Development Areas will be auctioned in the Celtic Sea.



- **GRR models and awards:** On July 5, 2022, the UK **Department for Business, Energy & Industrial Strategy** announced the commencement of an open consultation process in respect of its business model for greenhouse gas removal (GRR) technologies: [Business models for engineered greenhouse gas removals: accelerating investment in engineered carbon removals](#). The consultation period closes at 11.45 pm on September 27, 2022. On July 8, 2022, the UK **Department for Business, Energy & Industrial Strategy** announced the [Projects selected for Phase 2 of the Direct air capture and greenhouse gas removal programme](#), with 15 projects awarded funding: each project and its funding is outlined in the attached link.
- **Energy Security Bill introduced:** On July 6, 2022, the UK **Energy Security Bill** was introduced into the UK Parliament by the **Business and Energy Secretary, Mr Kwasi Kwarteng**. On enactment, the **Energy Security Bill** will effect the "biggest reform of [the UK] energy system in a decade". The **Department for Business, Energy & Industrial Strategy** published background to the **Energy Security Bill** under [Plans to bolster UK energy security set to become law](#), contains key points in the following publication: [Energy Security Bill – Building a clean, affordable, home-grown energy system](#).
- **Contracts for differences awarded:** On July 7, 2022, the UK **Department for Business, Energy & Industrial Strategy** announced the results of its renewables auction scheme for contracts for differences (CfDs), with CfDs awarded in respect of **10.8 GW** of clean energy. As announced, CfDs were awarded in respect of nearly **7 GW** off-shore wind field capacity, **1.5 GW** of onshore wind capacity, and **2.2 GW** of photovoltaic solar capacity. Attached is a [link](#) to the full list of the successful applicants for CfDs.
The awards on July 7, 2022, were made under the fourth round of the CfD scheme. The CfDs awarded under the scheme provide revenue certainty to those developing and financing clean energy projects. The award of CfDs in respect of **10.8 GW** in the fourth round is only a little less than **11.26 GW** awarded across the first three rounds combined.
On July 7, 2022, **Ørsted** announced that it had been awarded a CfD for the world's single biggest off-shore wind field – its **2.85 GW Hornsea 3** off-shore wind field project. In addition to the CfD for **Hornsea 3**, CfDs were awarded as follows for off-shore wind fields: **1.396 GW Norfolk Boreas (Phase 1)**, **1.372 GW East Anglia Three**, **1,080 Inch Cape (Phase 1)** and **294 MW Moray West**.
- **FSRU arrives at Eemshaven:** Edition 40 of Low Carbon Pulse reported on the activity around Europe to procure Floating Storage and Regasification Units (FSRU) to allow the regasification of imported liquified natural gas (LNG). On July 5, 2022:
 - **Exmar** [announced](#) its floating **FSRU EEMSHAVEN LNG** is being prepared to commence operation at the **Gasunie**-operated Dutch LNG terminal in **Eemshaven**. The rate at which a number of countries across Europe have mobilised to import LNG has been marked, and it seems unlikely that this rate of progress will slow.
 - **Uniper** [announced](#) that it had commenced construction of the **LNG Receiving Terminal** at **Wilhelmshaven**, to be located at the **Voslapper Groden trans-shipment facility**. As reported in previous editions of Low Carbon

Pulse, **Uniper** is developing the **LNG Receiving Terminal** with the support of the German Federal Government. Once constructed, the **LNG Receiving Terminal** will be able to import and re-gasify LNG to supply around 8.5% of the current natural gas demand of Germany.

On **July 7, 2022**, **Shell Western LNG** was reported to have joined **ČEZ** in booking regasification capacity with **Gasunie** to allow it to import LNG at the **Eemhaven LNG hub** – the **EemsEnergy Terminal**.

An earlier progress check on FSRUs: The long form versions of **Editions 37** and **39** of Low Carbon Pulse reported on the procurement of floating storage regasification units (**FSRUs**) across Europe so as to address energy security concerns by allowing the import of liquified natural gas (**LNG**), as follows:

- **Germany chartering four FSRUs:** On **May 5, 2022**, German Federal Government Economic Minister, Mr Robert Habeck announced that the **German Federal Government** had committed to charter **four FSRUs**, a commitment of **€2.04 billion (USD 3 billion)** to allow the import of sufficient LNG to provide 20% of the demand for natural gas in Germany;
- **Gasunie chartering FSRUs:** On **May 10, 2022**, it was reported widely that **Gasunie** had agreed to charter an FSRU from **New Fortress Energy** to allow the import of LNG at the **EEM Energy Import Terminal**.
- **Gasrid chartering FSRU:** On **May 20, 2022**, marinelink.com reported that **Gasgrid Finland Oy** had entered into a 10 year charterparty with **Excelerate Energy** to allow the import of LNG for regasification to provide natural gas to the **Baltic Sea Region**, including **Finland** and **Estonia**. In addition, Estonia plans to develop an on-shore LNG receiving and re-gasification terminal at Paldiski; and
- **Lithuania Klaipeda FSRU:** **Latvenergo** has indicated that hopes to import LNG through the **Klaipeda FSRU**. In addition, Latvia has indicated an intention to develop an on-shore LNG receiving and re-gasification terminal at the Port of Skulte.

Americas:

- **Biden Administration opens applications for USD 2.3 billion grid funding:** On **July 6, 2022**, the **US Department of Energy (DOE)** opened the application period for State, Tribal nations and territories to apply for the **USD 2.3 formula grant program** intended to modernise and to strengthen the US power grid against extreme weather, wild fires, and other natural disasters ([Preventing Outages and Enhancing the Resilience of the Electric Grid Program](#)), administered through the **DOE's Building a Better Grid Initiative**.
- **Photovoltaic and wind out generate nuclear:** On **July 7, 2022**, solarpowerworldonline reported that during the first four months of 2022 electrical energy generation from renewable energy sources accounted for over 25% of the electrical energy generated across the US, and for the first time, in April 2022, renewable energy sources generated more electrical energy than nuclear generation power stations.

France and Germany:

- **Germany publishes draft off-shore wind development plan:** On **July 1, 2022**, offshorewind.biz reported that the German Federal Government Maritime and Hydrographic Agency (**BSH**) had published a draft of the offshore wind area development plan and environmental reports for the North Sea and the Baltic Sea.
As reported, area development plan covers areas with capacity for **60 GW** of installed capacity **by 2038**.
As reported in recent editions of Low Carbon Pulse, **Germany** is **committed** to the installation of at least **30 GW** of off-shore wind field capacity **by 2030**, at least **40 GW by 2035**, and at least **70 GW by 2045**.
- **German Bundestag approves green energy law reforms:** On **July 8, 2022**, renewablesnow.com reported that on **July 7, 2022**, the German Federal Parliament approved the **Easter Package** (see **Edition 39** of Low Carbon Pulse) and with **Easter Package** given effect through amendment to **Renewable Energies Act**.
The key amendments increase the target for installed photovoltaic solar from **60 GW** to **210 GW by 2030** (requiring an additional **22 GW** of photovoltaic solar to be developed and deployed annually), **115 GW** of on-shore wind **by 2030** (requiring an additional 10 GW annually), and, as noted above, for off-shore wind field installed capacity **30 GW by 2030, 40 GW by 2035**, and at least **70 GW by 2045**.

Australia:

- **ARENA shortlisted for funding support:** On **July 6, 2022**, the **Australian Renewable Energy Agency (ARENA)** announced that it had invited **12 BESS** projects to submit full applications for the purposes of the **Large Scale Battery Storage Round**. The aim of the **Large Scale Battery Storage Round** is to support grid-scale batteries to be equipped with advanced inverter technology.
The **12 BESS** projects invited by **ARENA** to submit full applications (drawn from 54 expressions of interest reported to have been received by **ARENA**) have an aggregate storage capacity of **3.05 GW / 7 GW**.
- **Quinbrook Infrastructure plans data storage precinct:** On **July 8, 2022**, it was reported widely that **Quinbrook Infrastructure** plans to develop a **AUD 2.5 billion** data storage precinct in Brisbane, Queensland. The data storage precinct will source electrical energy to power the data storage precinct from renewable energy sources, and will develop and deploy a **2 GWh BESS**.
The project has been christened the **Supernode project**. The **Supernode project** is to be located in the vicinity of the South Pine substation at Brendale (around 30 kms from Brisbane's central business district). The South Pine substation being the central node of the Queensland Electricity Network, ideal for the data storage precinct.

Blue and Green Carbon Initiatives and Biodiversity

- **UN Ocean Conference – key takeaways:** **Edition 41** of Low Carbon Pulse reported on the **UN Ocean Conference** (under **Continued emphasis on the Burning Platform**), that ended on **July 1, 2022**, and included a link to the [communiqué / new political declaration \(Lisbon Declaration\)](#).
The **key themes** that **emerged** include: the need to address the cumulative impacts of a warming planet and the degradation of eco-systems: "We are committed to halting and reversing the decline in the health of the ocean's ecosystems and biodiversity, and to protecting and restoring its resilience and ecological integrity".

At the **UN Ocean Conference** more than 150 Member States made voluntary commitments to conserve or to protect or both, at least 30% of the global ocean within Marine Protected Areas.

- **Blue Economy Financing Guidelines:** On the side-lines of **UN Ocean Conference, UNEP F1, Asian Development Bank, (ADB), International Capital Markets Association (ICMA), International Finance Corporation (IFC)**, and **UN Global Compact** announced that they are to work together to develop a guide for bonds to finance the **sustainable blue economy**. As announced, the guide will provide clear criteria, examples and practices for blue bond lending and issuance. The guide is expected to be published in Q3 of 2022.
- **International Institute for Sustainable Development (IISD) score-card:** On **July 4, 2022**, the ever-excellent **IISD** published its **[Ocean Conference Final: Earth Negotiations Bulletin](#)**. **Pages 3 to 7** of the Bulletin outline the substance of the key debates at the **Ocean Conference**. While the balance of the Bulletin is helpful the text covering the key debates is both informative and succinct.
- **IPBES 9 held in Berlin:** From **July 3 to July 9, 2022**, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (**IPBES 9**) was held in Bonn, Germany.
On **July 8, 2022**, the **IPBES Secretariat** issued a media release. The media release includes a **[Summary for Policymakers of the thematic assessment of the sustainable use of wild species of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services](#)**. The summary for policymakers provides key messages as follows: Sustainable use of wild species is critical for people and nature, status and trends in the use of wild species, key elements and conditions for the sustainable use of wild species, and pathways and levers to promote sustainable use and enhance the sustainability of the use of wild species in a dynamic future. For those interested in biodiversity, this is an excellent publication.
On **July 11, 2022**, the **[Values of Biodiversity Assessment Report](#)** was published.

BIODIVERSITY

In the broadest sense, **biodiversity** describes the variety of the fauna and flora globally, and in any particular area. The preservation of **biodiversity** is a key policy setting. In this context, human activities and the clearing of land to undertake agricultural, forestry or other land use (**AFOLU**) is a key focus of policy settings. Desertification and deforestation are key concerns (both as a result of **AFOLU**), as is the broader impact of climate change on habitats, critically, the impact on change in temperature on land and in the ocean.

There is a balance in habitats, with eco-systems that have developed overtime, and that continue to develop. The balance of habitats and their eco-systems are impacted by **AFOLU** and climate change. There are many examples, but a consistent example (that many will recognise) is the need to preserve the habitats of bees and other pollinators, and to avoid loss of bees and other pollinators. As a policy setting, the rewilding of habitats is one element of preservation, and, in some cases, restoration of eco-systems. As a broad statement, preserving wilderness areas, and rewilding of areas, and reducing old growth forestry, and afforestation and reforestation, are key to the preservation and restoration of **biodiversity**. These are policy settings over which we have control in the near, medium and long term. In addition, overtime, policy settings may extend to addressing optimal use of land, optimal in the sense of preserving or restoring **biodiversity** while at the same time addressing climate change. As always, what is needed is known. As always, the challenge is acting upon it.

Climate change will impact the effectiveness of these policy settings (in particular coastal habitats, and areas of increased drought and desertification, driven by rising sea-levels and changes in weather patterns, as a result of climate change), but they are policy settings that are necessary and need to be progressed in the near term. In addition, acting to preserve and to restore **biodiversity** is likely to yield benefits, economic and social.

Bioenergy and heat-recovery:

- **CMA CGM and Engie plan biomethane production:** On **July 4, 2022**, it was reported widely that **CMA CGM** (French shipping corporation) and **Engie** (leading international energy corporation) plan to develop a **biomethane** production project (**Project Salamander**), with a final investment decision contemplated in Q4 of 2022. Project Salamander will derive biogas and upgrade that biogas to produce **200,000 metric tonnes of biomethane** a year, with that **biomethane** (renewable natural gas) then liquified to produce renewable liquified natural gas (aka **Bio-LNG**) to be used by **CMA CGM** on its **E-methane-ready-vessels**.
- **A Gas for Climate report:** On **July 8, 2022**, the **Gas for Climate** consortium published an update **[Biomethane production potentials in the EU](#)**. The updated publication builds on the previous publication from **Gas for Climate** to take into account the acceleration of the use of biomethane now contemplated by the **EU** – see **Editions 37** and **40** of Low Carbon Pulse.

The **key findings** of the publication are: **1.** There is enough sustainable feedstock in the **EU** to achieve the **EU REPowerEU** target of **35 bcm by 2030**, with up to **41 bcm by 2030** and **151 bcm by 2050**; **2. Anaerobic digestion** is regarded as having the potential to derive up to **38 bcm by 2030**, and up to 91 bcm by 2050. In the **EU** context, France, Germany, Italy, Poland and Spain will be the top five producers of **biogas** derived **biomethane** using anaerobic digestion technologies. The **key feedstocks** for these purposes **to 2030** being **manure** (33%), **agricultural residues** (25%) and **sequential cropping** (21%); and **3. Thermal gasification** is regarded as having the potential to derive up to **2.9 bcm by 2030**, and **60 bcm by 2050**. In the **EU** context, France, Germany, Italy, Spain and Sweden will be the top five producers of biomethane using thermal gasification. The **key feedstocks** for these purposes **to 2030** are **forestry residues** and **wood waste**, together having 60% of the feedstock source.

BIOENERGY

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "**upgrading**") so that it can be used as pipeline gas. **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel or as a feedstock. Also either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia:** being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;
- **Bio-butanol:** being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel:** being diesel (i.e. synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol:** being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene:** being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF)**, is a synthetic paraffinic kerosene. Currently most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams (typically using some natural gas). (It is a drop-in fuel.);
- **Bio-LNG:** being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and
- **Bio-methanol:** being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

BESS and HESS (and energy storage):

Stanwell Power Station Big BESS: On **July 1, 2022**, it was reported widely that **Stanwell Power Station** (owned by Stanwell Corporation, a State of Queensland, Australia Government Owned Corporation) is to develop **1.45 GW / 2.9 GWh BESS** to be co-located with the existing coal-fired power station. The **BESS** is to be developed and deployed on a staged basis, with **stage 1** comprising **150 MW / 300 MWh** lithium-ion battery deployment, and **stage 2** to comprise **1,330 GW / 2.6 GWh** the deployment of either flow battery or lithium-ion technology.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

During the news-cycle of this **Edition 42** of Low Carbon Pulse, the author did not come across any new news item sufficiently material or significant to merit inclusion.

Carbon Credits and Hydrogen Markets and Trading:

Impact of VCM on Tropical Rainforests: During the first week of **July, 2022**, an **Environmental Defense Fund** financed study was published [**Impact of the Voluntary Carbon Market on Tropical Forest Countries – Implications for Corresponding Adjustments**](#). The study estimates the capacity of the tropical rain forests to match the demand for carbon credits. The study uses three scenarios for carbon credit demand covering two periods – 2021 to 2030 and 2021 to 2050. The study is excellent and well-worth a read.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

- **Howden and Raven SR compact:** On **July 1, 2022**, [hydrogen-central.com](https://www.hydrogen-central.com) reported that **Howden** (leading compression technology corporation) had contracted with **Raven SR** to provide compression technology to **Raven SR** at its first **waste-to-hydrogen** facility, Richmond, California. (See **Editions 20, 23, 37** and **39** for previous news items on **Howden** and **Raven SR**.)
- **Hydrogen to produce lime:** On **July 1, 2022**, the [constructionindex.com](https://www.constructionindex.com) reported that a trial, led by **Tarmac** (UK building and construction materials supplier) at its sites at Tunstead, near Buxton, Derbyshire, UK, had used hydrogen successfully to displace the use of natural gas. As reported, the trial has demonstrated that it is possible to displace the use of natural gas completely by the use of hydrogen. Currently, lime is manufactured from the use of high-heat temperature kilns, heating calcium carbonate from limestone, using natural gas to create that high-heat temperature. The use of hydrogen to displace natural gas reduces the **GHGs** arising from the combustion of fuel. It is important to remember however that this is the minor part of the **GHG** equation – the production of lime gives rise to one metric tonne of **CO₂** for each metric tonne of cement derived.
- **A first waste to hydrogen facility in the UK:** On **July 1, 2022**, **EQTEC** [announced](#) that it had appointed Wood as its technology partner for the design, development and deployment of a waste-to-hydrogen facility at its Hybrid Energy Park, Southport, Merseyside.
As announced **EQTEC** and **Wood** have agree to co-develop waste-to-hydrogen facility, using refuse derived fuel as the organic feedstock for the production of hydrogen.
- **Sunfire to provide first multi-megawatt high-heat temperature electrolyser:** On **July 5, 2022**, it was reported widely that **Sunfire GmbH** had delivered the first two of 12 high-heat temperature electrolyser modules to be installed at **Neste's** facility at the **Port of Rotterdam**, as part of the **MultiPLHY project**. Once all electrolysers

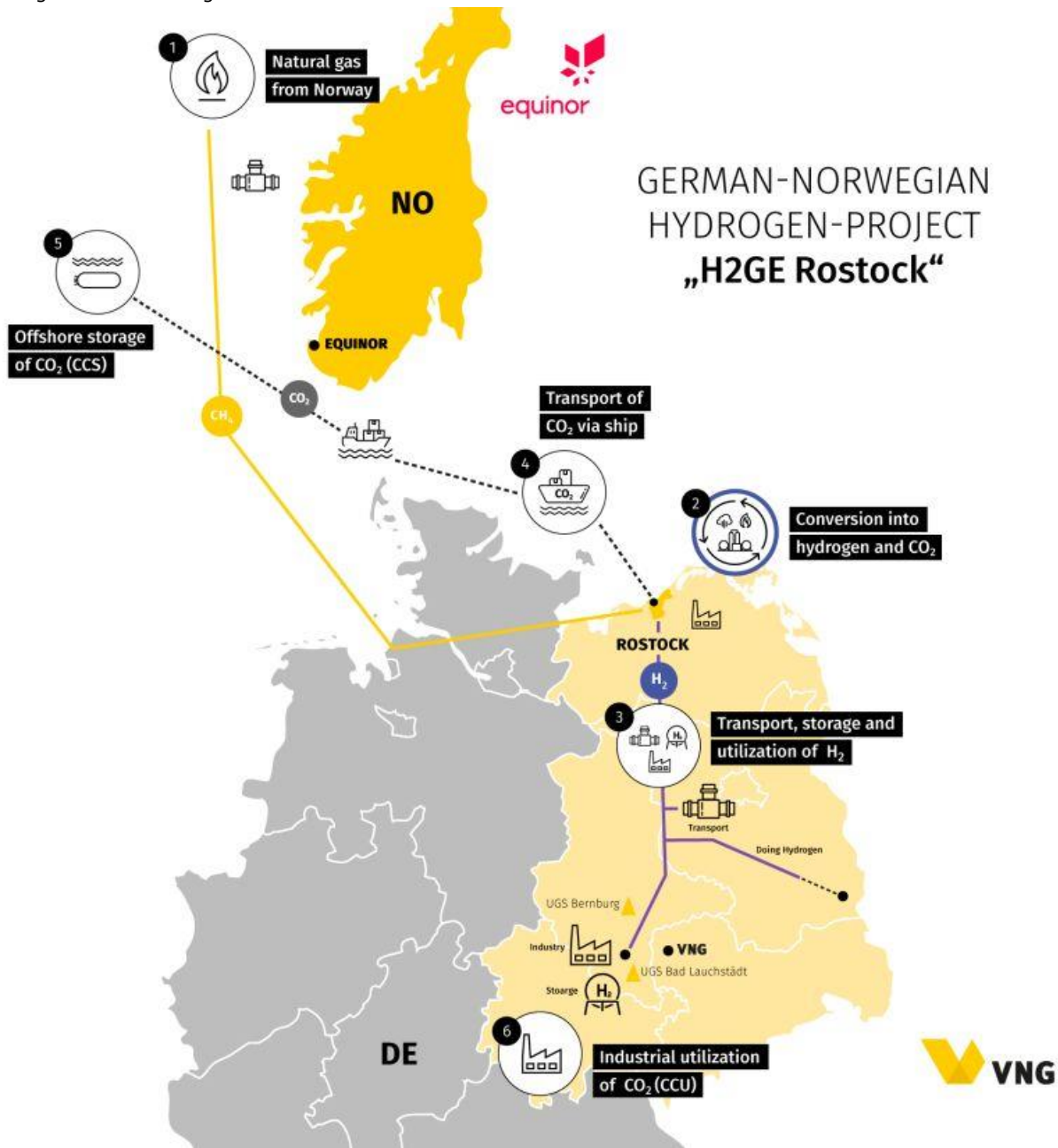
are installed they will provide **2.6 MW** high-heat temperature electrolyser capacity, using **Sunfire's solid-oxide electrolyser cell (SOEC)** which operates at temperatures of 850°C.

The announcement on **July 5, 2022**, follows the announcement on **July 4, 2022** that **Sunfire GmbH** is to receive funding support under the Important Projects of Common European Interest (**IPCEI**) initiative to allow it to scale-up its **alkaline electrolyser** and **SOEC technologies**. The German Federal Government (under Ministry for Economic Affairs and Climate Action) has granted an **early start** to the work of **Sunfire**.

- **Shell takes FID on Maasvlakte Green Hydrogen Project:** On **July 6, 2022**, Shell [announced](#) that it had taken a final investment decision (**FID**) to develop its Green Hydrogen production facility located on the **Tweede Maasvlakte**. The Green Hydrogen production facility will deploy **200 MW** of electrolyser capacity to produce **60,000 kgs (60 metric tonnes)** of Green Hydrogen a day (**Holland Hydrogen I** project), with the renewable electrical energy to power the electrolysers to be sourced from the **Hollandse Kust** off-shore wind field.

The Green Hydrogen production facility will be the largest in Europe. (See **Editions 27** and **31** of Low Carbon Pulse for previous coverage.) The **FID** in respect of **Holland Hydrogen I** project was "big news". This was reflected by the fact that Dutch Prime Minister, Mr Mark Rutte, and Shell CEO, Mr Ben van Beurden, together, announced the **Holland Hydrogen I** project (and the blanket coverage of the announcement across news-feeds and publications).

- **Equinor and VNG coherent whole:** On **July 6, 2022**, **Equinor** (leading international energy corporation) [announced](#) that it was working with **VNG** (German natural gas company) to assess options to produce low-carbon hydrogen from natural gas in Rostock on the Baltic Sea coast.



- **Air Products and VPI sign JDA:** On **July 6, 2022**, **VPI** (UK-based **power supply company**) announced that it had signed a joint development agreement with **Air Products** (one of the Big Three industrial gas producers) to allow

the development of the Humber **Hydrogen Humber Hub** (or **H3**). The **Humber Hydrogen Hub** involves the development of a 800 MW low-carbon hydrogen production facility in Immingham, Lincolnshire, England.

• **UK's first and second plastic parks approved:**

• **Edition 41** of Low Carbon Pulse reported as follows:

"On **June 9, 2022**, utilityweek.co.uk reported that West Dunbartonshire Council had approved the development of the UK's second plastics-to-hydrogen (**P-to-H2**) project. The **P-to-H2** project comprises a **13,000 metric tonne** facility that will derive sustainable hydrogen from non-recyclable plastics.

The **P-to-H2** project will use **Powerhouse Energy** technology, and will be developed by **Peel NRE**. The **P-to-H2** Is to be located at **Rothsay Dock**, on the banks of the River Clyde. The **Powerhouse Energy** technology is reported to shred non-recyclable plastic, with the shredded plastic then treated thermally, at high-heat temperatures, with the plastic converting in a gaseous state, with the gases then reformed to derive a synthetic gas comprising **CH₄** and **H₂** (and **CO**). The **CH₄** is used to generate electrical energy and the **H₂** is used as feedstock to produce fuel for the mobility sector. **Peel NRE** and **Powerhouse Energy** are reported to plan the development of **11 P-to-H2** projects in the UK. The development of the **P-to-H2** project on the banks of the River Clyde, follows the **Peel NRE Protos energy and resource hub** near Ellesmere Port, Cheshire, England".

• On **July 6, 2022**, the Councillors at Cheshire West and Chester gave unanimous approval to the **strategic energy and resource hub** located near Ellesmere Port, Cheshire, England. The **strategic energy and resource hub** will process and treat up to **367,500 metric tonnes** of plastics and mixed recyclables a year (**Plastic Park**). The approval for the **Plastic Park** includes approval for the development and deployment of a **materials recycling facility (MRF)**, **Plastics Recycling Facilities, One and Two**, a **Polymer Laminate Recycling Facility**, and a **hydrogen refuelling station**.

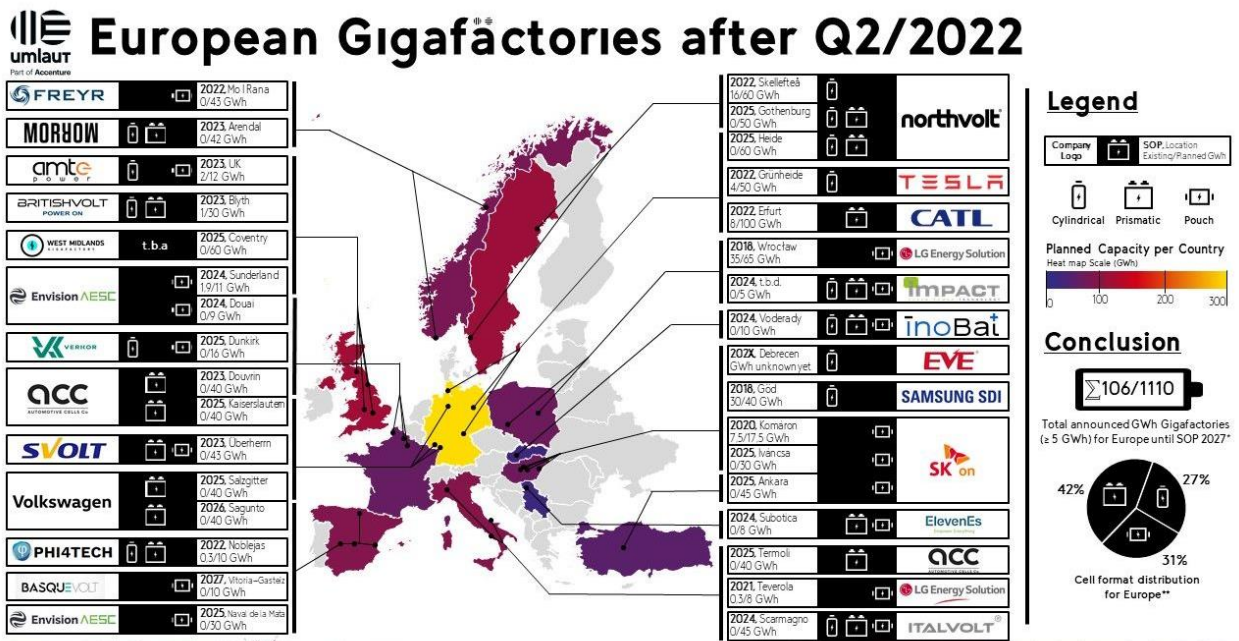
• **Tasmanian future fast-lane:** Over the weekend of **July 9 and 10, 2022**, it was reported that **HIF Global** (a Porsche "vehicle") intends to develop a **Future Fuels production facility** in the State of Tasmania, Australia.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

• **EuroAsia Interconnector selects HVDC supplier:** Previous editions of Low Carbon Pulse have covered the **1,208 km, €2.5 billion 2 GW EuroAsia Interconnector** (see **Editions 23, 32 and 34**) to connect **Greece (Crete), Cyprus and Israel**. The **EuroAsia Interconnector** is an Important Project of Common European Interest (**IPCEI**), and was provided with **€657** of funding support earlier in 2022 (see **Edition 34** of Low Carbon Pulse).

On **July 4, 2022**, **EuroAsia Interconnector Limited** announced its choice of **Nexans Norway AS** as its preferred bidder to supply the high voltage direct current cables for the project.

• **Umlaut giga-factory map:** On **July 5, 2022**, **umlaut company** published its giga-factory map for Europe capturing the Europe giga-factories at the end of Q2 2022.



The map is a great addition to the coverage of the ever-quicken development and deployment of giga-factories.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

• **Gravithy gets off the ground:** On **July 1, 2022**, it was reported widely that **Gravithy consortium** had announced plans to develop a **€2.2 billion 2 million metric tonnes** a year **direct reduced iron (DRI)** plant.

The **Gravithy consortium** comprising leading corporations, **EIT InnoEnergy, Engie New Ventures, Forvia, Groupe IDEC** and **Plug**, plans to develop the **DRI** plant at **Fos sur Mer, France**. It is contemplated that the **DRI** produced will be used on-site as feedstock to produce Green Steel or it will be traded as **hot-briquetted iron (HBI)**.

• **EC Technical Report on iron and steel:** In the first week of July, the author of Low Carbon Pulse read the **European Commission Joint Research Centre (JRC) JRC Technical Report – Technologies to Decarbonise the EU Steel Industry**. The technical report is excellent, outlining the challenges with the decarbonisation of the iron and steel

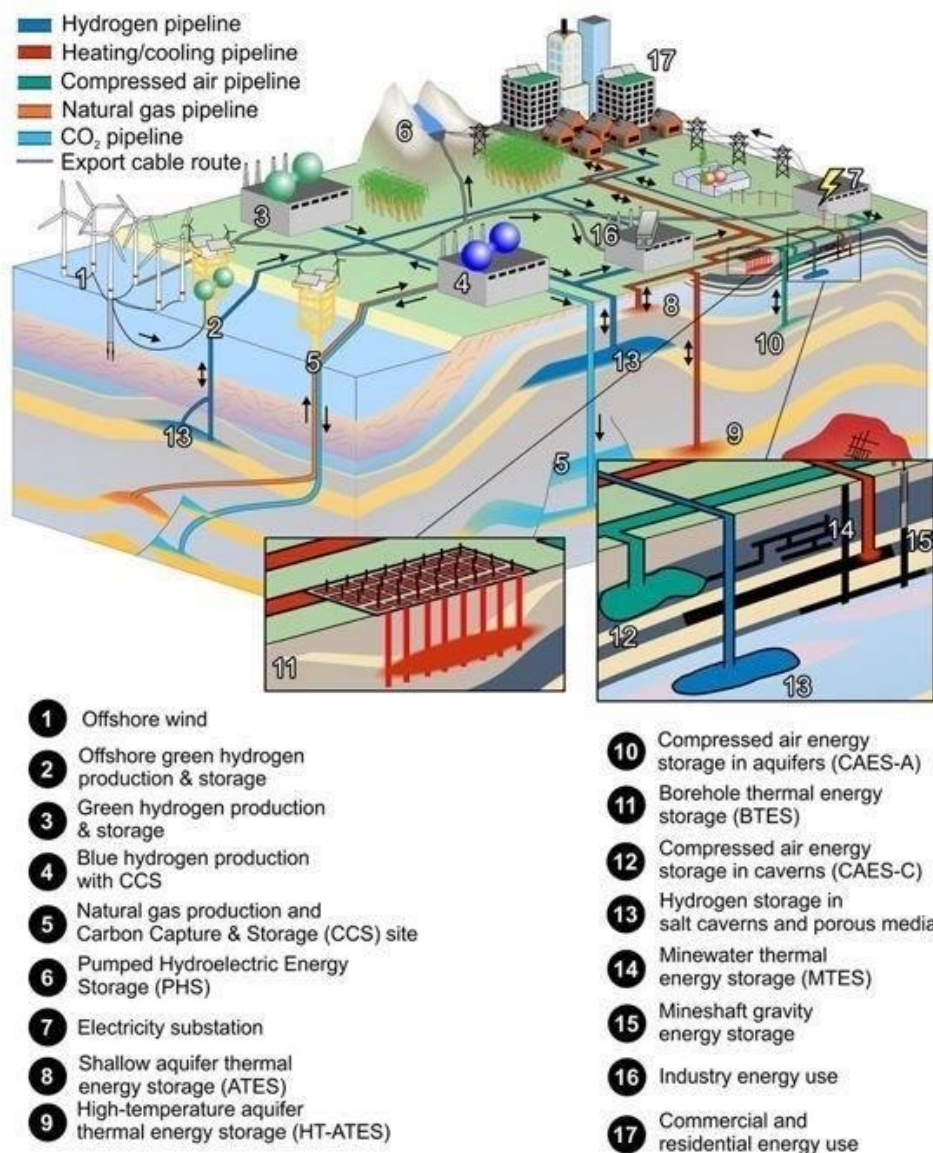
industry, the current size and scale of the iron and steel industry, the means of achieving decarbonisation (including hydrogen to produce direct reduced iron, CCS and CCUS, and iron ore electrolysis) and the cost of achieving decarbonisation, all placed in the context of current levels of **GHG** emissions and commitments to reduce them.

The **JRC Technical Report** follows the publication of [The Sustainable STEEL Principles](#) (in late June, 2022), which comprises "a set of bank-led commitments to adopt a common measurement and disclosure framework to support the steel industry in forging a pathway to net-zero carbon emissions". There are five **STEEL Principles** reflecting: 1. **S**tandardised assessment; 2. **T**ransparent reporting; 3. **E**nactment; 4. **E**ngagement; and 5. **L**eadership. The **STEEL Principles** were developed within **RMI** (Independent non-profit clean energy development consultant) and five working group banks, led by **Citi, ING, Societe Generale, Standard Chartered** and **UniCredit**.

It is estimated that greening the iron and steel industry in the **EU** will require **25.4 GWh** of renewable energy to produce sufficient Green Hydrogen. Stated another way, this is more than half of the increase in wind power capacity contemplated by the **EU REPowerEU** initiatives. As noted in a number of news items, the **EU** iron and steel sector is lobbying for **31 GW** of renewable electrical energy capacity to be developed and deployed by 2030.

Wind round-up, on-shore and off-shore:

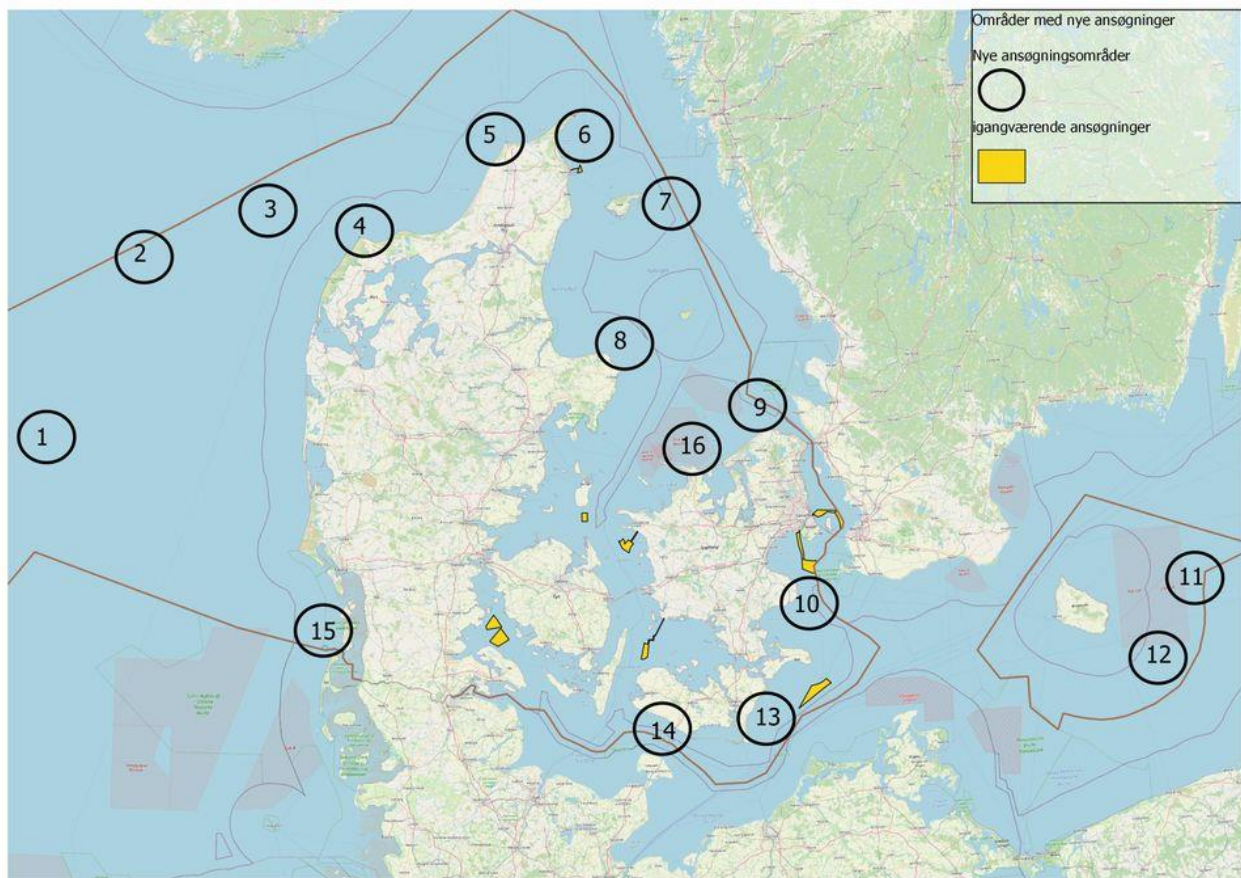
- **Australis and wpd AG JV:** On **July 1, 2022**, ([wpd announcement](#)) it was reported widely that **Australis Energy Limited** (see [Edition 14](#) and [28](#) of Low Carbon Pulse) had entered into a **50:50 joint venture** with **wpd AG** (leading on and off-shore wind development corporation) for the purpose of the development and deployment of up to **1.4 GW** of offshore wind field capacity off the coasts of the States of South Australia, Victoria, and Western Australia.
- **Excellent info-graphic for OWF:** On **July 3, 2022**, the author of Low Carbon Pulse came across the following infographic posted by Charley Rattan on LinkedIn. The graphic is excellent, providing a clear sense of the ecosystem necessary to off-shore wind field development.



Source: Geoscience Solutions for Sustainable Offshore Wind Development

- **Corio and JERA align:** On **July 4, 2022**, it was reported widely that **Corio Generation** (part of the Macquarie Group Green Investment Group) and **JERA** (leading utility corporation headquartered in Japan) had agreed to work together for the purposes of off-shore wind field auction process scheduled for Taiwan to take place in Q3 of 2022.

- **Door open:** On **July 5, 2022**, [offshorewind.biz](https://www.offshorewind.biz) reported that from **April 4, 2022** to **June 30, 2022**, the **Danish Energy Agency (DEA)** had received **43** applications to develop off-shore wind fields. Of the **43** applications received, **16** were **rejected** due to overlap with state land reservations, and of the **27** applications accepted for consideration, most of the applications are from **Andel, Copenhagen Infrastructure Partners** and **European Energy**.



Source: Danish Energy Agency

- **Island deferred:** On **July 5, 2022**, it was reported widely that the **Danish Energy Agency (DEA)** had announced its decision to defer for 12 months the commencement of the tendering process in respect of the development of the energy / power island to be developed in the Danish sector of the North Sea – the **North Sea Energy Island**. (See **Editions 5, 8, 9, 27, 32, and 39** of Low Carbon Pulse.)
- **EIB loan to Vestas:** On **July 5, 2022**, it was reported widely that the **European Investment Bank (EIB)** had agreed a **€475 million loan facility** with **Vestas** (Danish wind technology corporation). As reported the **€475 million loan** is to **fund research and development, and innovation initiatives**.
- **Rhode Island green:** On **July 7, 2022**, [offshorewind.biz](https://www.offshorewind.biz) reported that the **Governor of Rhode Island, Mr Dan McKee** had signed a bill to produce between **600 MW** and **1 GW** of off-shore wind field capacity off the coast of the **State of Rhode Island**. Under the bill **Rhode Island Energy** (electric utility corporation) is required to undertake a competitive procurement process by no later than October 15, 2022.

Solar and Sustainability (including NZE Waste):

- **Floating photovoltaic solar and hydroelectric hybrid:** On **July 1, 2022**, the good folk at the **National Renewable Energy Laboratory (NREL)** published [Enabling Floating Solar Photovoltaic Deployment](#) considering the deployment of photovoltaic solar and hydroelectric sourced renewable electrical energy in combination. At a high level, **NREL** found that hybridisation of the two renewable electrical energy sources could reduce the curtailment of photovoltaic solar. The opportunities are regarded a highly prospective for South East Asia.
- **Tetra Pak progress to enhanced recycling:** On **July 3, 2022**, [gulfnews.com](https://www.gulfnews.com) reported that **Tetra Pak** had committed to a goal of developing the most sustainable for packaging, to be made solely from recycled and renewable sources, so as to achieve carbon-neutral packaging. This commitment is outlined in [Go Nature, Go Carton](#).

Clarke Creek construction commences: On **July 7, 2022**, [pv-magazine-australia.com](https://www.pv-magazine-australia.com) reported that construction had commenced of the **Squadron Energy 1.2 GW** hybrid renewable energy precinct in **Central Queensland** (around 150 kms north-west of Rockhampton, Queensland). The **Clarke Creek renewable energy precinct** comprises a **800 MW wind**, and a **400 MW photovoltaic solar**, farm.

As reported in previous editions of Low Carbon Pulse, the electrical energy from renewable energy precinct is the subject of an agreement between **Squadron Energy** and **Stanwell Corporation** (Queensland Government state-owned generation corporation).

Land Mobility / Transport:

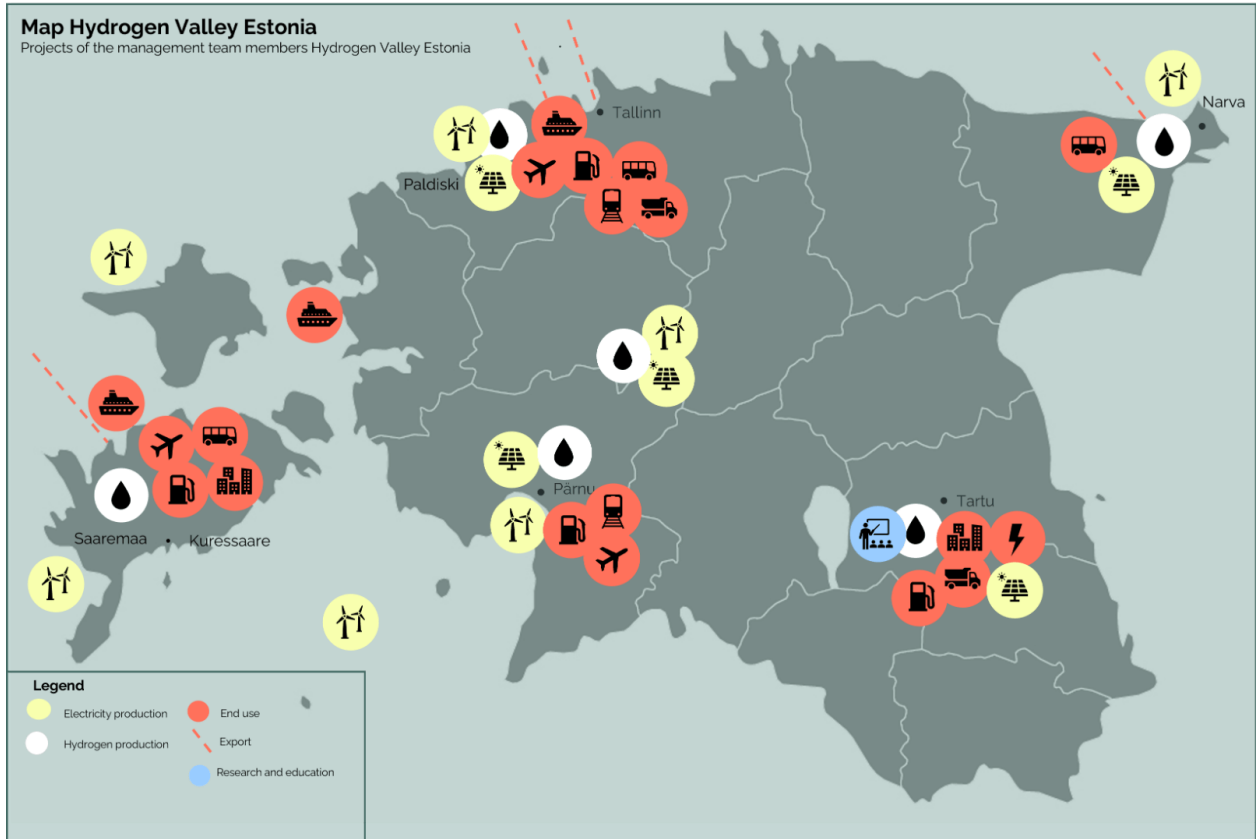
- **Buses and coaches:**

- **Qatar procures fleet in time for World Cup:** On **July 4, 2022**, it was reported widely that **741 Yutong electric buses** had been delivered to Qatar, and will operated during the World Cup to be held later in 2022.
- **Luxembourg procures midi-bus fleet:** On **July 7, 2022**, sustainable-bus.com reported that on **July 19, 2022**, **89 Karsan e-Atak eight-metre** electric buses will be mobilised in Luxembourg.
- **Cars (including taxis and air-taxis): Macquarie approved for Green Climate Fund:** On **July 4, 2022**, **Macquarie Group** [announced](#) that it had been approved to lead the development of a finance platform to drive the adoption of the electric vehicles (**EVs**) across India. The finance platform will source financing from the private sector to provide leasing and financing options to help address the upfront capital costs of **EVs**, and the impediments around the development and deployment of **EV** charging infrastructure, and to manage uncertainty around performance of **EVs**.
- **Battery, Fuel Cell and ICE Technology:**
 - **China Yuchai hydrogen engine:** On **July 6, 2022**, hydrogen-central.com reported that **China Yuchai International Limited** (leading manufacturer and distributor of internal combustion engines), through its subsidiary, Guangxi Yuchai Machinery Company Limited, had announced its hydrogen fuelled, **heavy-duty ICE, YCK16H**, being a **16-litre, 560 horsepower ICE**.
 - **ICE for heavy-duty commercial vehicles:** On **July 8, 2022**, it was reported widely that **Commercial Japan Partnership Technologies Corporation, DENSO Corporation, HINO Motors Limited, Isuzu Motors Limited** and **Toyota Motor Corporation** are to work together to assess the basis of the use of the internal combustion engine (**ICE**) fuelled by hydrogen for heavy-duty commercial vehicles.
- **Industrial Vehicles and Trucks:**
 - On **July 6, 2022**, forbes.com reported that **Tevva** (UK headquartered advanced clean vehicle manufacturer) is to launch production of its **7.5 metric tonne** hydrogen fuel-cell powered and propelled electric truck.
 - On **July 8, 2022**, [Resilient Group](https://resilientgroup.com) announced the **first-ever hydrogen truck** deployment in **Spain**. As announced the deployment was achieved by **Hydrogenizing BCN** working together with **Butransa, Hyzon Motors, Redexis** and **Transportes Portuarios**.
- **Recharging and refuelling infrastructure:**
 - **LOHC HRS:** On **July 2, 2022** it was reported widely that on **July 1, 2022**, a hydrogen refuelling station (**HRS**) had been opened on Henri-Dunant-Strasse 2 on the Siemens AG campus, in **Erlangen, [Germany]**. The **Erlangen HRS** has been developed and deployed by **H2 Mobility Deutschland** together with its shareholder **Linde**, and **Hydrogenious LOHC Technologies** and **SiemensEnergy**, and supplying electrolytically produced hydrogen and hydrogen in **LOHC** form. (See the [announcement](#) from **H2 Mobility Deutschland** for more detail.) **Hydrogenious LOHC Technologies** supplies the **Erlangen HRS** with Green Hydrogen compounded in liquid organic hydrogen carrier (**LOHC**) form – as benzyl-toluene **LOHC**. The use of **LOHC** means that hydrogen comprised in it can be handled as a liquid fuel, being a fuel with high energy density and more readily and safely stored in underground tanks. This is a significant development.
 - **Europe's most powerful EV recharging station launched:** On **July 5, 2022**, **Energy Superhub Oxford** [announced](#) that **Pivot Power** (part of **EDF Renewables**), **Fastned**, **Oxford City Council**, **Tesla Superchargers** and **Wenea** had opened the most powerful **electric vehicle (EV)** charging hub, marking the completion of the **Energy Superhub Oxford**. The **Energy Superhub Oxford** provides ultra-rapid charging for **42** vehicles at one time, with the electrical energy used to charge / recharge being 100% renewable electrical energy.
 - **BP and BOC refuelling plans:** On **July 6, 2022**, forecourtrader.co.uk reported that **BP** (leading international energy corporation) and **BOC** (leading industrial gas corporation, and part of the Linde Group) are working together to assess how they may work together to develop a network of hydrogen refuelling stations across the UK. **BP** and **BOC** are building on a feasibility study that concluded that in the near term distribution of hydrogen as compressed gas (using road / tube-trailers) was the best option in the UK market, focusing on the heavy-goods vehicle sector.
 - **Daimler Truck AG, TRATON Group and Volvo Group JV:** On **July 8, 2022**, it was reported widely that **Daimler Truck AG, TRATON Group** and **Volvo Group JV** had formalised their joint venture to develop and to deploy electric vehicle (**EV**) charging / recharging infrastructure across Europe (**EV JV**). As reported, the **EV JV** intends to install and to operate **1,700 high-performance EV** charging points to be located close to highways and motorways and within logistics hubs for use by the heavy-truck / vehicle sector. The investment contemplated currently is in the region of **€500 million**.
 - **Trains: Static testing of bi-mode train:** On **July 7, 2022**, fuelcellworks.com reported that **FCH2Rail** (a hydrogen powered and propelled train project) led by **Construcciones y Auxiliar de Ferrocarriles (CAF)** was to static test the electrical energy generation system of **FCH2Rail**, which sources electrical energy from hydrogen fuel-cells and from electric batteries (bi-mode). **FCH2Rail** will be a train without **GHG** emissions.

Ports Progress and Shipping Forecast:

- **Ferries and other craft:**
 - **Green City Ferries AB Beluga24 vessel:** On **July 4, 2022**, [batteryindustry](https://batteryindustry.com) reported that **Green City Ferries AB** was expanding its water-borne public transport offering in Stockholm, Sweden, with the development of the **Beluga24** ferry – stated to be the world's first fully emission-free, high-speed, carbon fibre catamaran. For these purposes, **Green City Ferries AB** has contracted with **Enchandia** (Swedish developer of heavy-duty energy solutions for maritime electrification) for the supply of fuel-cell technology.
 - **By way of a reminder: Edition 34** (under **Having a whale of a time**) reported that: "In late January 2022, **Green City Ferries** provided an overview of fast passenger ferries power and propelled by hydrogen, outlining the **Beluga24** – the world's first hydrogen powered and propelled high-speed catamaran ferry. The **Beluga24** has an electric energy option for shorter journeys. Both the hydrogen fuel cell and the electric energy options are designed to carry 150 passengers and 28 bicycles. As announced the first **Beluga24** is to be used in the Stockholm archipelago, with support from the **EU** funding".

- **TECO 2030 fast route:** On **July 4, 2022**, **TECO 2030** (leading technology corporation, including fuel-cell technology) [announced](#) that it is to lead a consortium of Norwegian corporations to develop the world's first hydrogen-powered-and-propelled-high-speed vessel. The consortium comprises **BLOM Maritime** (Marine engineering and maritime service company), **TECO 2030**, and **Umoe Mandal** (leading provider of surface effect ship technology), and the planned high-speed vessel is to carry between 200 and 300 passengers at speeds of up to 25 knots.
- **Green Ports (including infrastructure): Port of Tallinn leading public private partners:** On **July 6, 2022**, it was reported widely that the Port of Tallinn was a founding partner in the Management Team, Steering Group and a Support Group for Hydrogen Valley Estonia. Other founding partners include Tallinn Airport, Alexela, Eesti Energia, Terminal, Tartu University, the Island of Saaremaa, and the Municipalities of Pärnu and Tartu. The Port of Tallinn is the mouth of the hydrogen valley. The following map outlines the Estonian hydrogen valley currently contemplated:



- **Green Shipping:**
 - **MPC Container Ships orders methanol powered box-ships:** On **July 4, 2022**, [splash247.com](https://www.splash247.com) reported that **MPC Container Ships** (Oslo based box-ship owner) had contracted for two **dual-fuel-methanol-powered-and-propelled 1,300 TEU** newbuild vessels from Taizhou Sanfu Ship Engineering.
 - **MSC and Fincantieri order hydrogen powered cruise ships:** On **July 6, 2022**, it was reported widely that **MSC Group** and **Fincantieri S.p.A** (leading shipbuilding corporation) are to construct two next generation cruise ships powered and propelled by hydrogen and liquified natural gas (**Explora V** and **VI**), with the hydrogen to power the on-broad hotel operations using a 6 MW fuel-cell, and allowing zero-emission operation in port. For these purpose **MSC Group's Explora Journeys**, and **Fincantieri** have signed a memorandum of agreement.
 - **Biofuels be used to ship DHL:** On **July 7, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **DHL Global Forwarding** (part of **Deutsche Post DHL Group**) had signed an agreement with container shipping line **Hapag-Lloyd** for **Hapag-Lloyd** to use advanced biofuels (being biofuels from waste fats, greases and oils (**FOGS**) to produce fatty acid methyl ester (**FAME**), and hydrotreated vegetable oil (**HVO**)) to ship **18,000 TEUs**.
- **Elemanta H2 barge in:** On **July 8, 2022**, [h2-mobile.fr](https://www.h2-mobile.fr) reported that the **Elemanta H2** is to be installed in the river port of Rouen, France to provide electrical energy, and hydrogen bunker service, to vessels in dock. As reported, the **Elemanta H2** is able to provide power and refuelling services to container ships, cruise ships and to tankers. The **Elemanta H2** is being developed by a group of leading corporations led by **Hydrogène de France**.



Airports and Aviation:

SAF continues to find, and to expand, market: On **July 7, 2022**, [channelnewsasia.com](https://www.channelnewsasia.com) reported that **ExxonMobil** (leading international energy corporation) had delivered its first sustainable aviation fuel cargo to **Changi Airport, Singapore** under a pilot program. Under the pilot program, **ExxonMobil** is supplying **SAF** to **Singapore Airlines** and to **Scoot**. (See **Edition 35** of Low Carbon Pulse.)

Low Carbon Pulse - Edition 43

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 43** of **Low Carbon Pulse** – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Monday July 11, 2022** to **Sunday July 17, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering the period from October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering the period from October 7, 2021 to March 31, 2022), and [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39** to **42** covering **April, May** and **June, 2022**).

Welcome to the weekly news-cycle Low Carbon Pulse:

During July 2022 we are trialling a weekly news-cycle for Low Carbon Pulse. As regular readers of Low Carbon Pulse will know, for April, May and June 2022 we trialled a monthly news-cycle, having previously used a two week news-cycle. Both the monthly and two weekly news-cycles resulted in long publications, not ideal for those seeking a "quick-read". It is hoped that the weekly news-cycle will provide the right balance / length, ideally between 8,000 and 10,000 words in length, noting, however, that this **Edition 43** is around 11,500 words given the weight of news in the news-cycle.

Bigger news stories of the week, and the gem of the week:

- On **Tuesday July 12, 2022**, the **European Union (EU)** committed **€1.8 billion** in funding support for **17 clean-tech projects** across the **EU**.

On **Friday July 15, 2022**, the **European Commission (EC)** approved **€5.4 billion** of funding support for an **EU-wide hydrogen research and innovation project** involving **15** of **27 Member States** of the **EU**. The approval from the **EC** permits **EU Member States** to provide up to **€5.4 billion** of funding support to **35 corporations** in one or more **Member State**, support that otherwise would have been proscribed as contrary to State Aid rules.

The section of this **Edition 43** of Low Carbon Pulse headed **Europe and UK** (on pages 5 and 6) outlines the basis for, and the spread of, funding support across industry sectors and countries in the **EU**. The level of funding support and the spread of industry sectors is consistent with the **EU** policy settings, and is wonderful to see.

- During the last week the author of Low Carbon Pulse caught up on a back-log of reading. A key axiom re-emerged - all activities, and all goods and services, have a carbon impact / implication. While this is axiomatic and one knows this intuitively, it is helpful to be reminded, and to reflect on it, including that all activities are interconnected.

Publication very much worth a read:

On **July 14, 2022**, the **Mission Impossible Partnership** published [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](#). Whether your day job involves aviation or not, the publication is excellent and well-worth a read (see the [Airports and Aviation](#) section below on pages 18 and 19).

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

- **Cities Climate Finance Leadership Alliance:** On **July 11, 2022**, the **Cities Climate Finance Leadership Alliance** published [Financing Net Zero Carbon Buildings – A background and scoping paper](#). The publication provides an excellent overview of the dynamics of new building construction, driven by population growth, and increased urbanisation, and increased prosperity of a growing middle-class. The publication notes that achieving net-zero across the building sector will require changes to each element of every building, including materials, thermal envelopes, passive heating and cooling design, active heating and cooling, appliances, lighting and electrical energy generation. As might be expected, the publication notes that the: "*greatest opportunities lie in reducing embodied carbon in construction materials and clearer and more efficient heating and cooling, including through passive design*".
- **International Energy Agency (IEA) publications:**
 - On **July 12, 2022**, the **IEA** published [Securing Clean Energy Technology Supply Chains](#). The publication was prepared for the **Sydney Energy Forum** that took place on **July 12 and 13, 2022**. The forum was co-hosted by the **Australian Federal Government**, the **Business Council of Australia** and the **IEA**. The publication is a pre-cursor to the 2023 edition of the **IEA** flagship publication, [Energy Technology Perspectives](#), which will provide a detailed analysis of what is needed to develop and to expand the required range of clean-energy technologies to achieve **NZE**.
 - On **July 13, 2022**, the **IEA** published its [Oil Market Report July 2022](#). While the oil and natural gas markets are not the focus of Low Carbon Pulse (sibling publications focus on those markets), this month's publication is well-worth a read, providing a good sense of the state of markets.
 - On **July 20 2022**, the **IEA** will publish its [Electricity Market Report – July 2022 Update](#), which will be covered in **Edition 44** of Low Carbon Pulse.
- **International Renewable Energy Agency (IRENA) publications:** On **July 13, 2022**, **IRENA** published [Renewable Power Costs in 2021](#) and an [Executive Summary](#). The headlines from the publication are that: "*renewables are by far the cheapest form of power today*". As a result: "*Low cost renewables provide the most compelling pathway to decarbonisation in pursuit of climate-safe 1.5°C target and the goals of the Paris Agreement*".

For the author of Low Carbon Pulse, the following table provides a telling summary of the progress over the last ten years of so.

Table ES.1 Global weighted average total installed cost, capacity factor and levelised cost of electricity trends by technology, 2010 and 2021

	Total installed costs			Capacity factor			Levelised cost of electricity		
	(2021 USD/kW)			(%)			(2021 USD/kWh)		
	2010	2021	Percent change	2010	2021	Percent change	2010	2021	Percent change
Bioenergy	2 714	2 353	-13%	72	68	-6%	0.078	0.067	-14%
Geothermal	2 714	3 991	47%	87	77	-11%	0.050	0.068	34%
Hydropower	1 315	2 135	62%	44	45	2%	0.039	0.048	24%
Solar PV	4 808	857	-82%	14	17	25%	0.417	0.048	-88%
CSP	9 422	9 091	-4%	30	80	167%	0.358	0.114	-68%
Onshore wind	2 042	1 325	-35%	27	39	44%	0.102	0.033	-68%
Offshore wind	4 876	2 858	-41%	38	39	3%	0.188	0.075	-60%

Source: [IRENA](#)

While there is little to surprise in the publication, the publication provides a valuable up-to-date assessment of the levelised cost of electricity (LCOE) from renewable energy sources.

Climate change reported and explained:

- **Extreme weather events:** Recent editions of Low Carbon Pulse have reported on the elevated levels of **CO₂** and **CH₄** in the climate system. **Edition 25** of Low Carbon Pulse reported on extreme weather events during the northern hemisphere summer of 2021.

The **International Panel on Climate Change (IPCC)** defines an extreme weather event as follows:

"An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme".

It is fair to say that North America, North Africa, India and Europe, and increasingly the **PRC**, have been experiencing **extreme weather events**, and in many instances those extreme weather events, having persisted, may be characterised as **extreme climate events**. The climate system has changed, and continues to change.

- **NOAA June Report:** On **July 14, 2022**, the US National Oceanic and Atmospheric Administration (**NOAA**) published its June Report. The headline from the June Report is that: "*June's average global temperature continued 2022's remarkably warm trend, as the both the month and the year so far ranked as the sixth warmest on record June 2022 marked that 46th consecutive June and the 450th consecutive month with temperatures above the 20th century average. The ten warmest Junes on record have all occurred since 2010*".

Selected Significant Climate Anomalies and Events: June 2022

GLOBAL AVERAGE TEMPERATURE

June 2022 average global surface temperature was the sixth highest for June since global records began in 1880.



Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <http://www.ncei.noaa.gov/access/monitoring/>

Middle East including GCC Countries:

UAE aligns with Linde: On **July 11, 2022**, it was reported widely that the **UAE Ministry of Energy and Infrastructure** and **Linde** (one of the three global industrial gas giants) had signed a memorandum of understanding (**MOU**) under which the **UAE** and **Linde** are to work together to identify and to develop projects that will contribute to the achievement of the **Energy Strategy 2050** of the **Ministry of Energy and Infrastructure**.

UAE Undersecretary for Energy and Petroleum Affairs, HE Sharif Al Olama said: "*The UAE recognises Clean Energy as the main pillar of sustainability and a priority in the country. In line with our Net-Zero ambitions and the UAE Hydrogen Leadership roadmap, the UAE seeks to accelerate the adoption of the latest innovations to face climate change and accelerate the energy transition. Partnerships with the private sector are key in helping us achieve this*".

Africa:

- **Green Hydrogen for sustainable growth and a low-carbon economy in Tunisia (h2Vert.TUN)** was launched published in late June 2022. The **h2Vert.TUN** was commissioned by the German Federal Ministry for Economic Cooperation and Development (**DMZ**). During the first couple of weeks of July, the author of Low Carbon Pulse spent time reading into **h2Vert.TUN**, and reading the publication **Study on the opportunities of Power-to-X in Tunisia** (published by **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH**). As with all **GIZ** publications, the publication is excellent, and well-worth a read, with supply and demand are assessed and dissected.
- **Egypt updates Nationally Determined Contribution:** In **June 2022**, it was reported widely that Egypt had submitted its updated **Nationally Determined Contribution (NDC)** for the purposes of the **Paris Agreement – Egypt's First Updated Nationally Determined Contribution**. Over the last week or so, the author of Low Carbon Pulse has had the opportunity to read (and to re-read) the updated **NDC** for Egypt. Beyond the headlines, the **updated NDC** provides an excellent insight into the many factors that have to be considered for the purposes of considering, and settling upon, an **NDC**. While these factors are known, they are different for each country. The **updated NDC** is well-worth a read because it covers all factors, critically, it covers what is needed, and the cost of what is needed, including the means, and the cost, of adaptation and mitigation.
- **Gabon and TotalEnergies partner:** On **July 13, 2022**, **TotalEnergies** **announced** that it was to work together with **Compagnie des Bois du Gabon** to manage **600,000** hectares of forest in **Gabon**, to develop a new balance for these forest areas, by harvesting and local processing of sustainable wood and production of carbon credits through agroforestry, low-impact logging, and reforestation, so as to preserve natural forests.

By way of reminder: Edition [42](#) of Low Carbon Pulse (under **Gabon to create 187 million carbon credits**) reported that: "**Gabon** (the second-most forested nation after Suriname) intends to create **187 million carbon credits**, almost half of which may be sold in voluntary carbon markets. As reported, the creation of **187 million carbon credits** (representing **187 million metric tonnes of CO₂-e** emissions) would be the largest single creation of carbon credits to date. It is understood that the Government of Gabon is working with United Nations Framework Convention on Climate Change's **REDD+** mechanism to create the carbon credits".

India and Indonesia:

- **DNV and PIL blending project:** On **July 14, 2022**, DNV [announced](#) that it was working with **Pipeline Infrastructure Limited (PIL)** on the integration of blending hydrogen with natural gas to be hauled across **PIL's** gas network (including transmission, interconnectors, and spur-lines).

In the context of hydrogen broadly, the **CEO and MD of PIL, Mr Akhil Mehrota**, said: "*The hydrogen industry in India is still in its infancy, and has a huge scope to supplement the growing energy needs while supporting the shift to a cleaner environment. Backed by strong governmental support for clean energy and significant renewable energy potential, India has the unique opportunity to become a major producer and exporter of hydrogen*".

- **National Geographic sets the scene:** On **July 14, 2022**, **National Geographic Magazine** published [India is reinventing its energy strategy – and the climate may depend on it](#). The article is excellent, taking the reader through the everyday activities that need to be addressed by energy strategy, i.e., energy efficiency, the abundance of solar resources, abundance and the brilliance of the human capital resources, and the innovation that arises from them, all placed in the context of the continued growth and urbanisation of the population, and the attendant economic growth and prosperity, with the middle class in India expected to number 800 million people by 2030.

As the author of Low Carbon Pulse has noted in many presentations (in response to questions about what might be the greatest challenge in progress to **NZE**), the scale and scope of energy transition in India, and what needs to be done to decarbonise India, at the same time as the continued growth and urbanisation, and prosperity, of the population, is where the focus needs to be, both within India, and with the support from countries and economic blocs more progressed in **GHG** emission reduction than India. Even if the **EU** achieves **NZE** by 2050, or sooner, **NZE** in Europe will be for nought unless India is able to reduce its **GHG** emissions and progress to **NZE**.

Top Emitters

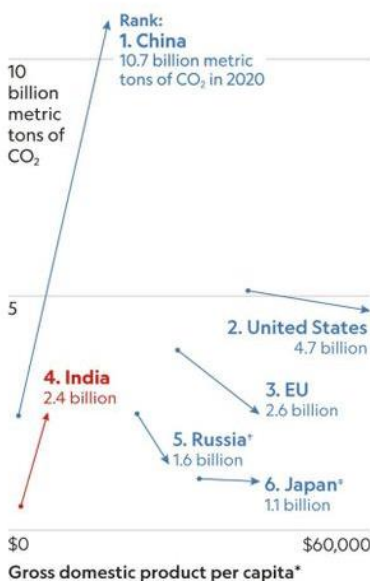
Greenhouse gas emissions have climbed as countries, many without strong carbon-curling regulations, have grown wealthier. China and India have low per capita emissions compared with such high-consuming nations as the United States. But they're home to a combined one-third of the world's population, elevating both into the list of top polluters.

Global population share, 2020



Annual carbon emissions by country, top six emitters

1990 → 2020

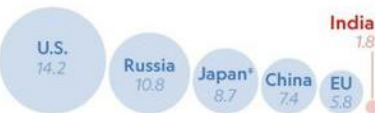


China and India rising

An urbanization boom has caused China's emissions to surge. As the populations of both developing countries moved out of poverty, fossil fuel use increased.

Annual CO₂ emissions per capita, 2020

Metric tons



*GDP data is based on purchasing power parity in constant 2017 international dollars.
*1990 data is FOR the Russian republic of the U.S.S.R.
*2019 data

Taylor Maggiamo, NGM Staff
Sources: Hannah Ritchie, Our World in Data; The World Bank

Source: [National Geographic Magazine](#)

The **National Geographic Magazine** article is well-worth a read. The scale and scope of the decarbonisation of India continues to be subject to comment. For example, on July 13, 2022, it was reported widely that if the pace of roll-out of renewable energy capacity continues at its current rate across India (recognising that the policy setting is to increase renewable energy capacity to 500 GW by 2030) this is likely to result in up to a 104 GW shortfall. This perspective is helpful, because it illustrates the need for policy settings that will ensure the achievement of the 500 GW target.

- **India Hydrogen Alliance- June 2022:** Attached is the link to the June edition of the [India H2 Monitor – June 2022](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link to, rather than to repeat the content of, the **India H2 Monitor**.

Japan and Republic of Korea (ROK):

During the news-cycle covered by this **Edition 43** of Low Carbon Pulse no news items sufficiently material or significant arose to merit inclusion. This said, a number of new-items covered in this **Edition 43** of Low Carbon Pulse cover Japanese and South Korean corporations active around the globe.

STOP PRESS: On **July 18, 2022**, asia.nikkei.com reported that leading Japanese steelmakers have unveiled a detailed timeline through fiscal 2030 for the development and deployment of investment of up to **USD 70 billion** to use **hydrogen** and **electric arc furnaces (EAF)** to decarbonise iron and steel production in Japan.

PRC and Russia:

- **Green Steel in PRC:** On **July 14, 2022**, greensteelworld.com published an article [The positive reality of Chinese green steel](#) providing a perspective on the **GHG** emissions arising from economic activity in the **PRC**, including as a result of the production of iron and steel.

The article notes that in 2021, the **PRC** produced around **1.033 billion metric tonnes** of iron and steel, representing around **53%** of total production globally, contributing around **15%** of **GHG** emissions arising from economic activity in the **PRC**. The rate of growth in iron and steel production is said to be slowing, and the percentage of iron and steel production using scrap metal is stated as likely to increase. The level of production of iron and steel production is assessed as likely to stay at about **1 billion metric tonnes** a year, with increased use of scrap metal over time such that by 2060 around 70% of iron and steel produced will be sourced from scrap metal, up from around 20% in 2021.

In addition to the dynamics outlined in the article, there is an increasing focus the need to decarbonise the iron and steel industry, recognising the importance of iron and steel to the economy of the **PRC** and the relatively short period of time available to reduce **GHG** emissions arising from the production of iron and steel. While the recycling of scrap metal is an element of this, so is the transition to electric arc furnace (**EAF**) technology, particularly for scrap metal, and the need to develop and to deploy low to no carbon technologies.

- **PRC and IRENA - China's route to carbon neutrality: Perspectives and the role of renewables:** As noted in **Edition 42** of Low Carbon Pulse, [China's route to carbon neutrality: Perspectives and the role of renewables](#) contains a **13-Point Plan** for the **PRC** (being recommendation for the **PRC** to consider and to explore), as the largest producer and consumer of energy, to reach **peak emissions by 2030**, and **NZE by 2060**.

The **13-Point Plan** makes the following recommendations:

1. Developing and implementing an integrated long-term energy plan;
2. Maintaining energy efficiency improvements as a priority;
3. Accelerating the phase-down of coal consumption;
4. Accelerating the transition toward renewable power;
5. Reforming power networks;
6. Increasing the electrification of the end-use sector;
7. Expanding the direct use of renewables, particularly biomass for energy purposes;
8. Scaling up the production and use of hydrogen and synthetic fuels;
9. Supporting cities as champions of low carbon living;
10. Continuing progress in light-duty transport and broadening to heavy-duty and long-haul modes;
11. Laying the groundwork for industrial sectors to achieve net-zero emissions;
12. Continuing to support technology RD&D and broader systemic innovation; and
13. Deepening global engagement.

These recommendations (and sub-recommendations) are to be found on **pages 7 to 16** of the publication, and, along with the rest of the publication, are well-worth a read.

Europe and UK:

- **EU Innovation Fund awards:** On **July 12, 2022**, the **European Union** [awarded](#) around **€1.8 billion** in funding support to **17** projects in the second round of large-scale funding for clean-tech projects under the **EU Innovation Fund** funding support initiative (and the third round of funding under the **EU Innovation Fund**).

The **EU Innovation Fund** is intended to promote, and to scale-up, the development of renewable hydrogen projects.

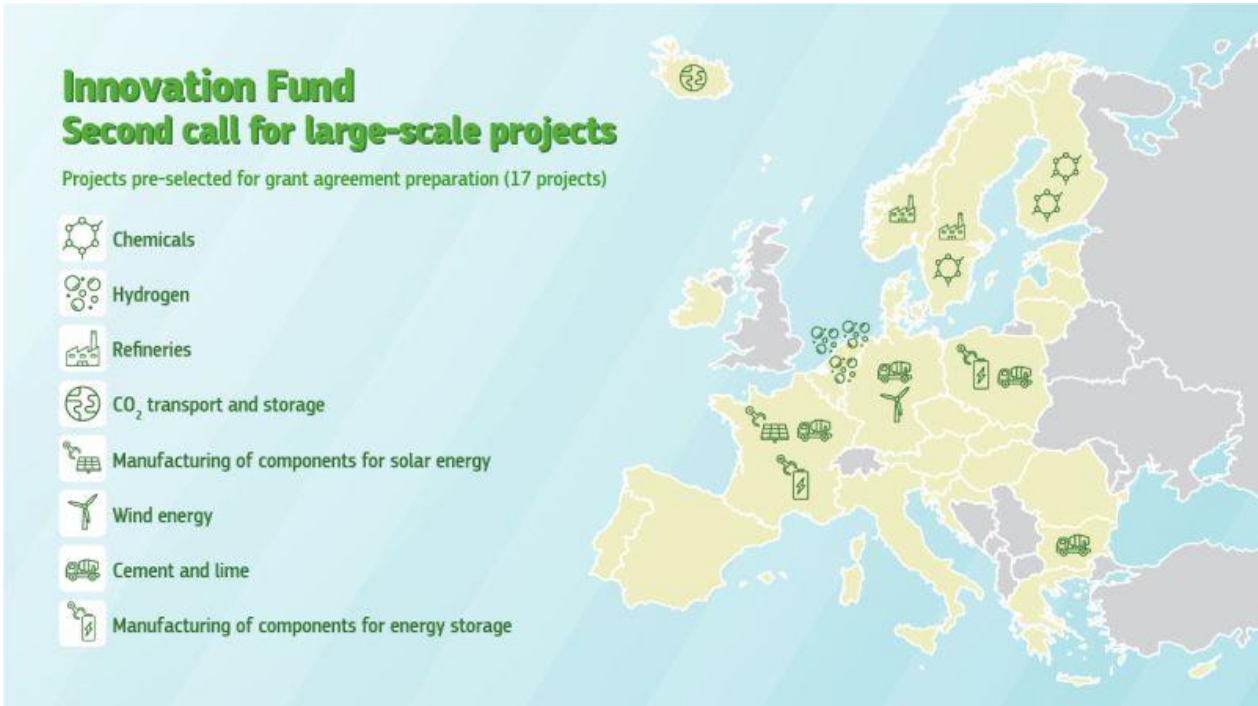
As reported on the europa.eu.com [link](#) **12** of the **17** projects awarded funding support are for energy intensive projects: four cement projects, three chemical projects, three hydrogen projects, and two refinery projects. In addition, three projects providing clean tech solutions were awarded funding for energy storage and renewable energy. The final two projects involve an off-shore wind field with innovative solutions for wind turbines and the production of hydrogen, and a carbon capture and storage project deploying a highly scalable on-shore carbon capture mineral storage terminal (with an estimated storage capacity of 880 million metric tonnes)

A link detailing each of the **17** projects successful in the second round of large-scale funding for clean tech projects is [attached](#), and are summarised below.

1. **Holland Hydrogen** - covered in **Edition 42** of Low Carbon Pulse;
2. **Project Pulse** - covered in previous editions of Low Carbon Pulse, and at [E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks](#) below;
3. **Nordsee Two Offshore Windfield Innovation Project** - a 450 MW off-shore wind field and 4 MW electrolyser project;
4. **FUREC** - covered in previous editions of Low Carbon Pulse and at [E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks](#) below;
5. **ReLieVe** - ERAMET SA's battery recycling project;
6. **Carbon2Business** - the Holcim Deutschland GmbH project deploying oxyfuel carbon capture at Holcim's **Lägerdorf, Germany**, cement plant;
7. **BIOZIN** - the Biozin Holding AS, Bergene Holm AS and Norske Shell AS commercial-scale drop-in biofuel production facility in **Åmli, Norway**;
8. **RISE** - a 2 GW a year photovoltaic solar module manufacturing plant developed by REC Solar Pte. Ltd;
9. **ANRAV** - a full-chain CCS project linking **CO₂** capture facilities at **Denya, Bulgaria**, cement plant, though an on-shore and off-shore pipeline system with off-shore storage;
10. **Coda Terminal** - covered in previous editions of Low Carbon Pulse and at [Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR](#) below;
11. **Project Air** - first-of-a-kind large-scale methanol plant using CCS processes to derive **CO₂** from residue streams to derive renewable hydrogen and biogas to methanol, being developed by Fortum Sverige AB, Perstrop Oxo AB and Sydkraft AB;
12. **HySkies** - a large-scale synthetic sustainable aviation fuel production facility in Sweden, being developed by Lanzatech Inc, Shell New Energies, and Vattenfall AB;
13. **ELYGATOR** - a 200 MW electrolyser project in **Terneuzen, the Netherlands**, to produce up to **15,500 metric tonnes** of Green Hydrogen a year using its "flexible electrolyser dispatch" concept, being developed by Air Liquide NL;
14. **NorthSTOR Plus** - covered in previous editions of Low Carbon Pulse, and at [BESS and HESS \(and energy storage\)](#) below;
15. **IONFibre** - Metsa Spring OY will produce a new fibre substitute for existing textile fibres;
- 16.

GO4ECOPLANT - is a Lafarge Cement SA project, creating an end-to-end **CO₂** capture and liquefaction facility at its **Kujaway, Poland**, cement plant, transporting the liquefied **CO₂** to **Gdansk, Poland**, for shipping into off-shore storage; and **17. CalCC** is a **CO₂** capture project, capturing exhaust gases arising during lime production, using Air Liquide Cryocap technology, and storing the **CO₂**, being developed by Air Liquide France Industrie and Chaux et Dolomies du Boulonnais).

The following map indicates the spread of the **17** projects across the **EU**.



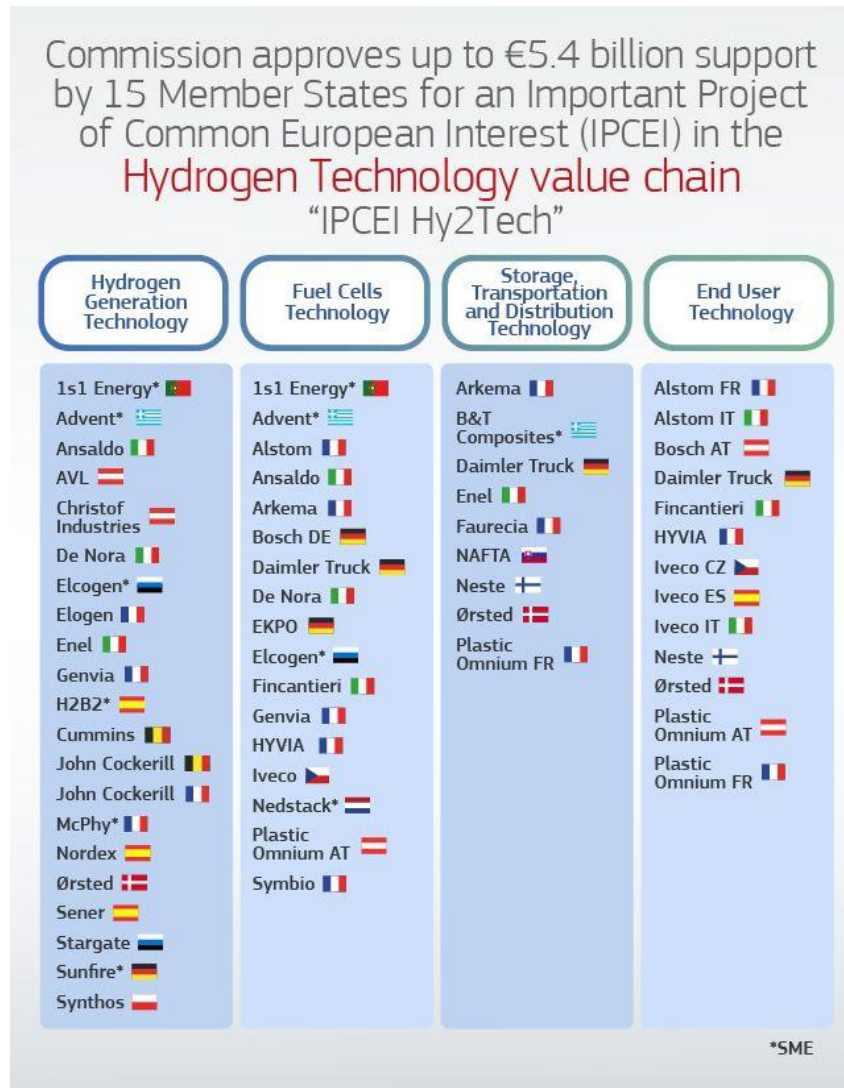
Source: [European Commission](#)

- **South Wales Cluster:** On **July 14, 2022**, the following infographic was shared providing an overview of the proposed South Wales Cluster.



- **Best prepared countries to achieve net-zero emissions:** On **July 14, 2022**, futurenetzero.com reported on new analysis by **Utility Bidder** (an energy advisory corporation) which found that the five best prepared countries to achieve net-zero emissions are Norway, the UK, Sweden, Denmark and Germany.
- **Important Project of Common European Interest across the EU:** On **July 15, 2022** the **European Commission (EC)** approved a hydrogen research and innovation project, involving **15** of the **27 EU Member States** (Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, the Netherlands, Poland, Portugal, Slovakia and Spain) as an **Important Project of Common European Interest (IPCEI)** under the name "**IPCEI HyTech**", with 41 projects to be undertaken across the **EU**.

The approval of a project as an **IPCEI** means that the project will have access to funding support (and regulatory benefits, critically in respect of State-Aid rules). The approval for the hydrogen research and innovation project as an **IPCEI** brings with it up to **€5.4 billion** in funding support for project development (to be provided by EU Member States), with an estimated **€8.8 billion** of accompanying private sector funding: effectively the **HyTech-programme** will promote investment of **€14.2 billion** across the **EU**.



Source: [European Commission](https://european-commission.eu)

For full coverage of this news item please click on the following link [europa.eu](https://european-commission.eu), titled **State Aid: Commission approves up to €5.4 billion of public support by fifteen Member States for an Important Project of Common European Interest in the hydrogen technology value chain.**

Americas:

- **Canada and US (and Russia) leads in trees gained (and lost):** On **July 11, 2022**, the **University of Maryland** and the **World Resources Institute** published **The Global 2000-2020 Land Cover and Land Use Change Dataset Derived From the Landsat Archive: First Results**. The publication analyses data on tree growth and loss, concluding that the world gained nearly 131 million hectares of new growth from 2000 to 2020, with 36 countries gaining more trees than they lost.

The critical point from the publication (and noted in Low Carbon Pulse previously) is that new growth does not make-up for the loss of carbon rich "old growth", with "old growth" areas providing ideal ecosystems for other flora and for fauna to thrive.

- Methane reduction funding:** On **July 12, 2022**, the US **Department of Energy (DOE)** announced its intent to issue a funding notice for research and development projects to help to reduce methane emissions across the US. The announcement notes that: "After carbon dioxide, methane is the most abundant ... GHG warming our planet, and methane emissions contribute significantly to the GHG intensity of natural gas".
 The funding for methane reduction research and development supports the Biden Administration [US Methane Emission Reduction Action Plan](#), which in turn reflects the [Global Methane Pledge](#) to reduce methane emissions by 30% from 2020 levels by 2030.
- Biden Administration opens USD 2.6 billion CCS funding:** On **July 13, 2022**, the US **DOE** issued notices of intent to fund two programs to advance carbon capture demonstration projects, and to expand regional pipeline networks for the haulage of **CO₂** for storage permanently or for use.
 The two programs are the [Carbon Capture Demonstration Projects Program](#) and the [Carbon Dioxide Transport / Front-End Engineering Design \(FEED\) Program](#). As announced, the two programs build on the Biden Administration actions to catalyse investments in clean energy any industrial innovation and advance the goal of a net-zero **GHG** emissions economy by 2050.
- Ceres and Clean Air Task Force report published:** On **July 14, 2022**, the **Clean Air Task Force** [announced](#) the publication of [Benchmarking Methane and other GHG Emissions of Oil and Natural Gas Production in the United States](#). The publication provides analysis from **Ceres** and **Clean Air Task Force** benchmarking the relative emissions intensity and total reported carbon dioxide (**CO₂**), methane (**CH₄**) and nitrous oxide (**N₂O**) emissions of more than 300 US oil and gas producers. As noted in previous editions of Low Carbon Pulse, **CO₂**, **CH₄** and **N₂O** (the three well-mixed **GHGs**) emitted to the climate system are responsible for the majority of the increase in average global temperature, and as such climate change. The publication is well-worth a read.
- Wyoming hydrogen roadmap:** During the first week of July the **Wyoming Energy Authority** and **Cheyenne-Laramie County Corporation for Economic Development** published the [Roadmap to Build a Hydrogen Economy](#). The principle purpose of the implementation of the Roadmap is for the State of Wyoming to commence the production of hydrogen, both Blue Hydrogen and Green Hydrogen. At the moment, the States of California, Louisiana and Texas lead the way in hydrogen production in the US.

France and Germany:

Electrolysers mapped: On **July 14, 2022**, **Dr Thomas Hillig** posted a map of the Green Hydrogen electrolysers across Germany. The post from **Dr Hillig** promises maps on hydrogen pilot projects in the iron and steel industry, hydrogen projects in the mining industry, Green Hydrogen in fertiliser, Electrolysers in Europe and in the World.



Australia:

- Prime Minister Albanese sets out Australian stall:** On **July 12, 2022**, the **Prime Minister of Australia, Mr Anthony Albanese** spoke at the **Sydney Energy Forum** (as noted above co-hosted by the **Australian Federal Government**, the **Business Council of Australia**, and **IRENA**). **Prime Minister Albanese** stated that investment in clean energy projects had stalled previously, but there was a "once-in-a-generation opportunity, and .. government policies are designed to seize that opportunity ...".
- South Australia closing in on 100% renewable dispatch:** On **July 15, 2022**, [pv-magazine.com](#) reported that the latest **OpenNEM** (National Energy Market) report shows that during financial year 1 July 2020 to 30 June 2021 more than two-thirds of the dispatched electrical energy in South Australia was from a renewable energy source. The report shows that on average 68.3% of the daily load across the State of South Australia were matched by electrical energy dispatched from renewable energy sources.

Blue and Green Carbon Initiatives and Biodiversity

- **Nature Based Solutions:** During the first week of July, the author of Low Carbon Pulse read European Commission publication [The Vital Role of Nature-Based Solutions In a Nature Positive World](#), which was released by the **Directorate-General for Research and Innovation**. The publication is an excellent primer for **Nature-Based Solutions (NBS)** and **Nature-Based Enterprises (NBE)**. It is hoped the resources and time are devoted to the development of the thinking contained in the publication in the near term.

During the second week of July the author read the **ADB** publication [Integrating Nature-Based Solutions for Climate Change Adaptation and Disaster Risk Management – A Practitioner's Guide](#). The **ADB** publication, authored by John Matthews and Ernesto Ocampo Dela Cruz provides a wonderful addition to those active (or those interested) in the area of **NBS**. **NBS** are at the core of both Blue and Green Carbon Initiatives. One of the many good things about the **ADB** publications is that it applies a broader perspective as to what is an **NBS**.

- **Land-Based Climate Solutions for the United States:** On **July 11, 2022**, [carbon.direct.com](#) published an article that introduced [Land-Based Climate Solutions for the United States](#) by Messrs Robertson, Hamilton, Paustian and Smith. The article and the publication are both excellent, with a key point being that **NBS** are constrained by the time taken for carbon accrual in forest biomass and soils.

- **UN Biodiversity Conference:** As reported in **Edition 41** of Low Carbon Pulse, **Part 2 of the UN Diversity Conference** (fifteenth meeting of the Conference of Parties (**COP-15**) to the Convention on Biological Diversity) is to take place between **December 5 and 17, 2022**, in **Montreal, Canada**.

COP-15 is intended to adopt the **post-2000 global biodiversity framework**, which provides a strategic vision and global roadmap for the conservation, protection, preservation, restoration and sustainable management of biodiversity and ecosystems for the next decade. [Draft 1](#) of the **post-2000 global biodiversity framework** was released in July 2021.

BIODIVERSITY

In the broadest sense, **biodiversity** describes the variety of the fauna and flora globally, and in any particular area. The preservation of **biodiversity** is a key policy setting. In this context, human activities and the clearing of land to undertake agricultural, forestry or other land use (**AFOLU**) is a key focus of policy settings. Desertification and deforestation are key concerns (both as a result of **AFOLU**), as is the broader impact of climate change on habitats, critically, the impact on change in temperature on land and in the ocean.

There is a balance in habitats, with eco-systems that have developed overtime, and that continue to develop. The balance of habitats and their eco-systems are impacted by **AFOLU** and climate change. There are many examples, but a consistent example (that many will recognise) is the need to preserve the habitats of bees and other pollinators, and to avoid loss of bees and other pollinators. As a policy setting, the rewilding of habitats is one element of preservation, and, in some cases, restoration of eco-systems. As a broad statement, preserving wilderness areas, and rewilding of areas, and reducing old growth forestry, and afforestation and reforestation, are key to the preservation and restoration of **biodiversity**. These are policy settings over which we have control in the near, medium and long term. In addition, overtime, policy settings may extend to addressing optimal use of land, optimal in the sense of preserving or restoring **biodiversity** while at the same time addressing climate change. As always, what is needed is known. As always, the challenge is acting upon it.

Climate change will impact the effectiveness of these policy settings (in particular coastal habitats, and areas of increased drought and desertification, driven by rising sea-levels and changes in weather patterns, as a result of climate change), but they are policy settings that are necessary and need to be progressed in the near term. In addition, acting to preserve and to restore **biodiversity** is likely to yield benefits, economic and social.

Bioenergy and heat-recovery:

- **Air Liquide PRC biomethane project:** On **July 12, 2022**, **Air Liquide** (one of the three industrial gas giants globally) [announced](#) that its first **biomethane production facility** in the **PRC** is to open by the end of 2022. The **biomethane production facility** is located in **Huai'an City, Jiangsu Province**. **Air Liquide** has deep expertise across the **biomethane** supply / value chain, including deriving **biogas**, upgrading **biogas** to produce **biomethane**, and the storage and transportation of **biomethane** in compressed or liquified form. **Air Liquide** has **21 biomethane** projects globally.

The **biomethane production facility** will derive **biogas** from agricultural and livestock waste from local farms and upgrade that **biogas** to produce **biomethane**. The digestate arising from deriving **biogas** will be processed and pasteurised to produce **bio-fertilisers** that will be used by local farms. It is apparent that **biomethane** production is highly prospective across the **PRC**.

- **A Gas for Climate report:** **Edition 42** of Low Carbon Pulse reported that the **Gas for Climate** consortium published an update [Biomethane production potentials in the EU](#). The updated publication builds on the previous publication from **Gas for Climate** previous, to take into account the acceleration of the use of biomethane now contemplated by the **EU**.

The key findings of the publication are: **1.** There is enough sustainable feedstock in the **EU** to achieve the **EU REPowerEU** target of **35 bcm by 2030**, with up to **41 bcm by 2030** and **151 bcm by 2050**; **2. Anaerobic digestion** is regarded as having the potential to derive up to **38 bcm by 2030**, and up to **91 bcm by 2050**. In the **EU** context, France, Germany, Italy, Poland and Spain will be the top five producers of **biogas** derived **biomethane** using anaerobic digestion technologies. The **key feedstocks** for these purposes **to 2030** being **manure** (33%), **agricultural residues** (25%) and **sequential cropping** (21%); and **3. Thermal gasification** is regarded as having the potential to derive up to **2.9 bcm by 2030**, and **60 bcm by 2050**. In the **EU** context, France, Germany, Italy, Spain and Sweden will be the top five producers of biomethane using thermal gasification. The **key feedstocks** for these purposes **to 2030** are **forestry residues** and **wood waste**, together having 60% of the feedstock source.

BIOENERGY

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "upgrading") so that it can be used as pipeline gas (i.e., complying with the specification for hauling through the applicable natural gas pipeline, including the removal of **CO₂**, and other compounds and elements, such that the gas hauled through the pipeline is **CH₄**). **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel (typically, as a gas that is combusted / oxidised to produce electrical energy or heat energy or both) or as a feedstock. Also either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia:** being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;
- **Bio-butanol:** being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel:** being diesel (i.e. synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol:** being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene:** being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF)**, is a synthetic paraffinic kerosene. Currently most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams (typically using some natural gas). As noted below, typically fatty acids and hydrogenated acids are used to produce synthetic paraffinic kerosene. If the feedstock is sourced from Biomass it is a Bio-kerosene;
- **Bio-LNG:** being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and
- **Bio-methanol:** being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

BESS and HESS (and energy storage):

- **Wärtsilä and Clearway Energy Group contract for BESS:** On **July 11, 2022**, **Wärtsilä** announced that it had contracted with **Clearway Energy Group** for the supply of a **500 MW / 2 GW** portfolio of **BESSs**. The portfolio of **BESSs** will be located in the US States of **California** and **Hawaii**, and will include one of the world's largest combined **BESS** and photovoltaic solar facilities.
- **Northvolt energy storage system plant is a winner:** One of the successful applicants for funding support under **€1.8 billion** second round of large-scale funding for clean-tech projects under the **EU Innovation Fund** was the **Northvolt** (Swedish headquartered technology corporation) **NorthSTOR PLUS** energy storage system (**ESS**) assembly plant located in **Gdańsk, Poland**. The **ESS** will use **high-nickel, nickel-manganese-cobalt (NMC)** cells, having a higher energy density than other technologies.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

- **DAC for Microsoft:** On **July 13, 2022**, **Climeworks** [announced](#) that it had signed a 10 year carbon removal offtake agreement with **Microsoft Corporation**. (See [Editions 25, 26, 36](#) and [41](#) for coverage of **Climeworks**.)
By way of a reminder: [Edition 25](#) of Low Carbon Pulse (under **Microsoft founded but not forgetting**) noted that: "**Microsoft Corporation** was founded in 1975 by Mr Bill Gates and, the late, Mr Paul Allen. As noted in [Editions 11](#) and [13](#) of Low Carbon Pulse, **Microsoft** is committed to achieving **NZE** by 2030 and, as noted in [Edition 2](#) of Low Carbon Pulse, to removing from the climate system a mass of **CO₂-e** equal to the mass of **GHG** emissions that it has emitted since it was founded (zero historical **GHG** emissions or **ZHE**) by 2050".
- **Coda Terminal funding support from European Innovation Fund:** On **July 12, 2022**, **Carbfix** [announced](#) that it and **Dan-Unity** had been awarded grant funding support from the **EU Innovation Fund** for the development of the **Coda Terminal**, a large-scale **CO₂** transport and storage hub at **Straumsvik, Iceland**. As announced, operation of the **Coda Terminal** will commence in mid-2026, with full capacity of **3 million metric tonnes** a year of **CO₂** storage to be achieved during 2031. (See [Edition 18](#) of Low Carbon Pulse for previous reporting.)
- **ExxonMobil – seven things to know about CCS:** On **July 13, 2022**, **ExxonMobil** published **Seven Things to know about carbon capture and storage technology**. **1. CCS** is proven technology; **2. CCS** could capture more than 90% of **CO₂** emissions; **3. CCS** is crucial to mitigating climate change; **4. Natural gas with CCS** ensures a more stable and cost-effective energy supply than renewables alone; **5. There is more than one way to capture CO₂**; **6. CO₂** can be stored permanently and safely underground; and **7. ExxonMobil** is responsible for capturing 40% of all the **CO₂** captured to date.
- **Peterhead Carbon Capture project awards FEED contract:** On **July 13, 2022**, **SSE plc** and **Equinor** [announced](#) that **Mitsubishi Heavy Industries**, **Tecnicas Reunidas** and **Worley** had been appointed to deliver carbon capture for the Peterhead Power Station. The **Peterhead Carbon Capture Project** is intended to capture **1.5 million metric tonnes** of **CO₂** a year. As announced and reported, the **Peterhead Carbon Capture Project** involves the

replacement of carbon-intensive generation capacity with renewable electrical energy, with the **CO₂** capture units to be integrated into a power turbine with generating capacity of 910 MW.

- **Timor-Leste project awards FEED contract:** On **July 13, 2022**, it was reported widely that **Santos Ltd** had appointed **Worley** to undertake **FEED** on the **Timor-Leste CCS** project.
- **CDR required, lots of it:** It is well-known and understood that **carbon dioxide removal (CDR)** is critical to achieving **NZE** by 2050 (see **Edition 38** of Low Carbon Pulse) – **165 billion metric tonnes** (or **165 giga-tonnes**) of it. The rate of development of mechanical carbon capture and storage (**CCS**) solutions and direct air capture (**DAC**) solutions is increasing, and deployment of both **CCS** and **DAC** accelerating (with **CCS** having been used for around 50 years, with around **300 million metric tonnes** injected into storage, currently with around 30 projects globally injecting into storage around 40 million metric tonnes a year of **CO₂**).

In addition, there is increasing focus on nature based solutions (**NBS**), at the core of which is the absorption or sequestration of **CO₂** in biomass, i.e., negative **GHG** emission solutions. The need for negative GHG emission solutions is known, and the means of implementing the solution is known, in particular in areas of the world impacted by climate change, including Africa.

- On **July 14, 2022**, illuminem.com published [**COP27 Why Africa Needs to be at the Forefront of the Climate Change Conversation**](#), by **Adetayo Adetuyi** and **Nnanke Williams**, which provides an overview of the current dynamics for Africa, critically, that while Africa is not responsible for the level of **GHG** emissions in the climate system, it is one of the most, if not the most, susceptible regions to the resulting climate change, and the resulting impact, including the adaptation and mitigation. The article is well-worth a read.

Carbon Credits and Hydrogen Markets and Trading:

- **Climate Impact X:** As reported previously, **Climate Impact X** is working with Nasdaq. (See **Editions 18, 27** and **37** for coverage of **Climate Impact X**.) On **July 13, 2022**, digfingroup.com included a feature on **Climate Impact X**, in particular the distribution channels to market for high-quality carbon credits, being an auction venue for new projects, a corporate sustainability market, and a spot market. As stated in the feature, the voluntary carbon market for carbon credits represents around **360 million metric tonnes** of **CO₂-e** emissions that have been captured and stored by mechanical means or sequestered by natural means.

As part of multi-faceted progress towards **NZE**, carbon credits have a role to play, but to play a meaningful role **CO₂-e** emissions need to be removed at a rate of **10 to 20 billion metric tonnes** if **NZE** is to be achieved. In scaling-up **CDR** on this level of removal, carbon credits and the voluntary carbon markets need to scale-up. As carbon credits and the voluntary carbon markets scale up, to provide functioning distribution channels, investment in **CDR** projects can be expected to increase. As Head of Product, at Climate Impact X, Mr Tom Enger says: "*The carbon market needs integrated solutions, including money, project development, credit analysis, product design, contract definition, and platforms for trading, matching and settlement. It needs buyers and sellers*".

Voluntary carbon markets allow buyers to purchase carbon credits that match the **GHG** emissions arising from the activities undertaken by the buyer. A carbon credit arises from an activity or project that avoids, reduces or removes **CO₂-e** emissions. From a policy setting perspective, the idea is that over time the cost of the carbon credits increases forcing the buyers of carbon credits to decarbonise the activities that give rise to **CO₂-e** emissions. As such the carbon markets do not effect decarbonisation, but with appropriate policy settings can buy time and overtime drive decarbonisation.

- **Climate Impact X and Puro.earth align:** As reported previously, in **June 2022**, **Climate Impact X** announced that it and **Puro.earth** are to work together to address the growing imbalance in supply and demand in the voluntary carbon markets, by making it easier for businesses and financial institutions globally to access new and emerging carbon credit types. The CEO of **Climate Impact X**, Mr Mikkel Larsen, said that: "*Our partnership with Puro.earth helps to unlock new supply by sending a clear demand signal. It is a unique collaboration that will help drive the creation of a science-aligned solution that reduces frictions for businesses and institutions looking to incorporate a blend of curated credits in their carbon portfolios*". (See **Edition 19** of Low Carbon Pulse for previous coverage of **Puro.earth**.)

- **Carbon markets can drive revenue:** On **July 13, 2022**, the **Environmental Defense Fund** published an article entitled [**Carbon Markets Can Drive Revenue, Ambition for Tropical Forest Countries, New Studies Show**](#). The article references publication [**Financial Opportunities for Brazil form reducing Deforestation in the Amazon**](#). Both the article and the publication are worth a read, providing an outline of how opportunities may be realised, in particular in the context of voluntary carbon markets.

This follows the new items covered in **Edition 42** of Low Carbon Pulse (under **Impact of VCM on Tropical Rainforests**) as follows: "During the first week of **July, 2022**, an **Environmental Defense Fund** funded study was published [**Impact of the Voluntary Carbon Market on Tropical Forest Countries – Implications for Corresponding Adjustments**](#). The study estimates the capacity of the tropical rain forests to match the demand for carbon credits. The study uses three scenarios for carbon credit demand covering two periods – 2021 to 2030 and 2021 to 2050. The study is excellent and well-worth a read".

The perspective of Climate Impact X is supported by these articles and studies.

- **Plastic Credits:** On **July 12, 2022**, the author of Low Carbon Pulse was introduced to the concept of a plastic credit in a paper from the good-folk at **South Pole**. At the outset, a plastic credit is not a carbon credit (because there is no carbon to off-set), rather a plastic credit is a credit to which value may be attached in the context of an appropriate policy setting framework.

The premise of a plastic credit is that there is environmental benefit / value in the collection of plastic that is at large in the climate system, and a means of encouraging collection may be the issue of plastic credits which will have value, and which will support projects to collect plastic that is at large.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

- **Neste Porvoo refinery funding support from the EU Innovation Fund:** On **July 12, 2022**, Neste [announced](#) that it had been awarded grant funding from the **EU Innovation Fund** for the development of chemical recycling facilities at its Porvoo refinery – **Project Pulse** (see [Editions 31](#) and [39](#) of Low Carbon Pulse for previous coverage). The recycling facilities will pre-treat and upgrade plastic waste, with the resulting fluid being used to produce Future Fuels or as feedstock for chemicals.

- **Sunfire on target:** On **July 13, 2022**, [Sunfire GmbH announced](#) that it was the "first" Green Hydrogen corporation headquartered in the **EU** to receive funding from the **USD 2 billion Climate Pledge Fund** established by the good folk at **Amazon**.

The CEO of Sunfire, Mr Nils Aldag, said:

"We are proud to welcome on to the most successful companies in the world as our investor. It's great recognition to the first EU-based green hydrogen company to receive investment from Amazon".

- **Shell invests in plastic circular economy:** On **July 13, 2022**, **Shell** announced its ambition to recycle more than **1 million metric tonnes** a year of **plastic waste** at its chemical plants **by 2025**. For these purposes, **Shell** is to invest to develop a **new pyrolysis oil upgrader** at the **Shell Chemicals Park** at Moerdijk, the Netherlands.

The **new pyrolysis oil upgrader** will improve the quality of the **pyrolysis oil**, being the liquid derived from the chemical recycling of plastic waste. The **pyrolysis oil** is suitable for the production of new chemical products at the facilities of **Shell** in the Netherlands and Germany.

As announced, the **new pyrolysis oil upgrader** will have capacity to produce **50,000 metric tonnes** of **pyrolysis oil** a year. With other international energy corporations, **Shell** is progressing towards convergence in the recycling of plastics – long hypothesised, now with us, with chemical recycling of plastic waste (in contrast with mechanical recycling), increasingly seen as economic and sustainable.

- **HyCC launches Project H2era project:** On **July 13, 2022**, it was reported widely that the **Hydrogen Chemistry Company (HyCC)** launched **Project H2era**, a **500 MW Green Hydrogen** production facility, to be developed within the Port of Amsterdam. **HyCC** is a joint venture between **Green Investment Group** and **Nobian**.

In addition to **Project H2era**, **HyCC** is to develop **Project H2ermes** at the Port of Amsterdam in combination with the Port and Tata Steel. (See [Edition 32](#) of Low Carbon Pulse for earlier reporting on the **Project H2era project**.)

- **Waste-to-SAF:** On **July 14, 2022** it was reported widely that a **GBP 1 billion Lighthouse Green Fuels** plant is planned to be developed in the North East of England, as part of the **Net Zero Teesside** industrial cluster, itself part of the **East Coast Cluster**.

The **Lighthouse Green Fuels** project is being developed by **alfanar** (Saudi Arabian engineering group).

The Chief Investment Officer of **alfanar** said:

"With the third largest aviation network on the world, and with one of the world's largest potential off-shore CO2 stores, the UK has the industrial and geological advantages to become a global leader in developing green aviation fuel with the lowest possible emissions using CCS technology. This is why we want to build our first ever SAF plant in the UK by 2027 and two further plants by 2035".

The **Lighthouse Green Fuels** project entered front end engineering design (**FEED**) during June 2022.

- **Project Air:** On **July 13, 2022**, **Uniper** [announced](#) that **Project Air**, a project involving **Fortum**, **Perstorp** and **Uniper** had been successful in its application in the second round of large-scale funding for clean-tech projects under the **EU Innovation Fund**. **Project Air** seeks to move the chemical industry from the use of raw fossil fuels and feedstocks to the use of bio-based fuels and feedstocks, to allow the production of chemicals without the use of fossil fuels and feedstocks.

For these purposes, **Project Air** uses existing technology innovatively, with large-scale industrial application, to produce sustainable methanol, using **CO₂** (and other residual emissions) from **Perstorp's** operations and biogas derived from new facilities, and an electrolyser facility, with the water for electrolysis sourced from wastewater, and the electrical energy to power the electrolyzers from renewable sources.

- **Enagas fully committed to hydrogen:** On **July 13, 2022**, the Hydrogen Economist ([pemedianetwork.com](#)) reported that **Enagas** (Spanish natural gas network operator) has earmarked **€800 million** for the development of hydrogen projects by 2030 as part of its plan to position itself as a "reference hydrogen network operator" by 2030.

- **RWE FUREC waste-to-H2 project gets EU funding support:** On **July 14, 2022**, **RWE** [announced](#) that it had been successful in its application in the second round of large-scale funding for clean-tech projects under the **EU Innovation Fund** in respect of its **Fuse Reuse Recycle (FUREC)** project.

The **FUREC** project involves the production of renewable hydrogen from waste arising to displace the use of natural gas. The **FUREC** project is being developed in in **Limburg**, the **Netherlands**, and will process and treat residual waste into raw material pellets, with the pellets converted in renewable hydrogen **Limburg's** Chemelot industrial park, with the renewable hydrogen to be supplied to OCI for use in its fertiliser production plants.

The **FUREC** project is designed to produce up to **54,000 metric tonnes** of renewable hydrogen a year.

- **Green Hydrogen Taskforce:** On **July 14, 2022**, [ammoniaenergy.org](#) published an article entitled [New roadmap for ammonia imports into Germany](#). The article touches on the 10 point plan (see [Edition 41](#) of Low Carbon Pulse). The article reminds us of the 10 point plan as follows:

- **Hy2Gen plans €500 million Green Hydrogen project:** On **July 15, 2022**, [fuelcellworks.com](#) reported that **Hy2Gen** (headquartered in Wiesbaden, Germany and specialising in the development of future fuel facilities) plans to develop **Green Hydrogen** and **SAF production facilities**, named the **JANGADA project**, with the intention for the **JANGADA project** to be in operation by 2027. The **JANGADA project** is to be located in the municipality of Jänschwalde, Germany, with **Hy2Gen** working with **Euromovement Industriepark GmbH**.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

- **Panasonic Energy Co., Ltd** (the battery business division of the Japanese technology conglomerate) and the **Governor of Kansas, Ms Laura Kelly** had announced jointly that the US State of Kansas had approved the application from **Panasonic Energy** under the State's Attracting Powerful Economic Expansion incentive scheme.

With the approval of the application, it appears likely that **De Soto, Kansas** will be the location for a **USD 4 billion giga-factory** to manufacture **lithium-ion batteries** for use in the Battery Electric Vehicle (**BEV**) market.

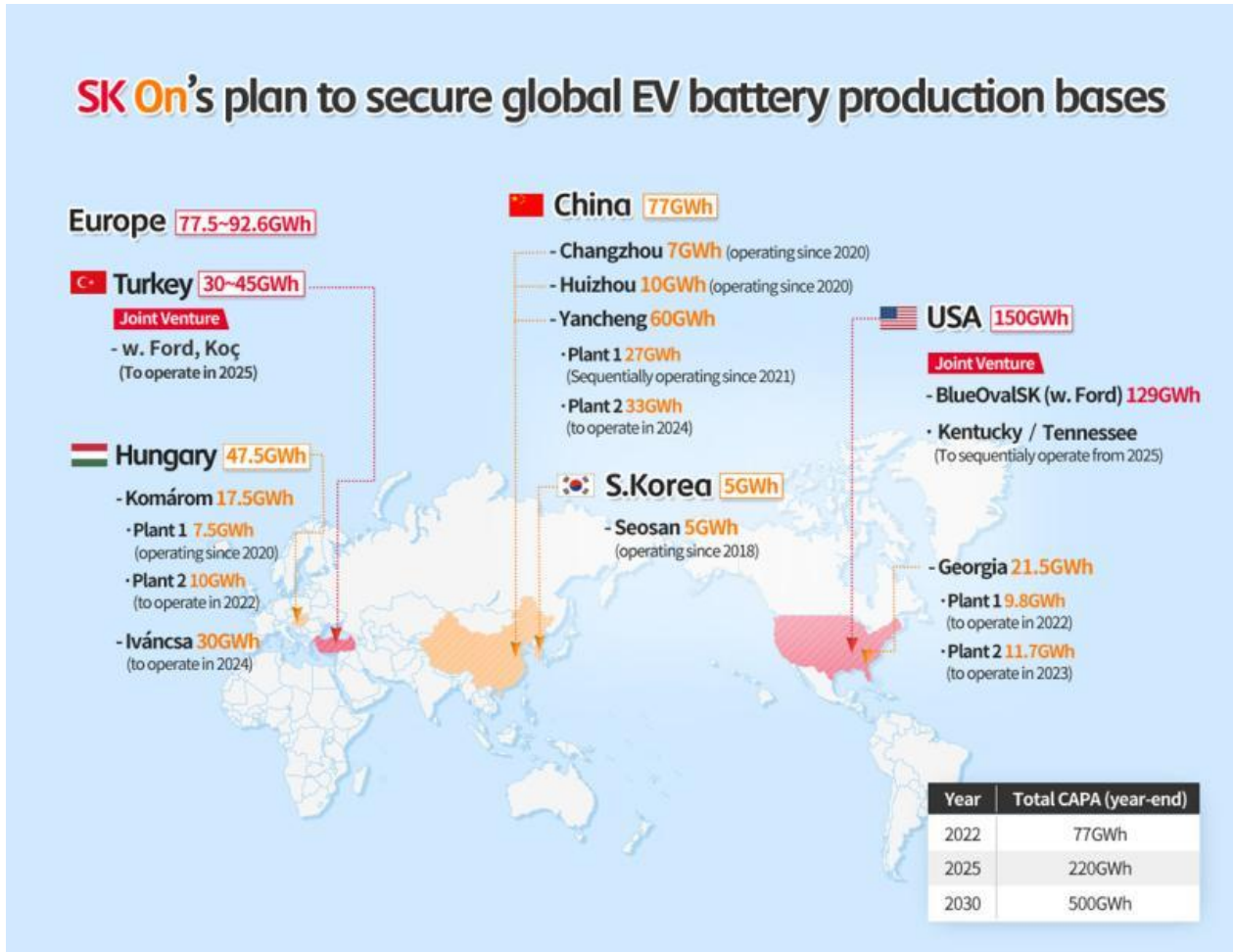
President and CEO of Panasonic Energy, Mr Kazup Tadanobu, said:

"With the increased electrification of the automotive market, expanding battery production to the US is critical to help meet demand".

- **SK On and Ford good to go**: On **July 13, 2022**, it was reported widely **Ford Motor Company** and **SK On** had progressed to establish **BlueOval SK**.

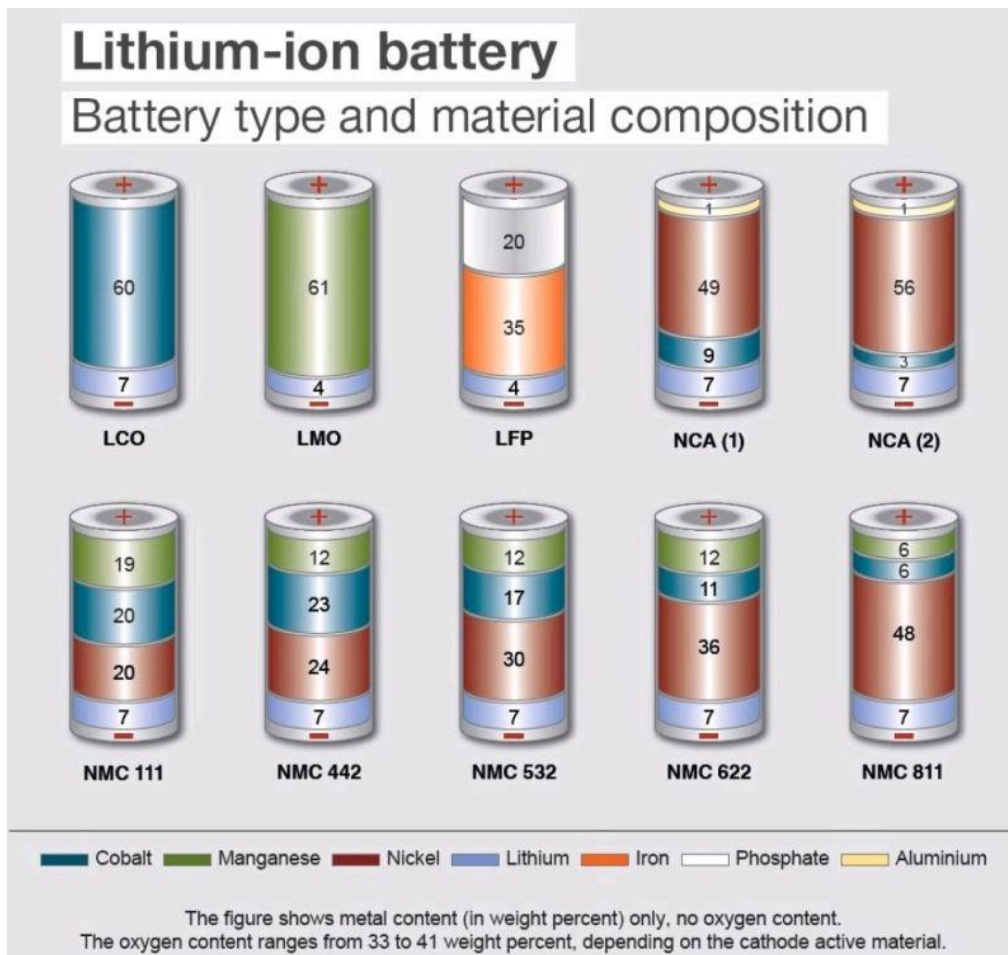
BlueOval SK, currently headquartered in the US State of Georgia, is to be headquartered in **BlueOval City** which Ford is developing in **Stanton, Tennessee**, at which **BlueOval SK's Tennessee EV battery giga-factory** will be developed, with **two further giga-factories** planned for the **US State of Kentucky**.

To regular readers of Low Carbon Pulse will know, **SK** is a leading corporation across all aspects of the energy transition. In respect of **EV** batteries, the map-info-graphic provides a snap-shot of the activities of **SK On** globally.



Source: [Batteriesnews.com](https://www.batteriesnews.com)

- **A infographic for this age**: On **July 15, 2022**, the good folk at the **visualcapitalist** (elements.visualcapitalist.com) published one of their sensational infographic providing a side by side comparison of lithium-ion battery and fuel-cell technologies.
- **And another ...** : On **July 15, 2022**, the author came across the following infographic from **Thermofisher** indicating the critical materials (metals and minerals) used in difference battery technologies.



Source: [Thermofisher](#)

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

- **Lower cases align:** On **July 11, 2022**, **bp** [announced](#) that it is to work with **thyssenkrupp** to advance the decarbonisation of iron and steel production. As announced, **bp** and **thyssenkrupp** are to work together to promote jointly policy setting to support the development of low carbon hydrogen (both Blue and Green Hydrogen) production and green steel production across Europe.

The alignment of **bp** and **thyssenkrupp** is framed in a memorandum of understanding signed by each of them on July 11, 2022. The production of iron and steel by **thyssenkrupp** gives rise to around 2.5% of **GHG** emissions arising from economic activity across Germany. Overtime **thyssenkrupp** (and other producers of iron and steel) will replace blast furnace technology with direct reduced iron or sponge iron produced using direct reduced iron technology and electric arc technology.

- **Salzgitter ironing out decarbonisation:** On **July 15, 2022**, the ever-excellent [rechargenews.com](#) published an excellent piece on the plans of leading Germany iron and steel producer, **Salzgitter**, to develop the **€723 million** first phase of its iron and steel decarbonisation project which will use Green Hydrogen as the high-heat temperature source for the production of iron and steel. As reported, the intention is to have developed the first phase by the end of 2023, with two further phases, 2 and 3, with direct reduction plants and electric arc furnaces to be developed to replace blast furnaces. (See [Editions 23, 34](#) and [36](#) for previous reporting about Salzgitter.)

In operation, the first phase will reduce total **GHG** emissions arising from economic activity across Germany by 1%. The iron and steel decarbonisation project is called **Salcos (Salzgitter Low CO₂ Steelmaking)**, which uses Green Hydrogen to displace the use of coking coal in blast furnaces (which produce pig iron).

As reported in previous editions of Low Carbon Pulse (and this [Edition 43](#) of Low Carbon Pulse), the use of Green Hydrogen will allow the production of direct reduced iron / sponge iron (in contrast to pig iron).

- **EC Technical Report on iron and steel:** In the first week of July, the author of Low Carbon Pulse read the **European Commission** Joint Research Centre (**JRC**) published **JRC Technical Report – [Technologies to Decarbonise the EU Steel Industry](#)**. The technical report is excellent, outlining the challenges with the decarbonisation of the iron and steel industry, the current size and scale of the iron and steel industry, the means of achieving decarbonisation (including hydrogen direct reduced iron, **CCS** and **CCUS**, and iron ore electrolysis) and the cost of achieving decarbonisation, all placed in the context of current levels of **GHG** emissions and commitment to reduce them.

The **JRC Technical Report** follows the publication of [The Sustainable STEEL Principles](#) (in late June, 2022), which comprises "a set of bank-led commitments to adopt a common measurement and disclosure framework to support the steel industry in forging a pathway to net-zero carbon emissions". There are five **STEEL Principles** reflecting: 1. **S**tandardised assessment; 2. **T**ransparent reporting; 3. **E**nactment; 4. **E**ngagement; and 5. **L**eadership. The **STEEL**

Principles were developed within **RMI** (Independent non-profit clean energy development consultant) and five working group banks, **Citi**, **ING**, **Societe Generale**, **Standard Chartered** and **UniCredit**.

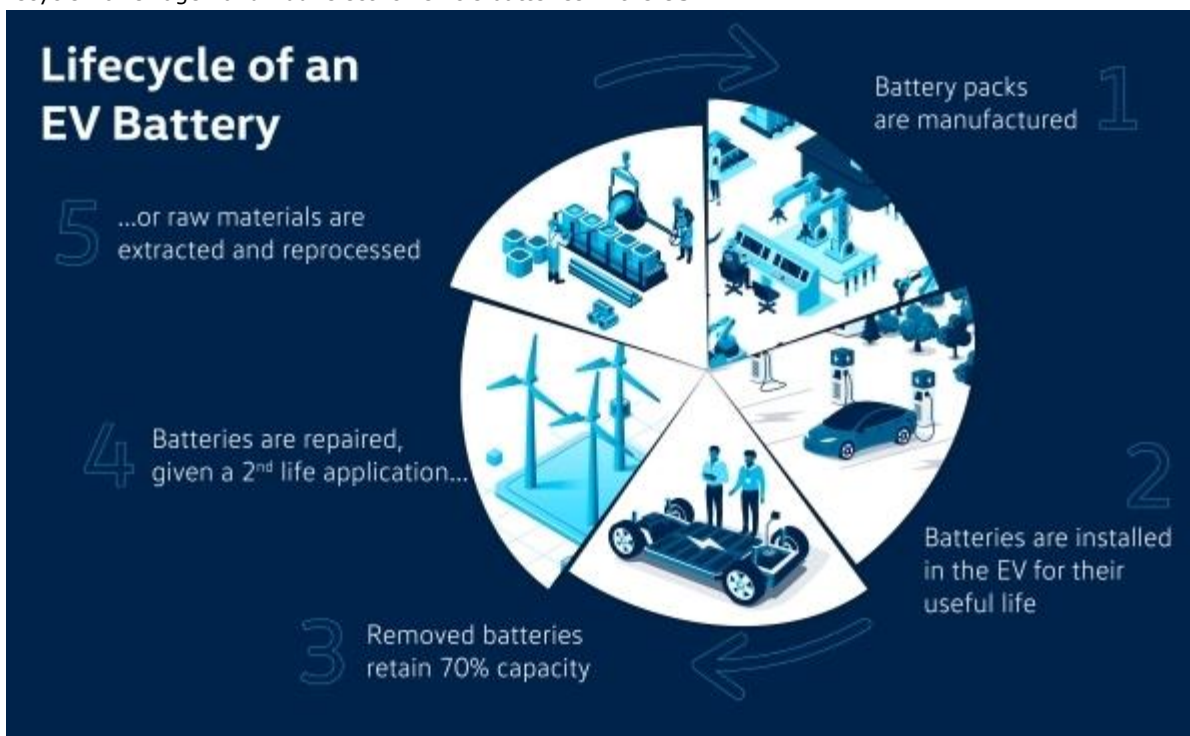
It is estimated that greening the iron and steel industry in the **EU** will require **25.4 GWh** of renewable energy to produce sufficient Green Hydrogen. Stated another way, this is more than half of the increase in wind power capacity contemplated by the **EU REPowerEU** initiatives. As noted in a number of news items, the **EU** iron and steel sector is lobbying for **31 GW** of renewable electrical energy capacity to be developed and deployed by 2030.

Wind round-up, on-shore and off-shore:

- **DP Energy and Iberdrola proceed with Inis Ealga Marine Energy Park:** On **July 14, 2022**, 4coffshore.com reported that **DP Energy** and **Iberdrola** had published an **EIAR Scoping Report** for their proposed **1 GW Inis Ealga Marine Energy Park** off the south coast of the Republic of Ireland. Consultation on the **EIAR Scoping Report** is open until **September 21, 2022**. The **EIAR Scoping Report** is said to be a significant milestone on the path to the preparation of a Development Permission for the off-shore wind field development application in due course.
- **Finnish Government approves permits:** On **July 15, 2022**, renews.biz reported that the Finnish Government had approved permits to lease state-owned sea area for Suomen Hyötytuuli's 500 MW Tahkoluoto 2 off-shore wind field and the 1.3 GW Korsnas project under development by Metsähallitus (a state-owned corporation). The State of Finland will receive rental income under the leases, and the municipalities of Korsnas and Pori will receive payment in the form of property taxes.

Solar and Sustainability (including NZE Waste):

VWG and Redwood to develop recycling supply chain: On **July 13, 2022**, batteriesnews.com reported that **Volkswagen Group North America, Inc.** and **Redwood Materials, Inc.** are to work together to create a supply chain to recycle Volkswagen and Audi electric vehicle batteries in the US.



Source: Volkswagen

Land Mobility / Transport:

• Buses and coaches:

Electric buses:

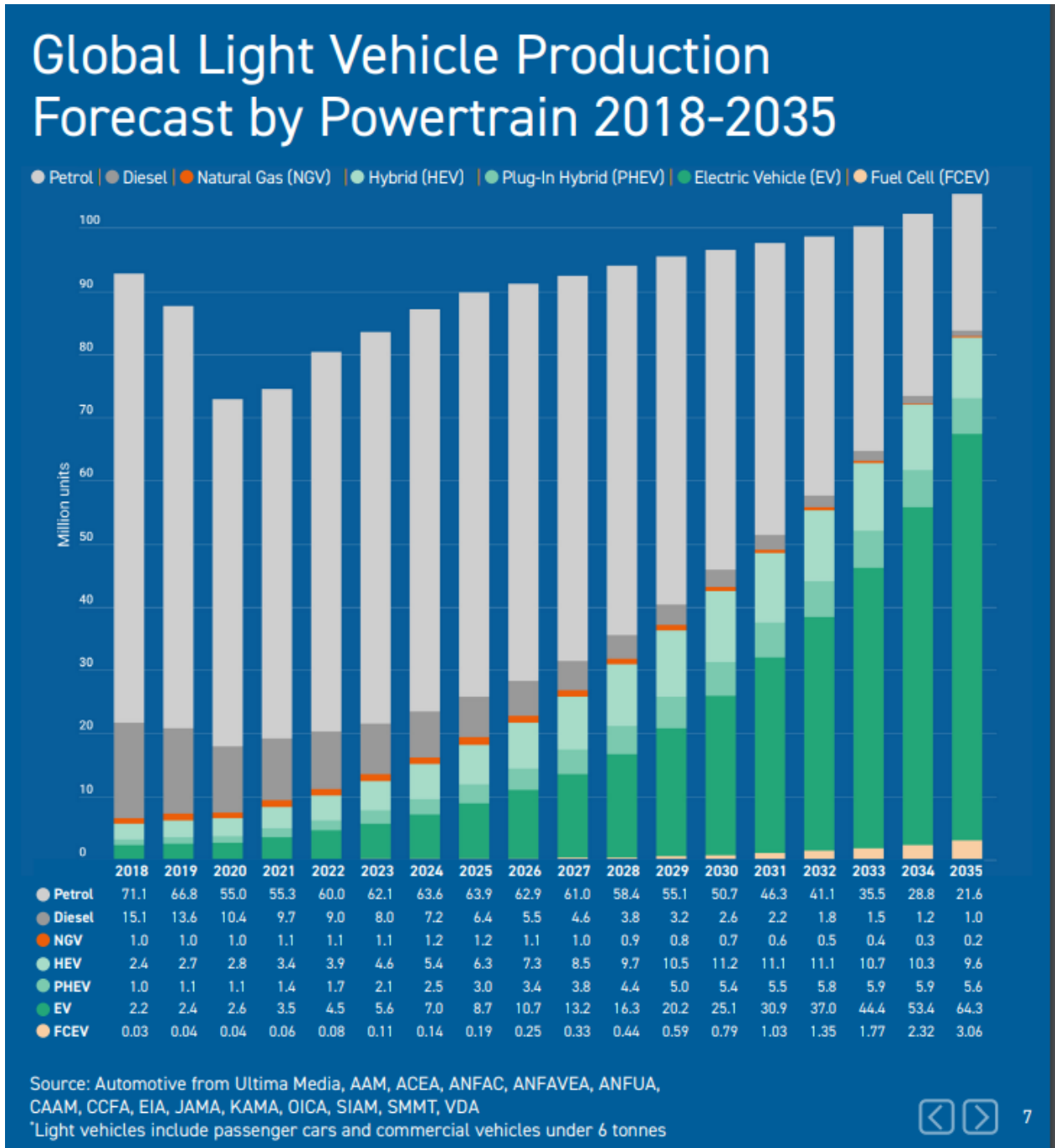
- **Austria to procure 289 electric buses:** On **July 11, 2022**, it was reported that the Austrian government had committed **€122 million** to support the procurement of **289 electric buses**. Among the procurement are 16 double-articulated trolleybuses and 70 electric battery buses for Vienna. It is understood that Austria has a fleet of 184 electric batter buses, with the aim to have 682 e-buses in operation by 2026.
- **16 Mercedes eCitaro electric buses head for Trento:** On **July 12, 2022**, it was reported that **Evobus Italia** and **Enel X Italia** had won a tender for **16 Mercedes eCitaro** to be operated in the **Province of Trento, Italy**.
- **Ebusco to go:** On **July 12, 2022**, it was reported that **Ebusco** had contracted with **Nobina** for the supply of 19 **Ebusco 3.0 12 metre** buses for delivery during 2023.
- **Agrale MT17.0LE sails for Buenos Aires:** On **July 13, 2022**, it was reported that the **Agrale MT17.0LE** was being shipped to Buenos Aires, Argentina, to commence in service trials for 12 months. The 70 PAX, 12 metre, single deck **Agrale MT17.0LE** is powered and propelled by an **Equipmake** powertrain.

Fuel cell buses:

- **Ile-de-France Mobilités to procure 47 hydrogen buses:** On **July 12, 2022**, it was reported widely that **Ile-de-France Mobilités** is to procure 47 hydrogen powered and propelled fuel-cell technology buses. This is a departure for **Ile-de-France Mobilités** which currently has a mixed fleet of electric battery buses and bio-natural gas vehicles.
- **Liverpool City Region to get yellow bus:** On **July 12, 2022**, hydrogen-central.com reported that the **Liverpool City Region** is to get 20 state-of-the-art hydrogen powered and propelled fuel-cell technology buses, the procurement of the buses being funded through the Liverpool City Region **Transforming Cities Fund**.

Cars:

- During the week beginning **July 11, 2022**, **A.P. Moller – Maersk** published [Regional powerhouses – How logistics will charge EV battery localisation](#). The publication is excellent, providing an economically literate perspective on the shift in technologies used to power and to propel vehicle. The publication is well-worth a read, containing many useful facts and stats, but the high-light for the author of Low Carbon Pulse is the following bar-chart.



Source: [A.P. Moller – Maersk](#)

- Battery, Fuel Cell and ICE Technology:** During the news-cycle covered by this **Edition 43** of Low Carbon Pulse, no news items sufficiently material or significant arose to merit inclusion. This said, it is hoped that the following infographic is helpful.

E

Lithium Ion BATTERY vs Hydrogen FUEL CELL

Electric Vehicles

BEVs contain a large battery to store electricity.

Onboard charger
Converts AC electricity from power outlets into DC power.

Electric motor
Propels the car using energy from the battery.

Lithium-ion battery
Lithium ions create an electrical current by moving between the negative (anode) and positive (cathode) electrodes.

Cathode	Liquid Electrolyte	Anode
Lithium ions	→	→
Charging		
←	←	←
Discharging		

The longest-range BEV is the 2022 Lucid Air Dream Edition, which has an EPA rating of **505 miles**.

The longest-range FCEV is the 2022 Toyota Mirai XLE, which has an EPA rating of **402 miles**.

Source: U.S. Department of Energy

FCEVs use a hydrogen fuel cell to create electricity. This requires a tank to store hydrogen gas.

Fuel tank
Hydrogen gas is stored in a high-pressure tank. Liquid hydrogen can't be used because it requires cryogenic temperatures.

Exhaust
The only waste product of an FCEV is water.

Battery
Stores energy from regenerative braking.

Electric motor
Propels the car using energy produced by the fuel cell stack.

Fuel cell stack
The fuel cell combines hydrogen and oxygen to generate electricity.

Hydrogen gas (H₂) intake

Oxygen (O₂) intake

Anode | **Catalyst** | **Electrolyte** | **Cathode**

H₂ passes through the catalyst and splits into protons (H⁺) and electrons (e⁻)

Protons (H⁺) pass through the electrolyte

Chemical reaction creates water (H₂O)

Water emitted through exhaust

Electrons can't pass through the electrolyte, so they take an external path. This creates an electrical current which powers the car.

ELEMENTS.VISUALCAPITALIST.COM

- Industrial Vehicles and Trucks:** During the news-cycle covered by this **Edition 43** of Low Carbon Pulse, no news items sufficiently material or significant arose to merit inclusion.

- **Recharging and refuelling infrastructure:**

- **BOC and BP on the road:** On **July 14, 2022**, [h2-view.com](https://www.h2-view.com) reported that **BOC** (part of the Linde Group) and **bp** (leading international energy corporation) had announced that they have agreed to develop and to deploy a hydrogen refuelling station at a bp truck-stop at **Lytton, Queensland**.

BOC will supply and install the state-of-the-art Linde designed and developed hydrogen refuelling station, and **BOC** will supply Green Hydrogen produced at its **Bulwer Island** production facility.

As reported, this will be the first service station in Australia with hydrogen refuelling capacity, and will open later in 2022.

- **Hynion to install two hydrogen refuelling stations:** On **July 15, 2022**, [h2-view.com](https://www.h2-view.com) reported that **Hynion** (hydrogen refuelling station designed, developer and operator) is to develop and to deploy two high-capacity hydrogen fuelling / refuelling stations at **Västerås** and **Jönköping**, Sweden. The two stations are to be developed with funding support from the Swedish Energy Agency. Each station is reported to have capacity of 1,500 kgs a day.

- **Trains:** During the news-cycle covered by this **Edition 43** of Low Carbon Pulse, no news items sufficiently material or significant arose to merit inclusion.

Ports Progress and Shipping Forecast:

- **Ferries and other craft:**

- **Saronic Ferries to procure 800 pax Ro-Pax ferry:** On **July 12, 2022**, it was reported that **Saronic Ferries** (Greek ferry operator) had appointed **C-Job Naval Architects** (the Netherlands based design and engineering corporation) to develop the design for a **Ro-Pax ferry** with capacity for 800 pax, and that is to have a fully electric propulsion system. The home port of the **Ro-Pax ferry** will be **Piraeus** (where the batteries for its propulsion system will be recharged), and will ferry vehicles and pax between **Piraeus** and the islands of **Aegina** and **Agistri**.

- **MS Medstraum voyage:** On **July 14, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **MS Medstraum** had embarked on its maiden voyage from the Norwegian Fjellstrand shipyard to its home port of Stavanger. From late summer 2022, the **MS Medstraum** is to ferry passengers between Stavanger and Hommersåk.

As reported, the 30 metre **MS Medstraum** is the "world's first fully electric and zero emission fast ferry classed as a high-speed craft".

- **Green Shipping: Berge Bulk to install Anemoui rotor sails:** On **July 13, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Berge Bulk** had agreed with the assisted propulsion provider **Anemoui Marine Technologies** (UK headquartered technology corporation) to for the supply and installation of **rotor sails** on two of its bulkers, the **Berge Neblina** (a 388,000 dwt Valemax) and the **Berge Mulhacen** (a 210,00 dwt Newcastlemax).

Airports and Aviation:

- **Neste delivers CORSIA certified SAF to AA:** On **July 12, 2022**, **Neste** [announced](https://www.neste.com/en/press-releases/2022/07/12/neste-delivers-corsia-certified-saf-to-american-airlines) that: "For the first time in aviation history a CORSIA batch of sustainable aviation fuel (SAF) was delivered to a commercial airline. Neste, the world's leading SAF producer, delivered a batch of its Neste MV Sustainable Aviation Fuel TM to American Airlines at San Francisco International Airport".

CORSIA stands for **Carbon Offsetting and Reduction Scheme for International Aviation**, being a carbon offset and carbon reduction scheme to lower **CO₂** emissions arising from international flights. **CORSIA** was developed by the International Civil Aviation Organization.

- **SAF continues to find, and to expand, market:** On **July 14, 2022**, it was reported **Alaska Air Group Inc.**, **Microsoft Corporation**, and **Twelve**, had signed a memorandum of understanding to work together to develop the market for sustainable aviation fuel (**SAF**), including derived from re-captured **CO₂**, to work towards the first commercial demonstration flight in the US powered and propelled using **Twelve E-Jet[®]** fuel.

- **Making Net-Zero Aviation Possible:** On **July 14, 2022**, the **Mission Possible Partnership** (sponsored by Energy Transition Commission, RMI, We mean Business Coalition, and World Economic Forum, supported by knowledge partner McKinsey & Corporation), published [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](https://www.missionpossiblepartnership.com/publications/making-net-zero-aviation-possible).

The publication notes that it builds on others as follows: [Waypoint 2050](https://www.waypoint2050.com) by the **Air Transport Action Group** and its accompanying **ICF report Fuelling Net Zero; Report on the Feasibility of a Long-Term Aspirational Goal for the International Civil Aviation CO₂ Emission Reductions** by the **International Civil Aviation Organization**; [Decarbonising Air Transport](https://www.decisiontree.com/insights/decarbonising-air-transport) by the **International Transport Forum** and the **Organisation for Economic Co-operation and Development**; [Horizon 2050: A Flight Plan for the Future of Sustainable Aviation](https://www.aiaa.org/resources-reports/2021-aviation-climate-action-plan) by the **Aerospace Industries Association** and **Accenture**; [2021 Aviation Climate Action Plan](https://www.federalaviation.gov/2021-aviation-climate-action-plan) by the **US Federal Aviation Administration**; [PTL Roadmap](https://www.pptl.com/ptl-roadmap) by the **German Federal Government**; [Decarbonisation Road-Map](https://www.decisiontree.com/insights/decarbonisation-road-map) by **Sustainable Aviation for the United Kingdom**; and [Roadmap to Climate Neutral Aviation in Europe](https://www.transportandenvironment.com/roadmap-to-climate-neutral-aviation-in-europe) by **Transport and Environment**. All are excellent publications, and links to all are included for ease of reference.

The [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](https://www.missionpossiblepartnership.com/publications/making-net-zero-aviation-possible) provides **11 critical insights** as follows: **1.** Bringing aviation on a path to net-zero emissions by 2050 requires a doubling of historical fuel efficiency gains for aircraft, a rapid roll-out of **SAF**, and market development of novel propulsion aircraft by 2030; **2.** Aviation can comply with a sectoral 1.5°C carbon budget if all levers are pulled. Achieving net-zero by mid-century avoids cumulative **GHG** emissions of **25 to 26 Gt CO₂-e**; **3.** The average annual investments between 2022 and 2050 to get global aviation to net zero is estimated at about USD 175 billion, about 95% of which would be required for fuel production and upstream assets; **4.** Current project pipelines for **SAF** production are insufficient and need to be scaled-up by a factor of 5 to 6 until 2030; **5.** The faster the cost decline in renewable electrical energy generation, the higher the expected market share of Power-to-Liquids (PtL). In contrast, if electrical energy costs do not drop as rapidly, biofuels are likely to dominate the market; **6.** Hydrogen and battery-electric aircraft can make global aviation more efficient starting in the late 2030s and supply up to a third of the final energy demand by 2050; **7.** By 2050, net-zero emission aviation could require an additional **5,850 TWh** of renewable electrical energy, **95**

million metric tonnes of hydrogen, and **12 EJ** of **sustainable biomass**; **8.** Aircraft fuel efficiency gains and operational measures could avoid over 15 Gt CO₂-e of cumulative **GHG** emissions at zero or even negative abatement costs; **9.** Although average fuel costs are increasing in the net-zero scenarios, the cost of flying could remain stable, being counterbalanced by efficiency gains; **10.** Carbon dioxide removal (**CDR**) solutions are needed to remove residual emissions from renewable fuels, but are not a replacement for deep and rapid sector decarbonisation; and **11.** Policy makers must create a level playing field between fossil fuel jet fuel and **SAF**, industry collaboration across the value chain can ramp up **SAF** demand and supply, as well as trigger technological innovation.

The [**Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy**](#) is outstanding, and is worth-repeated reading and reflection.

Low Carbon Pulse - Edition 44

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 44** of **Low Carbon Pulse** – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Monday July 18, 2022** to **Sunday July 24, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering the period from October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering the period from October 7, 2021 to March 31, 2022), and [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39, 40** and **41** covering **April, May** and **June, 2022**).

Welcome to the weekly news-cycle Low Carbon Pulse:

During July 2022 we are trialling a weekly news-cycle for Low Carbon Pulse. As regular readers of Low Carbon Pulse will know, for April, May and June 2022 we trialled a monthly news-cycle, having previously used a two week news-cycle. Both the monthly and two weekly news-cycles resulted in long publications, not ideal for those seeking a "quick-read". It is hoped that the weekly news-cycle will provide the right balance / length, ideally between 8,000 and 10,000 words. In this **Edition 44** of Low Carbon Pulse, this ambition has been achieved.

Climate consequences of hydrogen emissions:

Previous editions of Low Carbon Pulse reported on research in respect of the impact on the climate system of the release of hydrogen emissions as the production, and use, of hydrogen becomes everyday over the coming years. The headline was that hydrogen emissions need to be avoided because on release, hydrogen will compound with other elements, to produce **GHG** emissions.

On **July 20, 2022**, [copernicus.org](https://www.copernicus.org) published [Climate consequences of hydrogen emissions](#). The article is compulsory reading for all. The abstract provides a clear sense of the need to understand and not to overlook or to underestimate the impact of hydrogen emissions, and part of it is quoted below:

"While zero- and low-carbon hydrogen hold great promise ... [hydrogen] is an indirect greenhouse gas whose warming impact is both widely overlooked and underestimated. This is largely because hydrogen's atmospheric warming effects are short-lived – lasting a couple of decades – but standard methods of characterising climate impacts of gases consider only the long-term effect from a one-time pulse of emissions. For gases whose impacts are short-lived, like hydrogen, the long-term framing masks a much stronger warming potency in the near- to medium term".

We live in a world of unintended consequences, but the mantra must be do no harm, and do it quickly.

Publication very much worth a read:

The **American Bureau of Shipping (ABS)** has published [Setting the Course to Low Carbon Shipping – Zero Carbon Outlook](#). Whether your day job involves shipping or not, the publication is excellent and well-worth a read (see page 2).

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

- **UK Net-Zero Strategy not sufficiently detailed:** On **July 18, 2022**, it was reported widely that **Justice Holgate** found that the UK Government had not complied with the UK **Climate Change Act** because its Net-Zero Strategy to achieve **NZE by 2050** was not sufficiently detailed and quantified. Justice Holgate ordered the UK Government to publish a revised Net-Zero Strategy compliant with the Climate Change Act by March 2023. A link to the case is [attached](#).
- **House of Lords Economic Affairs Committee warns of disorderly transition:** The judgment of **Justice Holgate** may be regarded as being consistent with the perspective of the **House of Lords Economic Affairs Committee**. On **July 21, 2022**, the **Committee** published [Investing in energy: price, security and the transition to net zero](#). At the core of the findings of the Committee is a lack of granularity, expressed in practical terms, providing a disconnect or gap between the ambitious targets and the practical plans to realise those targets. Also, the Committee notes the need to adopt a pragmatic medium term approach to natural gas to ensure energy security.
- **ABS Sets Course:** In the first couple of weeks of July the author finished reading the **American Bureau of Shipping (ABS)** published [Setting the Course to Low Carbon Shipping – Zero Carbon Outlook](#). As might be expected, the publication is data and information rich, and technology neutral, as to the transition in fuel use across the shipping industry.

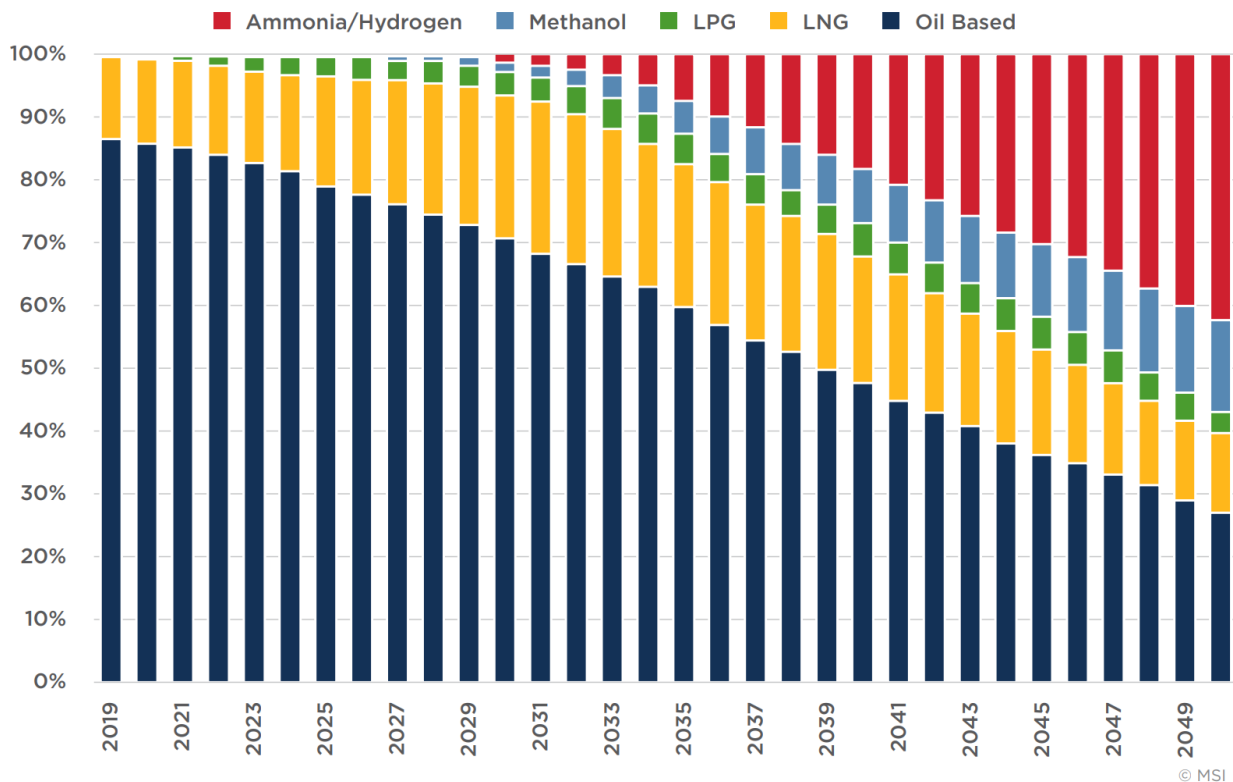


Figure 71: Fuel mix forecast.

Source: [American Bureau of Shipping](#)

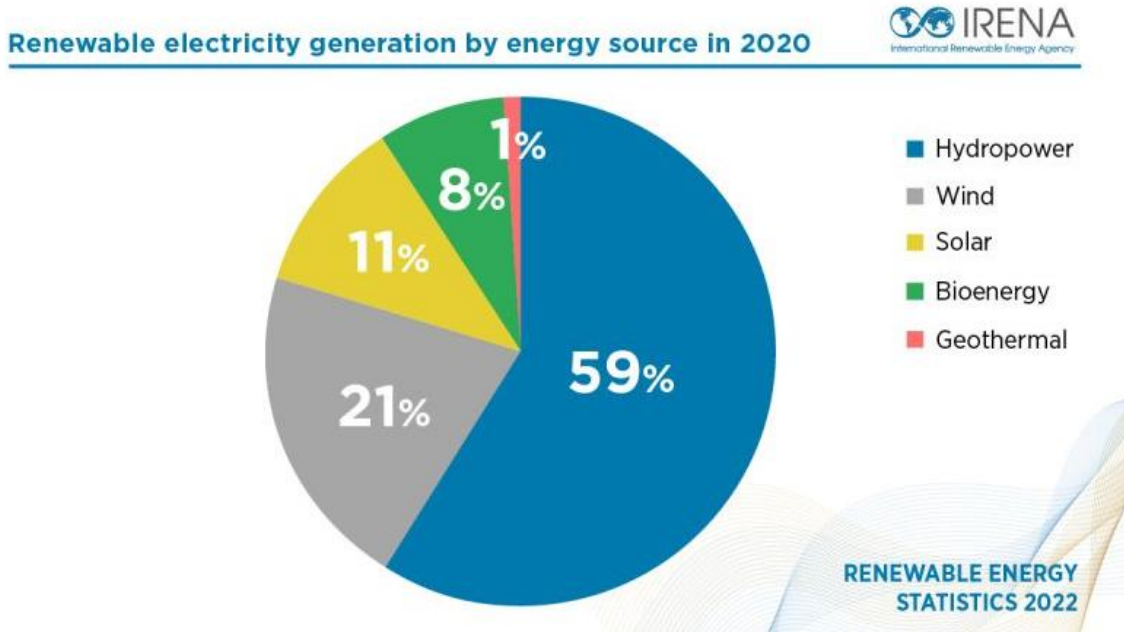
While the publication will be of considerable interest to those active (or interested) in the shipping industry, the report is to be commended in the same way that **Edition 43** commended **Mission Possible Partnership** publication [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](#). The quality of both publications is outstanding.

- **International Energy Agency (IEA)** publications: on **July 20 2022**, the **IEA** will publish its [Electricity Market Report – July 2022 Update](#). As with all **IEA** publications, this publication is well worth a read. The key findings of the report may be regarded as follows: **1.** Electricity demand growth is slowing significantly during 2022, slowing to 2.4%; **2.** Tight natural gas markets are favouring the use of coal-fired power plants in the near-term; **3.** The development and deployment of renewable energy capacity is growing at a faster rate than demand; **4.** The **GHG** emissions from the electricity sector are set to decline slightly; **5.** Wholesale electrical energy prices are skyrocketing in many countries; **6.** The **EU** is gearing up to reduce its reliance on Russian fossil fuel imports by accelerating its clean energy transition; and **7.** There remains uncertainty around estimates for 2023, both electrical energy demand and the supply side generation mix to match demand. Current forecasts are that electrical energy demand will increase by around 2.5% in 2023, with strong growth in the development and deployment of renewable electrical energy capacity.

On **July 19, 2022**, Ukraine joined the **IEA** as an Associate country.

- **International Renewable Energy Agency (IRENA)** publications:

- On **July 18, 2022**, **IRENA** published [Renewable Energy Statistics 2022](#). The headline from the publication is that during 2020 "the amount of electricity generated from renewables reached 7,468 TWh". The publication provides details, country by country, of the renewable electrical energy generated, and as such is data and information rich. The following pie-chart provides a global view of the renewable sources from which electrical energy was generated.



Source: [IRENA](#)

Attached is a two page summary prepared by **IRENA** entitled [Renewable energy highlights](#) which will avoid the need to plough through the full report.

- On **July 20, 2022**, **IRENA** published [Scenarios for the Energy Transition – Experience and good practice in Latin America and the Caribbean](#). The publication is well-worth a read, providing great examples of long-term scenario and energy planning tools for the purposes of developing and implementing national energy planning and strategies.

Climate change reported and explained:

- Extreme weather events:** Extreme weather events have continued during the week commencing July 18, 2022. The **International Panel on Climate Change (IPCC)** defines an extreme weather event as follows:

"An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme".

It is fair to say that North America, North Africa, India and Europe, and increasingly the **PRC**, have been experiencing **extreme weather events**, and in many instances those extreme weather events, having persisted, may be characterised as **extreme climate events**. The climate system has changed, and continues to change.

- NOAA June Report:** As noted in **Edition 43** of Low Carbon Pulse, on **July 14, 2022**, the US National Oceanic and Atmospheric Administration (**NOAA**) published its June Report. The headline from the June Report is that: "June's average global temperature continued 2022's remarkably warm trend, as the both the month and the year so far ranked as the sixth warmest on record June 2022 marked that 46th consecutive June and the 450th consecutive month with temperatures above the 20th century average. The ten warmest Junes on record have all occurred since 2010". We have repeated the information and infographic from the **NOAA** June Report, reflecting the continued impact of climate change.

Selected Significant Climate Anomalies and Events: June 2022



GLOBAL AVERAGE TEMPERATURE
June 2022 average global surface temperature was the sixth highest for June since global records began in 1880.



Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <http://www.ncei.noaa.gov/access/monitoring/>

Middle East including GCC Countries:

- **UAE aligns with France:** On **July 19, 2022**, it was reported widely that the **UAE** and **France** had signed a memorandum of understanding to establish a **Comprehensive Strategic Energy Partnership**. As reported, the partnership provides for the enhancement of energy security and affordability, decarbonisation and progressive action on climate change ahead of COP-28 to be held in the UAE in 2023. There has been considerable positive coverage of the **Comprehensive Strategic Energy Partnership** in both the UAE and France.
- **UAE aligns with France:** On **July 20, 2022**, it was reported widely that **ADNOC** (Abu Dhabi National Oil Company) and **TotalEnergies** had signed a **strategic partnership agreement** to ensure cooperation between the two energy giants, including in respect of CCS and natural gas (and product supply and trading). As with the **Comprehensive Strategic Energy Partnership**, this **strategic partnership agreement** has received positive coverage.

Africa:

- **The importance of peat swamps and wetlands:** On **July 21, 2022**, theconversation.com published [Congo peat swamps store three years of global carbon emissions – imminent oil drilling could release it](https://theconversation.com/congo-peat-swamps-store-three-years-of-global-carbon-emissions-immminent-oil-drilling-could-release-it-181111), providing a link to the nature geoscience publication of [Mapping peat thickness and carbon stocks of the central Congo Basin using field data](https://doi.org/10.1016/j.cop.2022.07.001). Both the article and the report are well-worth a read, providing a data and information rich assessment of the carbon trapped within the peatlands of the **Congo Basin**, and the possible consequences for the release of carbon into the climate system – it is stated that the **Congo Basin** contains close to 30% of the world's tropical peat carbon. Globally, peatlands cover around 3% of the landmass, and yet store around 600 giga-tonnes of carbon (this may be regarded as a conservative estimate). As noted in previous editions of Low Carbon Pulse, peatlands (and wetlands) are vulnerable to drainage and drying given climate change. We live in a world of unintended carbon consequences, and as such the mantra of do no harm, and do it quickly, is a sound one.
- **Construction commences on El-Dabaa Nuclear Power Plant (ENNP):** On **July 22, 2022**, energy-utilities.com reported that concrete has been poured for **Unit 1** of the **ENNP**, located 300 kms north-west of **Cairo, Egypt**. **Unit 1** is the first of four planned units, each with nameplate generating capacity of **1.2 GW**. The development agreement for **ENNP** was signed around five years ago, but it took time for approvals to be obtained. The developer of the **ENNP** is **Rosatom** (the Russian state-owned nuclear energy corporation).

India and Indonesia:

- **REMC Limited procuring up to 2.6 GW of renewable electrical energy:** On **July 18, 2022**, it was reported widely that **REMC Limited** (a corporation within the Indian Railways group) has issued documents to procure up to **2.6 GW** of electrical energy from renewable sources, with the electrical energy to match the load across a number of areas of the Indian rail network. It is understood that the renewable energy projects will be developed using a build-own-operate development model.

- **Ola announces battery innovations centre in Bengaluru:** On **July 18, 2022**, batteriesnews.com reported that it was to develop a **USD 500 million** battery innovations centre (**BIC**) in Bengaluru, India, providing an advanced cell research and development (**R&D**) facility.
- **Scale and size of hydrogen supply and demand in India:** On **July 18, 2022**, energyworld.com (under **Green hydrogen demand in steel, mobility, natural gas sectors to require \$78-bn funding in India**) reports on an interview with folk from the **Council on Energy, Environment, and Water (CEEW)**. For India to produce **5 million metric tonnes** of Green Hydrogen by 2030, this will require at least **100 GW** of installed renewable energy capacity and the development and deployment of **40 GW** of electrolyser capacity, at a cost of **USD 100 billion**. The perspective of the folk at **CEEW** is that Green Hydrogen can be used across the iron and steel and mobility sectors (using existing or repurposed natural gas pipelines), with the potential across these sectors equating to up to an **additional 3.5 million metric tonnes** of Green Hydrogen. The additional Green Hydrogen production will require at least **70 GW** of installed renewable energy capacity and the development and deployment of **28 GW** of electrolyser capacity, at a cost of **USD 78 billion**.

The folk at **CEEW** see **two challenges** with the development of the Green Hydrogen sector, **first**, the experience of financial institutions in India in lending on projects of this kind, and **secondly**, the rate at which funding may be made available (both debt and equity). As in other markets around the world, the cost and the efficiency, and utilisation, of electrolysers are regarded as factors that may affect the cost of debt funding, certainly where the Green Hydrogen produced is to be used in the mobility sector. The report is well-worth a read, providing other insightful commentary on the Indian market.

- **GUNVL procuring up to 1.5 GW of photovoltaic solar:** On **July 19, 2022**, pv-magazine-india.com reported that **Gujarat Urja Vikas Nigam Ltd (GUNVL)** has issued documents to procure up to **1.5 GW** of electrical energy from grid-connected photovoltaic solar projects located within the state of Gujarat.
- **Mumbai Climate Action Plan:** During the week-beginning **July 18, 2022**, the 240 page **Mumbai Climate Action Plan 2022, Towards A Climate Resilient Mumbai** was published (as part of the **C40 Cities** initiative) by **WRI India**. The publication is excellent, and may be regarded as compulsory reading. The publication identifies 24 action tracks under six priority areas. The following slides illustrate the six priority areas.



- **BHP and Tata Steel align:** On **July 20, 2022**, **BHP** [announced](https://www.bhp.com/announcements) that it and **Tata Steel** had signed a memorandum of understanding (**MOU**) to undertake jointly the assessment and study of the use of lower and low carbon iron and steel making technologies. As announced, under the **MOU BHP and Tata Steel** intend to work together to reduce the **GHG** emissions intensity of blast furnace iron and steel making via two priority areas, first, the use of biomass as a source of bioenergy and secondly the use of CCU in iron and steel making.
- **RPO Order to apply through 2029-30:** On **July 22, 2022**, the **Ministry of Power Government of India** released **Renewable Purchase Obligation (RPO) and Energy Storage Obligation Trajectory till 2029-30**.

Year	Wind RPO	HPO	Other RPO	Total RPO
2022-23	0.81%	0.35%	23.44%	24.61%
2023-24	1.60%	0.66%	24.81%	27.08%
2024-25	2.46%	1.08%	26.37%	29.91%
2025-26	3.36%	1.48%	28.17%	33.01%
2026-27	4.29%	1.80%	29.86%	35.95%
2027-28	5.23%	2.15%	31.43%	38.81%
2028-29	6.16%	2.51%	32.69%	41.36%
2029-30	6.94%	2.82%	33.57%	43.33%

Source: [Ministry of Power](#)

- **India Hydrogen Alliance- June 2022:** Attached is the link to the June edition of the [India H2 Monitor – June 2022](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link to, rather than to repeat the content of, the *India H2 Monitor*.

Japan and Republic of Korea (ROK):

- **ACWA and POSCO forge hydrogen tie-up:** On **July 19, 2022**, [renews.biz](#) reported that **ACWA Power** and **POSCO Holdings** had signed a Memorandum of Understanding under which the two leading corporations are to develop jointly Green Hydrogen, and Green Hydrogen derived-fuel, production capacity to decarbonise the activities of the **POSCO Group**. As reported, the Green Hydrogen, and Green Hydrogen derived-fuel, will be used across all activities undertaken by the **POSCO Group**, including the generation of electrical energy and the production of iron and steel, and will provide supply to other off-takers in the **ROK**.

The **CEO of ACWA Power, Mr Paddy Padmanathan** said: "With tangible project commitments in Saudi Arabia and Oman, ACWA Power is at the forefront of scaling up green hydrogen – whose output – ammonia – will lead to the outcome of decarbonising entire industries, including hard to abate industrial activities like steel manufacturing".

- **Hyundai Motor Group and Rolls-Royce up in the air:** On **July 19, 2022**, [hydrogen-central.com](#) reported that **Hyundai Motor Group** and **Rolls-Royce** have signed a memorandum of understanding under which they plan to work together to develop all-electric propulsion and hydrogen fuel cell technology to the **Advanced Air Mobility (AAM)** market, working to develop power and propulsion technology systems for **Hyundai's AAM** division, to commercialise / industrialise **Rolls-Royce** power and propulsion systems, to develop electric propulsion systems based on fuel-cells, to work together to bring to market a fuel-cell propulsion system to the wider **AAM** market, and to develop a fuel-cell electric demonstration aircraft by 2025.

As reported, both global leading corporations share a vision of leading the way in the **AAM** market, using battery electric and fuel-cell technology to develop the Urban Air Mobility and Regional Air Mobility markets.

PRC and Russia:

- **Air Liquide to develop two hydrogen production units:** On **July 19, 2022**, it was reported widely that **Air Liquide** (one the three global industrial gas giants) is to develop two hydrogen production units within the **Shanghai Chemical Industry Park**, each equipment with **CO₂** capture capacity. As reported, the development will require a capital investment of around **€200 million**. The return of, and return on capital, will be realised under long-term contracts with Covestro China and Shanghai Lianheng Isocyanate Company, both located within the **Shanghai Chemical Industry Park**.
- **PRC adds 30 GW of photovoltaic solar in the first half of 2022:** On **July 22, 2022**, [pv-magazine](#) reported that during the first six months of 2022, the **PRC** installed **30 GW** of photovoltaic solar capacity (the **PRC** now having **340 GW** of photovoltaic capacity installed cumulatively). The information is sourced from the **China Photovoltaic Industry Association**, which expects between **85** and **100 GW** of new photovoltaic solar capacity to be installed during 2022.

Europe and UK:

- **UK launches electricity market reform:** On **July 18, 2022**, the UK Government (under [UK launches biggest electricity market reform in a generation](#)) announced a major review of the electricity market design to ensure that cost benefits of cheaper energy are realised for the benefit of consumers. The announcement from the Department for Business, Energy & Industrial Strategy is fulsome, providing a clear rationale for reform. The announcement is well-worth a read.
- **The Crown Estate green lighted in respect of six projects under derogation:** On **July 19, 2022**, **The Crown Estate** [announced](#) that the **Secretary of State for Business, Energy and Industrial Strategy** has agreed that **The Crown Estate** can proceed to enter into leases, thereby proceeding with the implementation of the **Offshore Wind Leasing Round 4** under a derogation: as reported in [Edition 33](#) of Low Carbon Pulse (early February 2022), a number of applicants in the **Offshore Wind Leasing Round 4** process were awarded preferred bidder status, providing a basis to undertake further work to allow progress towards development, at which time an agreement for lease would be entered into with **The Crown Estate**. The derogation allows **The Crown Estate** to enter into agreements to lease in respect of each of the lease areas comprising the **Offshore Wind Leasing Round 4** process. As reported in [Edition 42](#) of Low Carbon Pulse, on **July 5, 2022**, **The Crown Estate** has announced plans to develop floating off-shore wind fields in the Celtic Sea, with the potential to install a further 4 GW of off-shore wind field capacity.
- **UK launches first clean-hydrogen subsidy scheme:** On **July 20, 2022**, it was reported widely that the UK Government is seeking expressions of interest by September 7, 2022, from those wishing to participate in a funding support initiative to help fund an initial **1 GW** of **Green Hydrogen** and **1 GW** of **Blue Hydrogen** (consistent with

the dual track approach of the UK Government). On **July 20, 2022**, the **Department for Business, Energy and Industrial Strategy** published [UK public sector support for hydrogen research and innovation](#), providing an overview of the bodies supporting public sector hydrogen research and innovation in the UK, how this support can be accessed, and case studies to demonstrate the type of support that is available.

Americas:

Biden Administration Executive Action: On **July 20, 2022**, **The White House, Briefing Room**, released **FACT Sheet: President Biden's Executive Actions on Climate to Address Extreme Heat and Boost Offshore Wind**. In respect of offshore wind, the release outlined that the Department of the Interior is proposing the first Wind Energy Areas in the Gulf of Mexico, covering 700,000 acres, and stated that President Biden had directed the Department to advance wind energy development in the waters offshore the mid and southern Atlantic Coast and Florida Coast.

France and Germany:

- **Fifth FSRU for Germany:** Since March 2022, Low Carbon Pulse has reported on the procurement of four floating storage and regasification units (FSRUs) to be located in German ports. FSRUs allow the import of liquified natural gas (LNG), and its storage and regasification, and send out. The procurement of the FSRUs has been in response to providing energy security. On **July 18, 2022**, **TotalEnergies** announced plans to procure an FSRU to be located in the port of **Lubmin, Germany**, with operation planned to commence in December 2022. **TotalEnergies** is to procure the FSRU and **Deutsche ReGas** is designing the shoreside facilities (including top-sides and send out) and connection to the **EUGAL** natural gas network to allow the send-out of natural gas to ultimate users.
- **Germany's bi-lateral relationships:** Previous editions of Low Carbon Pulse have reported on the bi-lateral relationships that Germany has established to develop hydrogen supply / value chains. The 23 bi-lateral relationships include 11 within the carriage of **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)**, GmbH for the German Federal Government. **GIZ** has published [Hydrogen Business Guide – Bilateral energy partnerships in development countries and emerging markets](#).
- **Electrolysers mapped: Edition 43** of Low Carbon Pulse noted that **Dr Thomas Hillig** had posted a map of the [Green Hydrogen electrolysers across Germany](#). We have retained this link for those who may have missed it. The post from **Dr Hillig** promises maps on hydrogen pilot projects in the iron and steel industry, hydrogen projects in the mining industry, Green Hydrogen in fertiliser, Electrolysers in Europe and in the World.

Australia:

- **Queensland Launches Skills Development Roadmap:** On **July 20, 2022**, the Government of Queensland, Australia, launched the first dedicated workforce development plan for the hydrogen industry – [The Hydrogen Industry Workforce Development Roadmap 2022-2023](#). The initiative was flagged by the Government of Queensland nearly three years ago, and demonstrates the progressive thinking of the Government.
- **Renewable natural gas on its way:** On **July 20, 2022**, [pv-magazine-australia](#) reported that Sydney is progressing to the first flow of renewable natural gas with biogas from wastewater upgraded to produce biomethane for injection into the pipeline network. The biogas is to be derived from the Sydney Water Wastewater Resource Recovery Facility with the biogas then ungraded to produce up to 95,000 GJ of biomethane. It is to be hoped that this project will blaze a trail along the East Coast of Australia.

Blue and Green Carbon Initiatives and Biodiversity

- **Global Mangrove Alliance and Wetlands International report on mangroves:** On **July 20, 2022**, **Global Mangrove Alliance, Save Our Mangroves Now!** and **Wetlands International** published [The State of Mangroves in the West Indian Ocean](#). The publication considers the state of the mangroves along the east coast of Africa, in particular Kenya, Madagascar, Mozambique and Tanzania. For those interested in Blue Carbon, the publication is rich in data and information, with a strong focus on the opportunities for restoration of mangrove forests and swamps within the West Indian Ocean region.
- **Nature Based Solutions:** During the first part of July, the author of Low Carbon Pulse read the **European Commission** publication [The Vital Role of Nature-Based Solutions In a Nature Positive World](#), which was released by the **Directorate-General for Research and Innovation**. The publication is an excellent primer for **Nature-Based Solutions (NBS)** and **Nature-Based Enterprises (NBE)**. It is hoped the resources and time are devoted to the development of the thinking contained in the publication in the near term.
The author also read the **Asian Development Bank (ADB)** publication [Integrating Nature-Based Solutions for Climate Change Adaptation and Disaster Risk Management – A Practitioner's Guide](#). The **ADB** publication, authored by John Matthews and Ernesto Ocampo Dela Cruz provides a wonderful addition to those active (or those interested) in the area of **NBS**. **NBS** are at the core of both Blue and Green Carbon Initiatives. One of the many good things about the **ADB** publication is that it applies a broader perspective as to what is an **NBS**.
- **UN Biodiversity Conference:** As reported in **Edition 41** of Low Carbon Pulse, **Part 2 of the UN Diversity Conference** (fifteenth meeting of the Conference of Parties (**COP-15**) to the Convention on Biological Diversity) is to take place between **December 5 and 17, 2022**, in **Montreal, Canada**.
COP-15 is intended to adopt the **post-2000 global biodiversity framework**, which provides a strategic vision and global roadmap for the conservation, protection, preservation, restoration and sustainable management of biodiversity and ecosystems for the next decade. [Draft 1](#) of the **post-2000 global biodiversity framework** was released in July 2021.

BIODIVERSITY

In the broadest sense, **biodiversity** describes the variety of the fauna and flora globally, and in any particular area. The preservation of **biodiversity** is a key policy setting. In this context, human activities and the clearing of land to undertake agricultural, forestry or other land use (**AFOLU**) is a key focus of policy settings. Desertification and

deforestation are key concerns (both as a result of **AFOLU**), as is the broader impact of climate change on habitats, critically, the impact on change in temperature on land and in the ocean.

There is a balance in habitats, with eco-systems that have developed overtime, and that continue to develop. The balance of habitats and their eco-systems are impacted by **AFOLU** and climate change. There are many examples, but a consistent example (that many will recognise) is the need to preserve the habitats of bees and other pollinators, and to avoid loss of bees and other pollinators. As a policy setting, the rewilding of habitats is one element of preservation, and, in some cases, restoration of eco-systems. As a broad statement, preserving wilderness areas, and rewilding of areas, and reducing old growth forestry, and afforestation and reforestation, are key to the preservation and restoration of **biodiversity**. These are policy settings over which we have control in the near, medium and long term. In addition, overtime, policy settings may extend to addressing optimal use of land, optimal in the sense of preserving or restoring **biodiversity** while at the same time addressing climate change. As always, what is needed is known. As always, the challenge is acting upon it.

Climate change will impact the effectiveness of these policy settings (in particular coastal habitats, and areas of increased drought and desertification, driven by rising sea-levels and changes in weather patterns, as a result of climate change), but they are policy settings that are necessary and need to be progressed in the near term. In addition, acting to preserve and to restore **biodiversity** is likely to yield benefits, economic and social.

Bioenergy and heat-recovery:

- **Biogas reading for those taking a vacation:** On **July 20, 2022**, the ever-excellent biogasworld.com published **Top 10 Biogas Reports To Add To Your Summer Reading List**.

The Top Ten Biogas reads listed are: **1. Best Practices for Reducing Costs of Anaerobic Digestion of Organic Waste**; **2. Biomethane Production Potentials in the EU** – see below; **3. Renewable Natural Gas as a Complementary Solution to Decarbonizing Transport**; **4. Fuelling Clean Mobility with Bio-LNG**; **5. Hitting Canada's Climate Targets with Biogas and RNG**; **6. Bioenergy Europe Statistical Report 2022**; **7. Green Gas: The Green Economy under our Feet**; **8. Turning Circle: How Bioenergy can Supercharge Australia's Circular Economy**; **9. The Landscape of Methane Abatement Finance**; and **10. Anaerobic Digestion Deployment in the UK**. To the surprise of the author of Low Carbon Pulse, a number of the publications sit in the "read-pile", with an equal number in the "to-read pile".

- **A Gas for Climate report: Edition 42** of Low Carbon Pulse reported that the **Gas for Climate** consortium published an update **Biomethane production potentials in the EU**. The updated publication builds on the previous publication from **Gas for Climate**, to take into account the acceleration of the use of biomethane now contemplated by the **EU**. The key findings of the publication are: **1.** There is enough sustainable feedstock in the **EU** to achieve the **EU REPowerEU** target of **35 bcm by 2030**, with up to **41 bcm by 2030** and **151 bcm by 2050**; **2. Anaerobic digestion** is regarded as having the potential to derive up to **38 bcm by 2030**, and up to **91 bcm by 2050**. In the **EU** context, France, Germany, Italy, Poland and Spain will be the top five producers of **biogas** derived **biomethane** using anaerobic digestion technologies. The **key feedstocks** for these purposes **to 2030** being **manure** (33%), **agricultural residues** (25%) and **sequential cropping** (21%); and **3. Thermal gasification** is regarded as having the potential to derive up to **2.9 bcm by 2030**, and **60 bcm by 2050**. In the **EU** context, France, Germany, Italy, Spain and Sweden will be the top five producers of biomethane using thermal gasification. The **key feedstocks** for these purposes **to 2030** are **forestry residues** and **wood waste**, together having 60% of the feedstock source.

BIOENERGY

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "upgrading") so that it can be used as pipeline gas (i.e., complying with the specification for hauling through the applicable natural gas pipeline, including the removal of **CO₂**, and other compounds and elements, such that the gas hauled through the pipeline is **CH₄**). **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel (typically, as a gas that is combusted / oxidised to produce electrical energy or heat energy or both) or as a feedstock. Also, either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia:** being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;
- **Bio-butanol:** being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel:** being diesel (i.e., synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol:** being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene:** being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF)**, is a synthetic paraffinic kerosene. Currently, most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams

(typically using some natural gas). As noted below, typically fatty acids and hydrogenated acids are used to produce synthetic paraffinic kerosene. If the feedstock is sourced from Biomass it is a Bio-kerosene;

- **Bio-LNG:** being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and
- **Bio-methanol:** being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

BESS and HESS (and energy storage):

- **Iberdrola inaugurates 40 GWh pumped hydro-electric plant on July 18:** On **July 19, 2022**, [energy-storage.news](#) reported that **Iberdrola** had inaugurated its **Tâmega Giga-battery** in northern Portugal, as part of its renewable energy complex. As reported, **Iberdrola** has invested **€1.5 billion** in the renewable energy complex which combines **two run-of-river hydroelectric plants** and a **880 MW** pumped hydro energy storage (**PHES**) unit (Gouvães), with combined electrical energy output of 1.158 GW.

By way of reminder: Edition 35 of Low Carbon Pulse reported on the renewable energy complex as follows:

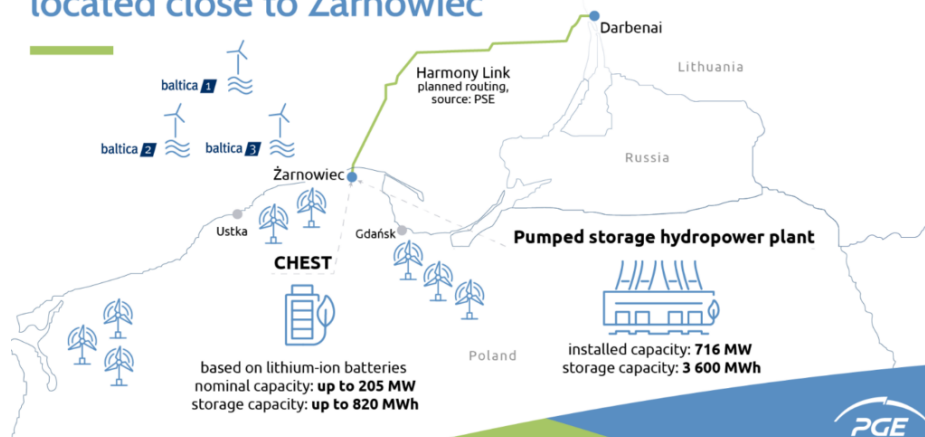
Iberdrola pumps-up scale: On February 8, 2022, it was reported widely that Spanish renewable energy giant, Iberdrola is developing a MW hydro-electric power complex in northern Portugal, using water from three reservoirs: Alto Tâmega, Daivões and Gouvães.

The hydro-electric power complex will deploy a 880 MW reversible storage facility (pumped-storage), which is able to store water from the Daivões reservoir delivered into the Gouvães reservoir. There is a 650 metre differential between the two reservoirs, use of the differential will generate renewable electrical energy, with the water in the Gouvães reservoir pumped into the Alto Tâmega reservoir. The pumped storage is being described as the "Alto Tâmega giga battery": on operation the energy storage of Portugal will increase by 30%.

- **PGE Group to develop Big BESS:** On **July 21, 2022**, [energy-storage.com](#) reported that **PGE Group** (state-owned energy corporation) had obtained approval to develop and to deploy a **200 MW / 820 MWh BESS** in Poland – named **CHEST (Commercial Hybrid Energy Storage)**. As reported, **CHEST** will be integrated with the existing **716 MW / 3,300 MWh** pumped hydro-electric storage (**PHES**) plant at Żarnowiec, and with wind farm generation capacity (**PGE Group** is permitted to install up to **3.5 GW** of wind farm capacity).

The development is part of a broader plan to provide energy market and grid flexibility, and the planned synchronisation of Estonian, Latvian and Lithuanian power grids under the Harmony Link project (see **Edition 34** of Low Carbon Pulse).

Commercial Hybrid Energy Storage (CHEST) located close to Żarnowiec



Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

- **DNV and Petronas Southeast Asian focus:** On **July 19, 2022**, [upstreamonline.com](#) reported that **Petronas** (Malaysia's natural energy corporation) and **DNV** are to work together on CCS and CCUS initiatives, in particular to address the business, regulatory and technical challenges of the development and deployment of CCS and CCUS within Southeast Asia. As reported, **Petronas** and **DNV** will work together on environmental and safety, risk generally, including technology, and identify and assess sites for storage, and the legislation and regulatory matters that are required.
- **"First of its kind" CCS project in North Dakota:** On **July 19, 2022**, [politicopro.com](#) reported that **Red Trail Energy LLC** (which operates an ethanol production facility in western North Dakota) had announced that the US's "first carbon capture and storage project allowed under state primacy" started operating during June 2022. As reported, in 2018 North Dakota became the first state to secure primacy over Class VI injection wells, being wells used to inject **CO₂** deep into rock formations for long-term (permanent) storage. **Red Trail Energy LLC** has announced that it is capturing **100%** of **CO₂** arising from its ethanol production facility.
- **WoodMac Energy Super Basins:** The **July Edition of Wood McKenzie's Horizon** publication [Energy super basins: Where the renewable CCS and upstream stars align](#). The publication is excellent, and compulsory

reading for those in the upstream oil and gas industry working towards energy transition and **NZE**. As is an emerging theme, Scope 3 emissions are critical, and CCS is critical to sequestration of Scope 3 emissions, but CCS is not feasible in many oil and gas basins globally.

- **The Week in Carbon Dioxide Removal:** On **July 22, 2022** Mr Wil Burns published his [Week 1 Edition](#). The **Week 1 Edition** is great and is commended to anyone interested in CCS / CCUS.

Carbon Credits and Hydrogen Markets and Trading:

REDD+ Framework: On **July 22, 2022**, the good folk at **Sylvera** published [Our Carbon Credit Ratings Framework for REDD+ Projects Reducing Emissions from Deforestation and Forest Degradation Project \(REDD+\)](#). The purpose of the publication is to provide a bottom-up approach to assess and to produce accurate ratings and analyses for carbon projects from which carbon credits are to be sourced for the voluntary carbon market.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

Portugal to the Netherlands supply chain: On **July 18, 2022**, the **Port of Rotterdam Authority** announced that **Engie, Shell New Energies NL BV, Anthony Veder** and **Vopak** had signed an agreement to study jointly the feasibility of producing and liquifying (in the precincts of the Sines Port) and transporting Green Hydrogen from the Sines Port in Portugal to the Port of Rotterdam in the Netherlands. Assuming that the feasibility of the Green Hydrogen supply chain is proved-up, the plan is for the first cargoes of liquified Green Hydrogen to be shipped from Sines Port to the Port of Rotterdam in 2027.

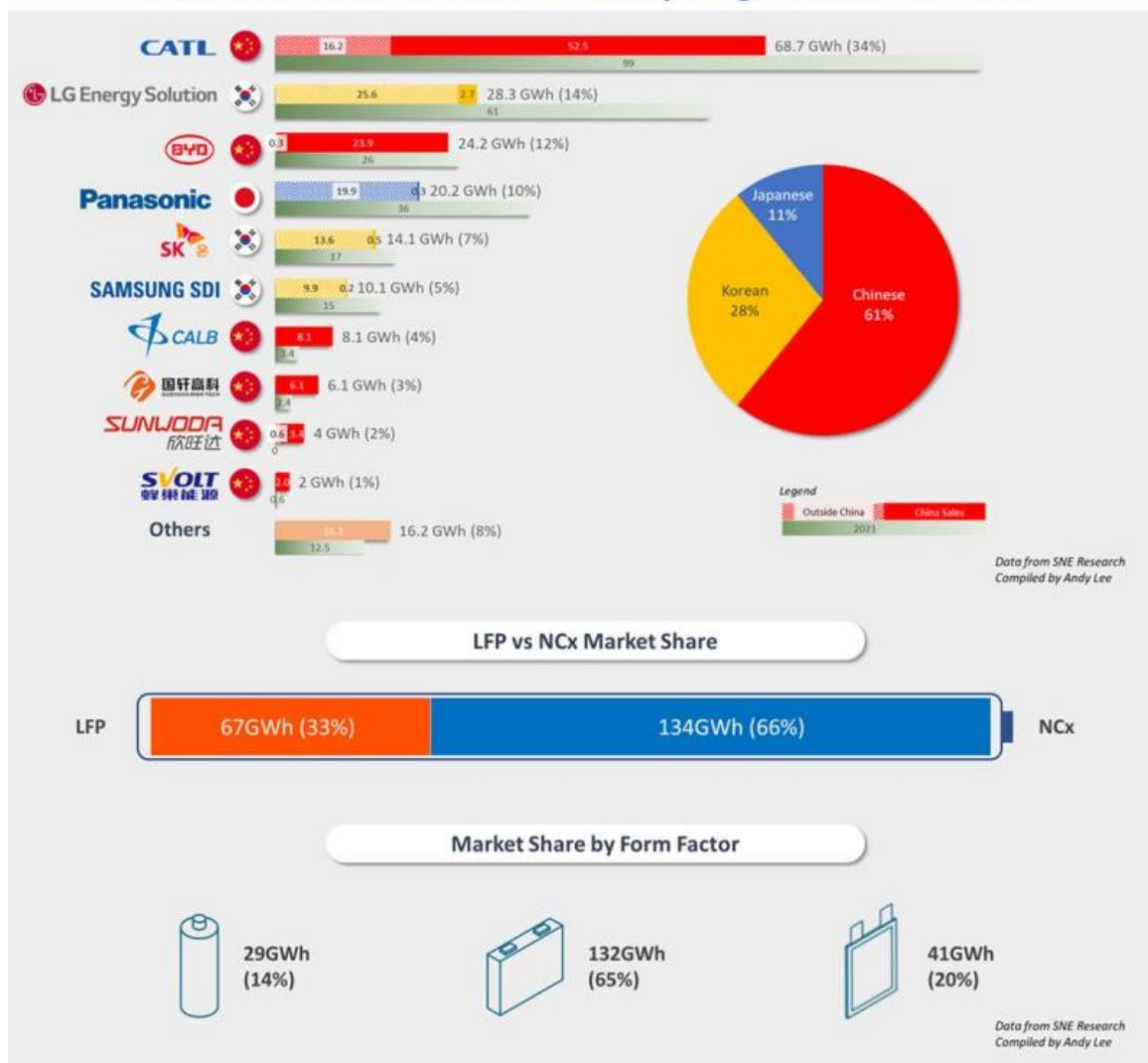
In passing, the author of Low Carbon Pulse notes that after a bumper news week covered by **Edition 43** of Low Carbon Pulse, there was a drop-off in reported activity and projects during the week July 18 to July 24, 2022.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

- **CATL down Mexico way:** On **July 19, 2022**, it was reported widely that the world leading battery manufacturer, **Contemporary Amperex Technology Co (CATL)** is considering the development of two giga-factories to be located in Mexico – one in Ciudad Juarez, Chihuahua, and other in Saltillo, Coahuila. As reported, the two giga-factories will manufacture batteries for the **Ford Motor Company** and for **Tesla**.

On **July 19, 2022** the market share of battery manufacturers were released for the first half of 2022. The bar-chart below provides an overview of the market leaders, and their market shares.

1H2022 Global EV Lithium-ion Battery Usage and Market Share



- **Envision and Spain have clear vision:** On **July 20, 2022**, it was reported widely that **Envision** and the **Government of Spain** had signed a Strategic Partnership Agreement (General Protocol for Collaboration) under which Envision and the Government are to work together to develop the first net-zero industrial cluster / park in Europe (**Net Zero Industrial Park**), with the first stage of the **Net Zero Industrial Park** including the development of a giga-factory for the manufacture of batteries for electric vehicles.

NeuConnect achieves financial close: On **July 21, 2022**, the **European Investment Bank (EIB)** [announced](#) that **NeuConnect** (the **730 km, 1.4 GW** subsea interconnector between Germany and the UK) had achieved financial close, with construction of **NeuConnect** to commence during 2022, and operation planned to commence in 2028. **NeuConnect** will traverse Dutch, German and UK waters, running from the converter station at **Fedderwarden**, close to **Bremerhaven, Germany** (operated by Tennet) to the converter station at the **Isle of Grain** (operated by the National Grid) in the **UK**. The converter stations will step-up and step-down the high voltage current to be conveyed by **NeuConnect**, a 525 kV high voltage direct current (**HVDC**) interconnector. The **EIB** is providing **€400 million** in debt funding for the **€2.8 billion project**. The **EIB** led a consortium of 20 lenders. The equity investors are reported to be Allianz Capital Partners, Kansai Electric Power Company and Meridiam ACP. The Japan Bank for International Corporation (JBIC) and the UK Infrastructure Bank policy banks provided funding along with the **EIB**.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

- **H2 Green Steel and Hitachi Energy partner:** On **July 20, 2022**, it was reported widely that **H2 Green Steel** and **Hitachi Energy** are to work together to develop an industrial steel start-up plant located in **Boden, Sweden**. For these purposes, **H2 Green Steel** and **Hitachi Energy** have entered into a memorandum of understanding, under which they will work together with **Hitachi** being a customer for green steel, developing and optimising a supply / value chain to provide distribution channels for green steel, and providing the development and operation of power infrastructure.

- **Size and scale of greening iron and steel:** On **July 22, 2022**, the good folk at rechargenews.com published an excellent piece in the greening of iron and steel - "[Average EU steel plant would need a whopping 1.2 GW of electrolyzers and 4.5 GW of solar to decarbonise](#)". As the title of the piece suggests, the size and scale of the greening of the iron and steel industry should not be underestimated. The piece is informed by a report from **Hydrogen Europe** [Steel from Solar Energy: A Techno-Economic Assessment of Green Steel Manufacturing](#).

- **EC Technical Report on iron and steel:** In the first week of July, the author of Low Carbon Pulse read the **European Commission** Joint Research Centre (**JRC**) published **JRC Technical Report – Technologies to Decarbonise the EU Steel Industry**. The technical report is excellent, outlining the challenges with the decarbonisation of the iron and steel industry, the current size and scale of the iron and steel industry, the means of achieving decarbonisation (including hydrogen direct reduced iron, **CCS** and **CCUS**, and iron ore electrolysis) and the cost of achieving decarbonisation, all placed in the context of current levels of **GHG** emissions and commitment to reduce them.

The **JRC Technical Report** follows the publication of [The Sustainable STEEL Principles](#) (in late June, 2022), which comprises "a set of bank-led commitments to adopt a common measurement and disclosure framework to support the steel industry in forging a pathway to net-zero carbon emissions". There are five **STEEL Principles** reflecting: 1. **S**tandardised assessment; 2. **T**ransparent reporting; 3. **E**nactment; 4. **E**ngagement; and 5. **L**eadership. The **STEEL Principles** were developed within **RMI** (Independent non-profit clean energy development consultant) and five working group banks, **Citi**, **ING**, **Societe Generale**, **Standard Chartered** and **UniCredit**.

It is estimated that greening the iron and steel industry in the **EU** will require **25.4 GWh** of renewable energy to produce sufficient Green Hydrogen. Stated another way, this is more than half of the increase in wind power capacity contemplated by the **EU REPowerEU** initiatives. As noted in a number of news items, the **EU** iron and steel sector is lobbying for **31 GW** of renewable electrical energy capacity to be developed and deployed by 2030.

Wind round-up, on-shore and off-shore:

Other than as reported elsewhere in this **Edition 44** of Low Carbon Pulse (under **Americas** and **Europe and UK**), during the week July 18 to July 24, 2022, the author of Low Carbon Pulse did not come across any news items sufficiently material and significant to merit inclusion in this **Edition 44**.

Solar and Sustainability (including NZE Waste):

- **Scatec and H1 Holdings gets to financial close of South African solar portfolio:** On **July 19, 2022**, renews.biz reported that **Scatec** (51% owner) and **H1 Holdings** (49% owner) had reached financial close in respect of their **540 MW photovoltaic solar** and **BESS** portfolio in **South Africa**: the portfolio to be developed comprises three photovoltaic wind farms and a **225 MW BESS**. The investment is the largest single project investment in the history of Scatec, with a total capex of USD 962 million, including USD 727 million of non-resource project finance debt. The debt providers include The Standard Bank Group as arranger.

On development the portfolio will be able to dispatch 150 MW under a 20 year power purchase agreement. The portfolio is being developed under the auspices of the [Risk Mitigation Independent Power Producer Procurement Programme](#).

- **RWE looks for hybrid off-shore fields:** On **July 19, 2022**, offshorewind.biz reported that **RWE** is working with **SolarDuck** at its exclusive provider of off-shore floating photovoltaic solar as part of **RWE's** bid for the **Hollande Kust (west) VII** area (see **Edition 40** (Long Form Version) of Low Carbon Pulse for detail). See **Edition 16** of Low Carbon Pulse for reporting on **SolarDuck**.

- **Worthy of note:** While Low Carbon Pulse does not report on investment activity (including merger and acquisition activity) in the ordinary course, it does when a particular transaction is material and significant in a particular market. On **July 18, 2022**, the **Green Investment Group** [announced](#) that it has completed its investment in **Galehead Development**. **Galehead** is stated to have **5 GW** of photovoltaic solar and wind capacity, with co-located energy storage projects, and is developing a further **4 GW** of renewable energy generation (and storage) capacity.

- **HSBC Reports on Scope 3 emissions:** On **July 11, 2022**, **HSBC** published [Scope 3 emissions: The largest piece in the net zero jigsaw](#), authored by **Wai-Shin Chan** and **Polo Heung** on **Scope 3 emissions** (being those

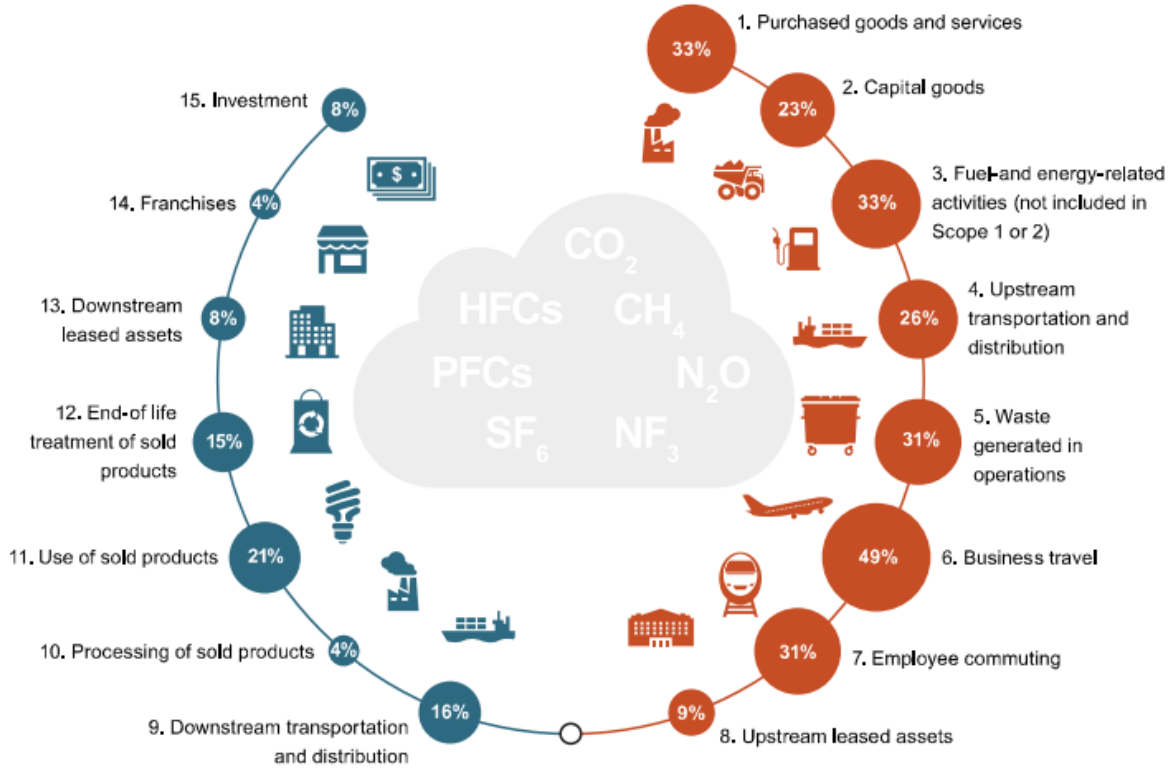
that "occur from sources owned or controlled by other entities in the value chain") – being emissions that provide most pieces in the 8 billion three dimensional jigsaw puzzle that we are seeking to finish by 2050. The following infographic gives a sense of the one dimensional jigsaw puzzle at it relates to Scope 3 emissions.

Scope 3 emissions in a nutshell

Scope 3 emissions come from a company's value chain ...

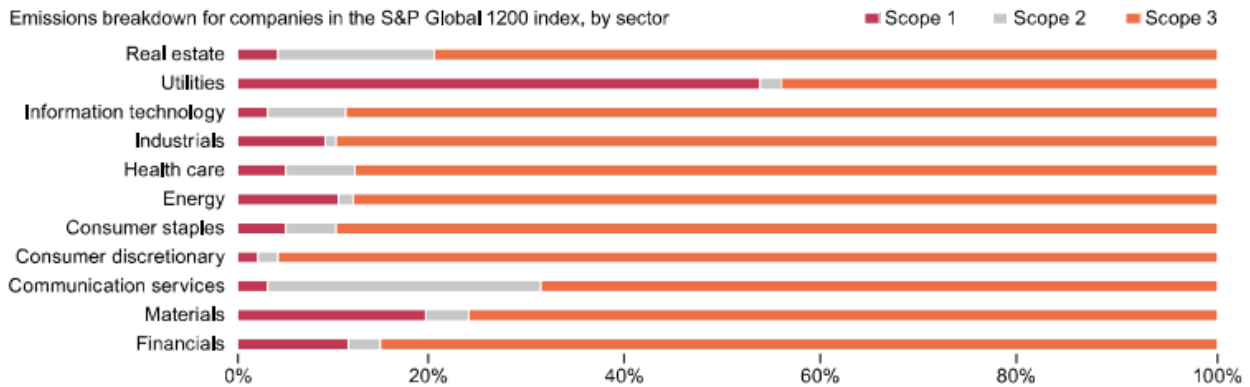
Disclosure rate by each of Scope 3's fifteen categories (FY2020, S&P Global 1200 index)

● Downstream activities | ● Upstream activities



... and often represent the greatest share of corporate-related emissions

Emissions breakdown for companies in the S&P Global 1200 index, by sector



Source: HSBC

- **What a life-time of fossil-fuel consumption looks like:** On **July 22, 2022**, the good folk at the visualcapitalist.com published **Fossil Fuels**. The infographic provides a perspective as to the mass of fossil fuels consumed by folk, on average:

FOSSIL FUELS

How Much Do You Consume in a Lifetime?

We consume fossil fuels every day for transportation, heating, and manufacturing, but over a lifetime of 80 years how much does the average American consume?

119.3 tonnes (131.5 tons)

COAL

5.2m
17.1ft

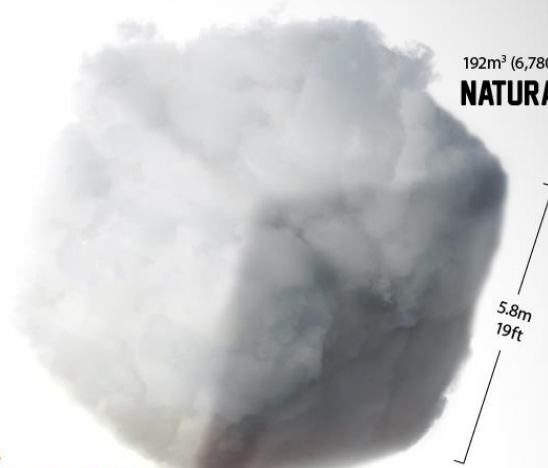


Coal is primarily used to generate electricity, but it is also used to manufacture steel, cement, and other industrial materials.

192m³ (6,780 ft³)

NATURAL GAS

5.8m
19ft



The primary use for natural gas is heating and electricity generation, but it is also used as a raw material in the manufacturing of anhydrous ammonia fertilizer.

6.7m
22ft

236.8 tonnes (261 tons)

PETROLEUM PRODUCTS

Along with automotive fuels, petroleum products are also used to manufacture pharmaceuticals, textiles, plastics, and wax.

1.7m
5.6ft

AVG. PERSON



Methodology: To visualize the average American's fossil fuel consumption, we took petroleum product, coal, and natural gas yearly consumption per capita data and multiplied it by 80 to calculate a "lifetime consumption" figure. The natural gas figure was already in cubic meters/feet, however the figures for coal and petroleum were still a weight (kgs/lbs). Using the density of these materials (833kg/m³ for bulk bituminous coal and 800kg/m³ for petroleum products) and the weight of a lifetime's worth of consumption we calculated the total volume the materials would make up.



Source: National Mining Association, Worldometer

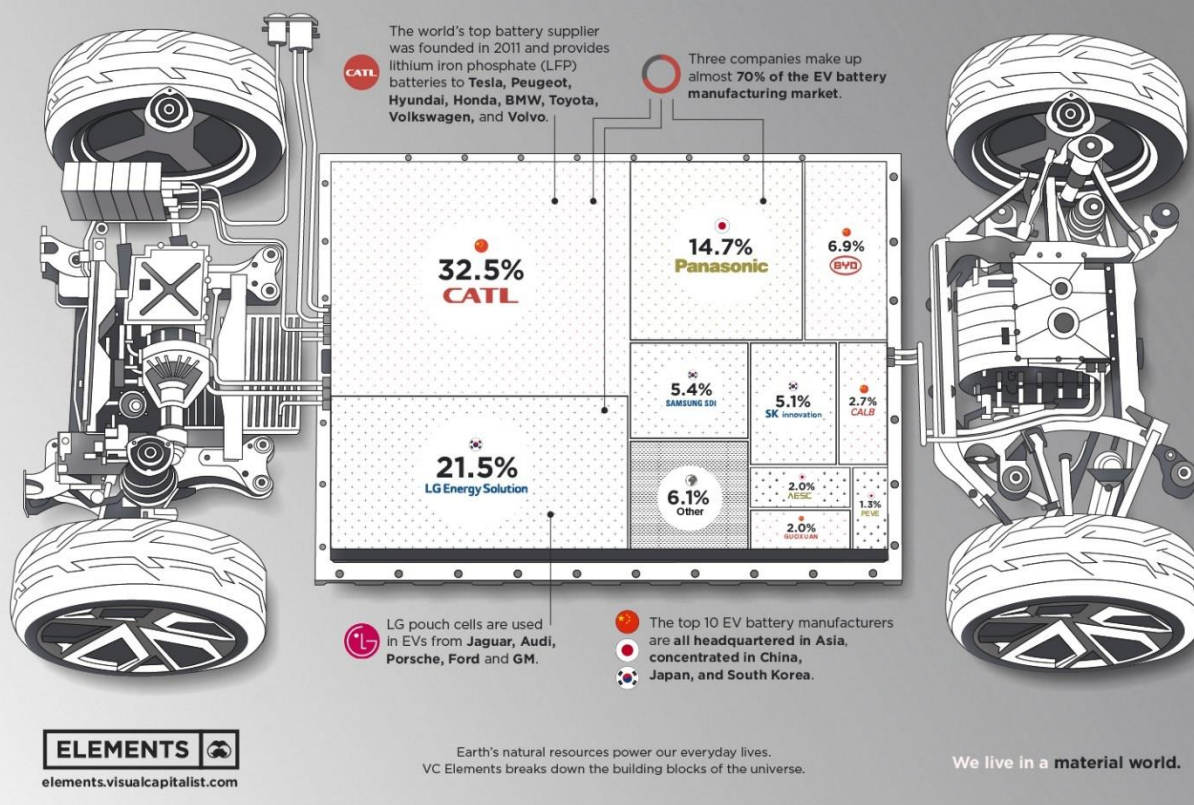
ELEMENTS.VISUALCAPITALIST.COM

Land Mobility / Transport:

- **Buses and coaches:** While there continued to be news items in respect for orders for electric battery and fuel cell technology buses during the period July 18 to 24, 2022, for the purposes of this **Edition 44** of Low Carbon Pulse the author has decided not to include, so as to manage the length of this **Edition 44**.
- **Cars:** During the news cycle of this **Edition 44** of Low Carbon Pulse, the author has not come across any news items sufficiently material or significant to merit inclusion.
- **Battery, Fuel Cell and ICE Technology:**
 - **Batteries from biomass:** On **July 22, 2022**, [cnn.com](https://www.cnn.com) reported (under **Volkswagen-backed Northvolt to develop wood-based batteries for EVs**) that **Northvolt** is to work with **Stora Enso** (one of the largest forest owners in the world) to develop batteries (under a joint development agreement) with an anode made from lignin-based hard carbon: as described by **Northvolt** and **Stora Enso**, the lignin is "a plant-derived polymer found in the cell walls of dry-land plants". The feedstock for the plant-derived polymer will be lignin derived from managed forestry. The development of this technology is both exciting and timely.
 - **Another graphic on market share:** On **July 24, 2022**, the author of Low Carbon Pulse came across another excellent infographic from the good folk at [element.visualcapitalist.com](https://www.element.visualcapitalist.com) entitled **Big Battery The Top 10 EV Battery Manufacturers**.

BIG BATTERY: THE TOP 10 EV BATTERY MANUFACTURERS

With an increased interest in EVs, the electric car battery market is now a \$27 billion per year business.



• Industrial Vehicles and Trucks:

- **H2Accelerate new Whitepaper:** On July 18, 2022, H2Accelerate (see Edition 26 of Low Carbon Pulse for background) published **Whitepaper – The need for hydrogen trucking**. The **Whitepaper** is balanced and insightful, and as such well-worth a read.

While the author of Low Carbon Pulse finds it difficult to sift to the core of publications, there is one piece in the Whitepaper that is balanced and compelling:

"There are three potential solutions to achieve zero emissions long-haul trucks, which result in zero CO2 tailpipe emissions: 1. Hydrogen fuel cell trucks, 2. Battery trucks with stationary charging, and 3. Battery trucks with catenary charging.

While biofuels, power-to-x type fuels, ... may be able to reduce CO2 emissions from trucking in the short term, these solutions do not mitigate the NOx and particulate emissions associated with internal combustion engines. Hydrogen fuel cell or battery-based solutions will therefore be required in the long term".

- **Toyota plans to roll-out fuel-cell trucks by 2023:** On July 21, 2022, [cnbc.com](https://www.cnbc.com) reported that the Toyota Motor Company, with Hino Motors and Isuzu, and Commercial Japan Partnership Technologies Corporation, is working to roll-out light-duty fuel-cell technology trucks in Japan during 2023.
- **Daimler Truck eEconic production commences:** On July 22, 2022, Daimler Truck announced that production of the Mercedes Benz **eEconic** had commenced at its Würth plant, the second battery electric truck from Daimler Truck, the first being the eActros. The **eEconic** is designed and built for inner-city municipal use.
- **Amazon delivering with Rivian:** On July 21, 2022, it was reported widely that Amazon had commenced the use of Rivian battery electric vehicles to make deliveries. The Rivian delivery vans are being used in Baltimore, Chicago, Phoenix and Seattle. By way of reminder: In 2019, Amazon committed to purchase 100,000 Rivian delivery vans.
- **Recharging and refuelling infrastructure:**
 - **H2 Energy Europe and Phillips 66 announce JV:** On July 20, 2022, [esqnews.com](https://www.esqnews.com) reported that H2 Energy Europe and Phillips 66 had established a 50:50 joint venture (Jet H2 Austria GmbH) to develop and to deploy a network of fuelling / refuelling stations across Austria, Denmark and Germany. Jet H2 Austria GmbH will combine the fuel retail expertise of Phillips 66 and the hydrogen expertise for H2 Energy, with the plan to roll-out around 250 fuelling / refuelling stations by the end of 2026.
 - **Element 2 and Exelby Services on the road:** On July 21, 2022, [H2-view.com](https://www.h2-view.com) reported that Element 2 and Exelby Services are to work together to develop and to deploy the UK's first public hydrogen fuelling / refuelling stations for heavy-goods vehicle / truck fleets. As reported, stations are to be deployed at Exelby Services' existing Coneygarth and Golden Fleece service station locations along the A1 (M) (in Yorkshire) and the M6 (in Cumbria) motorways / freeways.

- **Trains: Stadler Flirts:** On **July 21, 2022**, hydrogen-central.com reported that **Stadler Rail** (Swiss headquartered manufacturer of rolling-stock) had unveiled its hydrogen powered and propelled **FLIRT H2** multiple unit for use for rail passenger transport in the US. In addition to reporting on the **FLIRT H2**, the report recounts that **Stadler Rail** has developed the battery electric powered and fuel cell train FLIRT train, the EURO9000 model, which is the most powerful hybrid locomotive in Europe.

Ports Progress and Shipping Forecast:

Ferries and other craft: Norled AS takes delivery of second Ro-Pax Ferry: On **July 22, 2022**, **Sembcorp Marine Ltd** [announced](#) that its wholly owned subsidiary, **LMG Marine AS**, had delivered the **Dragsvik**, the second of three battery electric operated **roll-on-roll-off passenger (Ro-Pax) ferries** to **Norled AS**. The **Dragsvik** joins the **Hella** in the **Norled AS** fleet, both **Ro-Pax** ferries have an in service speed of 10 knots, powered and propelled by lithium-ion electric batteries, which are charged / recharged using electrical energy from renewable energy sources. The **Hella** started operating on the **Hella-Vangsnes-Dragsvik** run in May 2022.

By way of reminder:

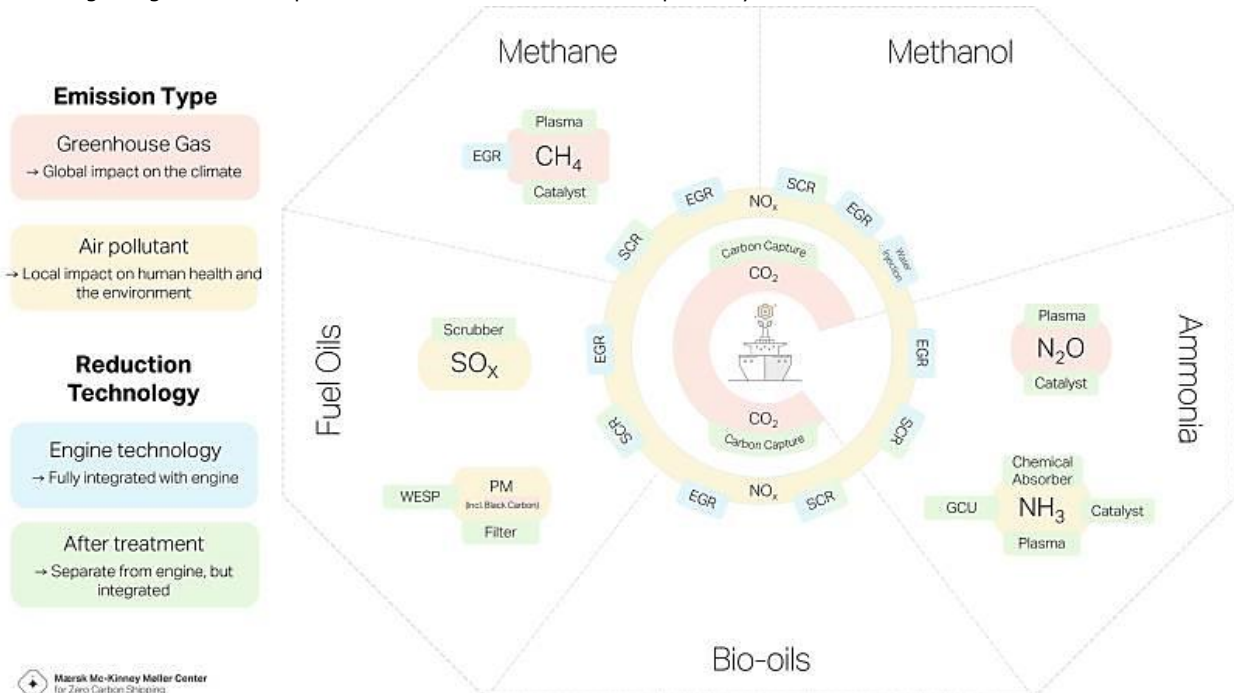
- **Editions 23** and **34** of Low Carbon Pulse reported that: "In late July 2021, the **MF Hydra** (styled as the first liquid hydrogen powered ferry) had been delivered. As reported, the **MF Hydra** is 82.4 metres in length, with capacity for 300 passengers and 80 motor cars. On February 2, 2022, it was reported widely that Ballard Power Systems is to supply two of its 200KW FCwave fuel cell modules to Norled A/S, the owner of the **MF Hydra**.

As will be apparent from the previous news items, during 2022 the **MF Hydra** will start to serve the Hjelmeland-Skipavik-Nesvik route in Rogaland."

- **Edition 37** of Low Carbon Pulse reported that: "On **March 16, 2022**, Sembcorp Marine announced that it had completed the fabrication of the first of three zero-emission battery powered Ropax Ferries for Norled AS.

The design of each of the Ropax Ferries has been optimised for the requirements of Norled A/S, with each ferry to be powered and propelled by lithium-ion batteries, and having a back-up battery-diesel hybrid mode. Each battery is to be charged / recharged using renewable electrical energy from hydroelectric sources."

- **Green Shipping: Wonderfully clear perspective from Maersk Mc-Kinney Moller Center for Zero Carbon (MMCO):** On **July 21, 2022**, the good folk at **MMCO** shared an info-graphic providing an Emissions Web, describing the general and specific emissions risk for four fuel pathways.



Airports and Aviation:

- **DAC and carbon credits:** On **July 18, 2022**, **Airbus** [announced](#) that it and a number of major airlines (Air Canada, Air France-KLM, easyJet, International Airlines Group, LATAM Airlines Group, Lufthansa Group and Virgin Atlantic) had signed letter of intention to assess opportunities for the future supply of carbon removal credits that may arise from the use of direct air capture (**DAC**) technology.

DAC and **Direct Air Capture and Storage (DACCS)** are regarded as high-potential technologies. Airbus explains that: "As the aviation industry cannot capture CO₂ emission releases into the atmosphere at source, a direct air capture and storage solution would allow the sector to extract the equivalent amount of emissions from its operations directly from the atmospheric air". The continued embrace of **SAF** and the prospective embrace of **DAC** and **DACCS** by the aviation sector, combined with continued development of hydrogen technology to power and to propel aircraft, illustrates that the aviation sector provides a large and ready market for **NZE** initiatives.

- **Airbus joins hydrogen infrastructure fund:** On **July 21, 2022**, **Airbus** [announced](#) that it had joined the "world's largest" hydrogen infrastructure investment fund (the **Hy24 Fund**). The move by **Airbus** underlines its commitment to the greening of aviation, and the attendant need for the development of infrastructure and supply from Green Hydrogen production facilities globally.

By way of reminder: To provide context and further understanding to the **Airbus** decision, **Edition 43** of Low Carbon Pulse reported as follows (under **Making Net-Zero Aviation Possible**): "

By way of reminder: On **July 14, 2022**, the **Mission Possible Partnership** (sponsored by Energy Transition Commission, RMI, We mean Business Coalition, and World Economic Forum, supported by knowledge partner McKinsey & Corporation), published [**Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy.**](#)

The publication notes that it builds on others as follows: [**Waypoint 2050**](#) by the **Air Transport Action Group** and its accompanying **ICF report [**Fuelling Net Zero; Report on the Feasibility of a Long-Term Aspirational Goal for the International Civil Aviation CO2 Emission Reductions**](#)** by the **International Civil Aviation Organization**; [**Decarbonising Air Transport**](#) by the **International Transport Forum** and the **Organisation for Economic Co-operation and Development**; [**Horizon 2050: A Flight Plan for the Future of Sustainable Aviation**](#) by the Aerospace Industries Association and Accenture; [**2021 Aviation Climate Action Plan**](#) by the US Federal Aviation Administration; [**PtL Roadmap**](#) by the German Federal Government; [**Decarbonisation Road-Map**](#) by Sustainable Aviation for the United Kingdom; and [**Roadmap to Climate Neutral Aviation in Europe**](#) by Transport and Environment. All are excellent publications, and links to all are included for ease of reference.

The [**Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy**](#) provides **11 critical insights**, as follows: **1.** Bringing aviation on a path to net-zero emissions by 2050 requires a doubling of historical fuel efficiency gains for aircraft, a rapid roll-out of **SAF**, and market development of novel propulsion aircraft by 2030; **2.** Aviation can comply with a sectoral 1.5°C carbon budget if all levers are pulled. Achieving net-zero by mid-century avoids cumulative **GHG** emissions of **25 to 26 Gt CO₂-e**; **3.** The average annual investments between 2022 and 2050 to get global aviation to net zero is estimated at about USD 175 billion, about 95% of which would be required for fuel production and upstream assets; **4.** Current project pipelines for **SAF** production are insufficient and need to be scaled-up by a factor of 5 to 6 until 2030; **5.** The faster the cost decline in renewable electrical energy generation, the higher the expected market share of Power-to-Liquids (PtL). In contrast, if electrical energy costs do not drop as rapidly, biofuels are likely to dominate the market; **6.** Hydrogen and battery-electric aircraft can make global aviation more efficient starting in the late 2030s and supply up to a third of the final energy demand by 2050; **7.** By 2050, net-zero emission aviation could require an additional **5,850 TWh** of renewable electrical energy, **95 million metric tonnes** of hydrogen, and **12 EJ** of **sustainable biomass**; **8.** Aircraft fuel efficiency gains and operational measures could avoid over 15 Gt CO₂-e of cumulative **GHG** emissions at zero or even negative abatement costs; **9.** Although average fuel costs are increasing in the net-zero scenarios, the cost of flying could remain stable, being counterbalanced by efficiency gains; **10.** Carbon dioxide removal (**CDR**) solutions are needed to remove residual emissions from renewable fuels, but are not a replacement for deep and rapid sector decarbonisation; and **11.** Policy makers must create a level playing field between fossil fuel jet fuel and **SAF**, industry collaboration across the value chain can ramp up **SAF** demand and supply, as well as trigger technological innovation.

- **AA purchases SAF from Gevo, Inc:** On **July 22, 2022**, [stattimes.com](#) reported that **American Airlines** and **Gevo, Inc.** (a biofuels production corporation) had signed an agreement under which **Gevo, Inc.** is to sell **500 million gallons** for **SAF** to **American Airlines** over five years.

Low Carbon Pulse - Edition 45

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 45** of **Low Carbon Pulse** – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Monday July 25, 2022** to **Sunday July 31, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering the period from October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering the period from October 7, 2021 to March 31, 2022), and [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39, 40** and **41** covering **April, May** and **June, 2022**).

Welcome to the weekly news-cycle Low Carbon Pulse:

During July 2022 we trialled a weekly news-cycle for Low Carbon Pulse. As regular readers of Low Carbon Pulse will know, for April, May and June 2022 we trialled a monthly news-cycle, having previously used a two week news-cycle. Both the monthly and two weekly news-cycles resulted in long publications, not ideal for those seeking a "quick-read". It was hoped that the weekly news-cycle will provide the right balance / length, ideally between 8,000 and 10,000 words.

A week of passing and progress, and the personal:

• July 26, 2022:

- **International Day for the Conservation of the Mangrove Ecosystem:** As regular readers of Low Carbon Pulse will know, the author has long included background on the role that mangrove forests and swamps play, and the increased role that they can play, as a nature based solution to mitigate the impact of climate change (see **Editions 31, 37** and **41** of Low Carbon Pulse). In 2015, the **General Conference** of **UNESCO** adopted **July 26, 2022** as the International Day for the Conservation of the Mangrove Ecosystem raising awareness of the importance of mangroves as a "unique, special and vulnerable ecosystem". The **Blue and Green Carbon Initiatives and Biodiversity** section of this **Edition 45** of Low Carbon Pulse details the importance of the mangrove ecosystem.
- **Passing of James Lovelock:** One of the first books that sparked the consciousness of the author of Low Carbon Pulse about the environment was James Lovelock's **Gaia**. On **July 26, 2022**, James Lovelock passed away on his 103rd birthday. In addition to authoring **Gaia** (laying the foundations of earth science), Mr Lovelock promoted global awareness of ozone-depleting fluorocarbons, the dangers of pollution (including lead in motor spirit), having been concerned about these (and other) matters since the 1960s, and advocated for nuclear power. Vale James Lovelock.
- On **July 27, 2022** the State of New York released the **Request for Proposals** for its **2022 Offshore Wind Solicitation**, the third offshore wind solicitation (**NY3**) for a further **2 GW** of off-shore wind capacity. **NY3** is covered in detail in the **Wind round-up, on-shore and off-shore** section of this **Edition 45** of Low Carbon Pulse.
- On **July 27, 2022**, the **Manchin-Schumer Act** took shape, and breathed life back into the decarbonisation agenda of the Biden Administration. If the **Manchin-Schumer Act** becomes law, it is estimated that it will provide a clear pathway for the US to reduce its **GHG** emissions by 40% by 2030.
- On **July 31, 2022**, the death of Bill Russell was reported. For regular readers of Low Carbon Pulse, the author's love of basketball will be well-known (**Editions 32** and **33** were named for Magic Johnson and Larry Bird). Bill Russell was sports star and social activist, and all time legend. Vale Bill Russell.

100 days to COP-27:

As of **July 29, 2022**, there were **100** days to go to the commencement of **COP-27** to be held in **Sharm El-Sheikh, Egypt** between **November 6 and 18, 2022**. As was the case in 2021 (see **Editions 23, 25, 26, 27 and 28**) ahead of **COP-26** held in Glasgow, Scotland, ahead of **COP-27** Low Carbon Pulse will commence coverage of key issues in respect of which progress needs to be made at **COP-27**.

In this context, it is noted that by **September 23, 2022**, countries that are parties to the Paris Agreement are scheduled to submit their updated nationally determined contributions (**NDCs**). Progress at **COP-27** will be more likely, and more viable, by being informed by updated **NDCs**, providing a basis to an informed assessment of any gap between the reductions in **GHG** emissions required to achieve the Paris Agreement goals, and the aggregate of the **NDCs** to which countries have committed. There remains a gap, both in headline aggregate **NDCs** and in the implementation of policy settings at a country level necessary to achieve **NDCs**. Picking up on a theme identified some time ago in Low Carbon Pulse, **GHG** emission reduction commitments are required at an increased rate and at a faster rate.

The assessments of climate change, and its impact, are becoming increasingly stark, and the depictions of climate catastrophe, ever more startling. The alarm bells have been ringing for some time. It is hoped that folk are not getting used to the alarm bells, or, worse, that they have become background noise.

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced.

Enquiry made of author during the last week of July:

During the first three days of the last week-of July, 2022, the author of Low Carbon Pulse was in Jakarta, Indonesia, to present to the Indonesian Petroleum Association on CCS / CCU and CCUS. While in Jakarta, the author was asked to outline the process for the development of each edition of Low Carbon Pulse.

The answer to the enquiry was as follows: each morning the author reads from 3 am to 6 am, and on each Saturday and Sunday morning the author writes and edits from 4 to 7 am, so that by Monday morning the current edition is ready to have links and graphics added by Florence Chan and Vanessa Wu. The author proofs each edition from 5 am to 8 am each Tuesday morning, and Florence and Vanessa finalise each edition in time for publication on Tuesday afternoon. From 6 am to 9 pm Monday to Friday (and 10 am to 6 pm on Sunday), the author does his day job.

The first two weeks of August:

During the first two weeks of August 2022 the author of Low Carbon Pulse is going to take some leave, how much leave is in the balance. As such, **Edition 46** of Low Carbon Pulse will be published either on **August 16, 2022** (covering the two week news-cycle from **August 1 2022 to August 14, 2022**) or **September 2, 2022** (covering the August news cycle), depending on the schedule of the author during August.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

- **The Economic of Direct Air Carbon Capture and Storage:** On **July 26, 2022**, the **Global CCS Institute** published [*The Economics of Direct Air Carbon Capture and Storage*](#).

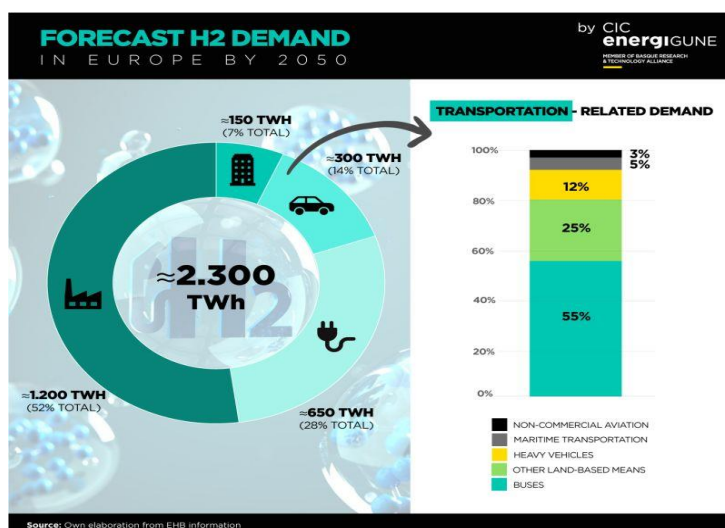
The key findings of the publication are:

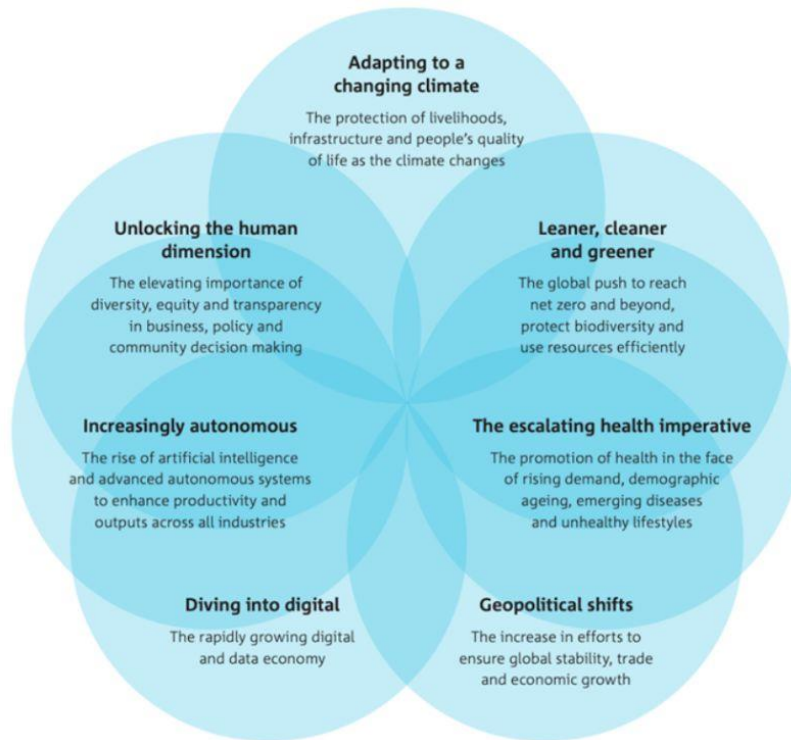
1. DACCS plays a unique role among climate mitigation options, functioning as a back-stop technology, potentially avoiding climate catastrophe if other lower or low cost pathways to avoiding, reducing and removing **CO₂** do not eventuate; **2.** If low-cost **DACCS** is realised, it would reduce the total cost of decarbonisation and the achievement of Paris Agreement goals and **NZE**; **3.** If low-cost **DACCS** is not realised, and as a result its deployment is limited, the main decarbonisation pathways for the industrial and the transport sectors (other than cars and light vehicles) is hydrogen; **4.** Building, electrical energy, and cars and light vehicles sector will be largely unaffected by the deployment of **DACCS**, with decarbonisation achieved through the use of renewable electrical energy; and **5.** The challenge for Governments is that the implementation of policy settings that incentivise the use of mitigation pathways that are available immediately, while supporting the development and deployment of **DACCS**. The publication is worth reading.

- **Forecast H2 Demand across Europe:** On **July 27, 2022**, the good folk at **CIC energigUNE** published an infographic forecasting estimated demand for hydrogen across Europe by 2050.

As explained by **CIC energigUNE** the forecast has been developed in the round, taking account of plans, roadmaps and strategies, and a range of estimates for long- term demand for hydrogen as an energy carrier / vector, and having regard to the thinking of The **European Hydrogen Backbone** (see **Editions 13, 14, 20, 37, 39 and 40** of Low Carbon Pulse).

- **CSIRO Our Future World Report drops:** On **July 27, 2022**, the **CSIRO** (Commonwealth Scientific and Industrial Research Organisation, Australia's National Science Agency) published [*Our Future World – Global megatrends impacting the way we live over coming decades*](#). While the publication focuses on the impact on the megatrends for Australia, the megatrends are global, and as such the publication is well-worth a read by folk wherever they are located. The graphic below provides an overview of the subject matter and content of the publication.

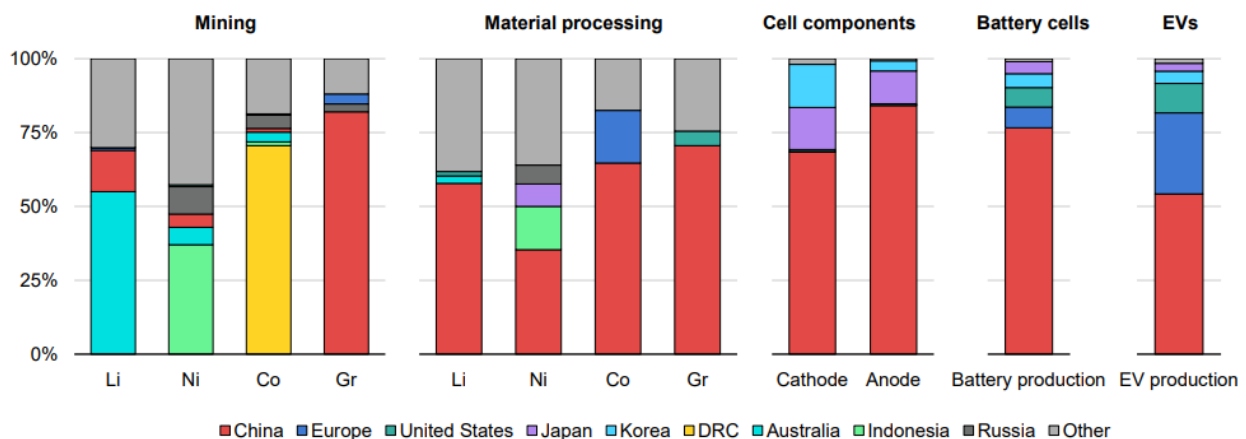




- **Historic day for human rights and healthy planet:** On **July 28, 2022**, the **UN General Assembly** adopted a resolution to recognise that everyone, everywhere, has a human right to live in an environment that is clean, healthy and sustainable. A link to the UN [press release](#) is attached. As at August 2, 2022, the text of the official resolution had not been updated.
- **International Energy Agency (IEA) publications:** On **July 29 2022**, the **IEA** published its [Global Supply Chains for EV Batteries](#). As with all **IEA** publications, this publication is well worth a read. The headlines from the report are as follows:
 1. As electric cars sales continue to break sales records, supply considerations move to the fore;
 2. The **PRC** dominates the entire EV battery supply chain. The following bar-chart illustrates this dynamic:

China dominates the entire downstream EV battery supply chain

Geographical distribution of the global EV battery supply chain



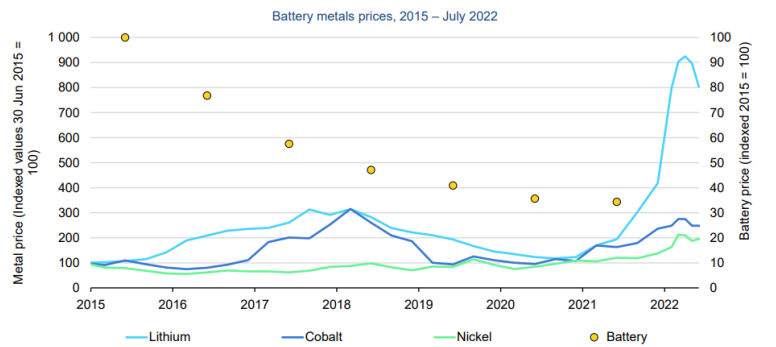
IEA. All rights reserved.

Notes: Li = lithium; Ni = nickel; Co = cobalt; Gr = graphite; DRC = Democratic Republic of Congo. Geographical breakdown refers to the country where the production occurs. Mining is based on production data. Material processing is based on refining production capacity data. Cell component production is based on cathode and anode material production capacity data. Battery cell production is based on battery cell production capacity data. EV production is based on EV production data. Although Indonesia produces around 40% of total nickel, little of this is currently used in the EV battery supply chain. The largest Class 1 battery-grade nickel producers are Russia, Canada and Australia.

Sources: IEA analysis based on: [EV Volumes](#); [US Geological Survey \(2022\)](#); [Benchmark Mineral Intelligence](#); [Bloomberg NEF](#).

3. Battery metal prices increased dramatically in early 2022, posing a significant challenge to the EV industry. The following graph illustrates this in respect of cobalt, lithium and nickel.

Battery metal prices increased dramatically in early 2022, posing a significant challenge to the EV industry



Sources: IEA analysis based on S&P Global
Notes: Lithium prices are from June 2022. Cobalt and Nickel from July 2022

IEA. All rights reserved.

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During the week covered by this **Edition 45** of Low Carbon Pulse, the **International Renewable Energy Agency (IRENA)** did not release any new publications.

Climate change reported and explained:

- **Extreme weather events:** Extreme weather events have continued during the week commencing July 25, 2022.

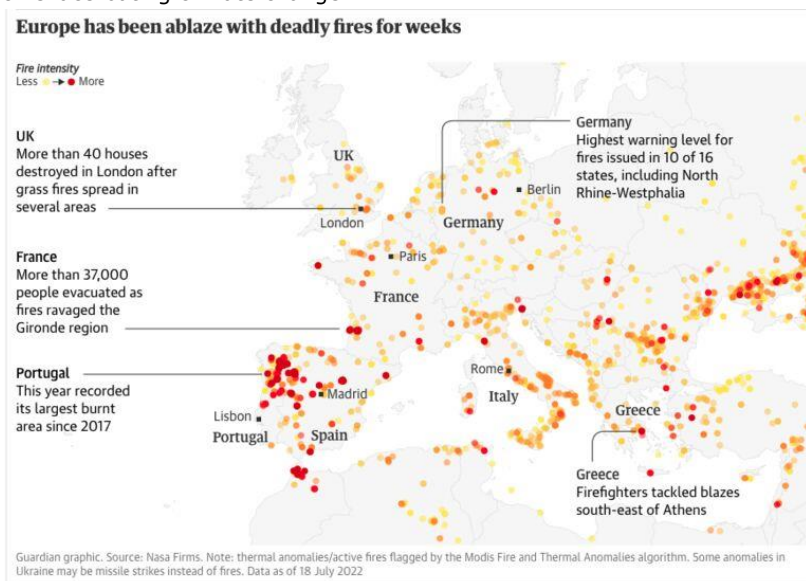
The **International Panel on Climate Change (IPCC)** defines an extreme weather event as follows:

"An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme".

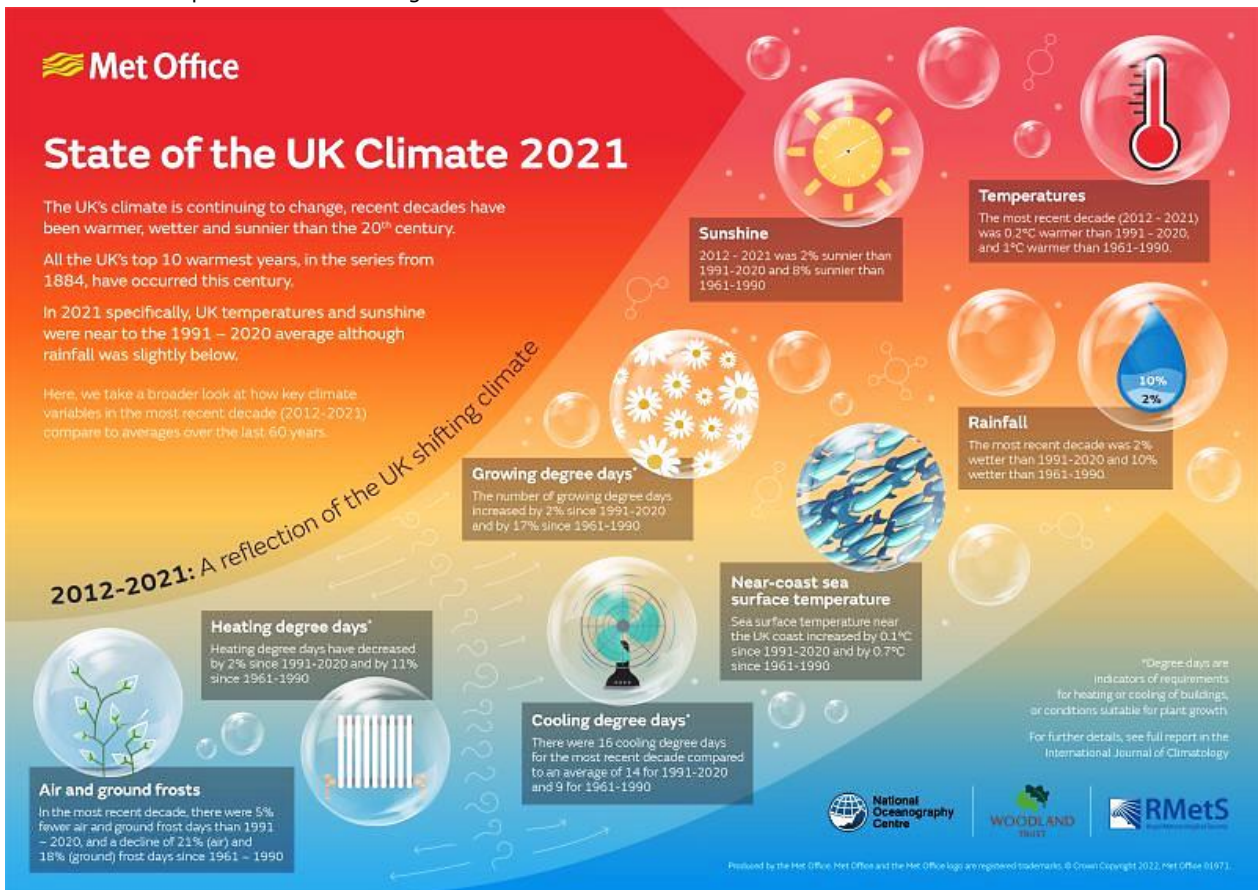
It is fair to say that North America, North Africa, India and Europe, and increasingly the **PRC**, have been experiencing **extreme weather events**, and in many instances those extreme weather events, having persisted, may be characterised as **extreme climate events**. The climate system has changed, and continues to change.

NOAA June Report: As noted in **Edition 43** of Low Carbon Pulse, on **July 14, 2022**, the US National Oceanic and Atmospheric Administration (**NOAA**) published its June Report. The headline from the June Report is that: "*June's average global temperature continued 2022's remarkably warm trend, as the both the month and the year so far ranked as the sixth warmest on record June 2022 marked that 46th consecutive June and the 450th consecutive month with temperatures above the 20th century average. The ten warmest Junes on record have all occurred since 2010*". **Edition 46** of Low Carbon Pulse will include the key findings of the **July 2022** report from the **NOAA**.

- **Record-breaking fire season across Europe:** On **July 27, 2022**, the ever-excellent, **Ms Roberta Boscolo** (Lead of Climate and Energy at the UN World Metrological Organization) shared an infographic providing an over-view of the spread of fire activity across Europe, so far affecting around **515,000 hectares** of land. As outlined in previous editions of Low Carbon Pulse, fires reduce **CO₂** absorption capacity and increase the mass of **CO₂** released to the climate system, each exacerbating climate change.



- **The State of the UK Climate 2021 report:** On **July 28, 2022**, the [metoffice.gov.uk](https://www.metoffice.gov.uk) published [The State of the UK Climate 2021](#) report. The report outlines the impact of average global temperature increases, reaffirming that climate change is not a problem for the future, rather climate change is upon us. The following infographic provides a sense of the impact of climate change on the UK climate.



- **State of the Climate in Latin America and the Caribbean:** On **July 31, 2022**, the author of Low Carbon Pulse read the **World Meteorological Organization (WMO)** publication [State of the Climate in Latin America and the Caribbean 2021](#). The publication makes for salutary, but essential, reading. Links to other publications in the **WMO** series are provided: [The State of the Global Climate 2021](#); [State of the Climate in Africa 2020](#); [State of the Climate in Asia 2020](#); [State of the Climate in the South-West Pacific 2020](#).

Middle East including GCC Countries:

- **The 170 km long city-building:** Throughout the week beginning **July 25, 2022**, tens of news-feeds reported on the planned development by the **Kingdom of Saudi Arabia** of a **170 km, 500 metre high**, long city-building – to many news-feeds the mirrored-mega-city or the Mirror Line, and officially **The Line**. As planned, **The Line** would accommodate up to **9 million** people.
- **ADNOC and K-EXIM:** On **July 29, 2022**, it was reported widely that **ADNOC (Abu Dhabi National Oil Company)** and the **Export-Import Bank of Korea (K-EXIM)** had agreed **USD 3 billion** in long-term financing. It is understood that **BBVA, MUFG, Santander** and **SMBC** participated in the covered facility, with **K-EXIM** providing direct lending.

Africa:

- **Egypt / EGAS and Wintershall Dea alignment:** On **July 26, 2022**, [energy-utilities.com](https://www.energy-utilities.com) reported that **EGAS** (Egyptian Natural Gas Holding Company) and **Wintershall Dea** (oil and gas corporation headquartered in Germany) had signed a memorandum of understanding (**MOU**) to provide a framework to assess the technical feasibility of **CCS**, having identified suitable geological formations / structures and the production of **Blue and Turquoise hydrogen** production in Egypt (with the carbon arising from production being captured and stored). As reported, the **MOU** puts "weight behind Egypt's recently announced **National Climate Change Strategy 2050**, which calls for reducing CO2 emissions. It also adds a focus on blue hydrogen to the country's green hydrogen ambitions".
- **Egypt and India alignment:** On **July 27, 2022**, it was reported widely that **Egyptian key state organisations** (well-known by now to regular readers of Low Carbon Pulse as the General Authority for the Suez Canal Economic Zone, The Sovereign Fund of Egypt, The Egyptian Electricity Transmission Company, and The New and Renewable Energy Authority) and **ReNew Power (ReNew Power Private Limited)**, an Indian corporation) had signed a memorandum of understanding (**MOU**) to provide a framework for the development of a **USD 8 billion Green Hydrogen** production facility in the **Suez Canal Economic Zone**, with the production facility to produce up to **220,000 metric tonnes** annually: as reported, among other things, the **MOU** provides for studies to be undertaken to assess the feasibility of the proposed facility.

As regular readers of Low Carbon Pulse will know, during 2022 there has been considerable activity in respect of the development of Green Hydrogen and Green Ammonia and clean and low carbon hydrogen, and other Future Fuel, production facilities in the **Suez Canal Economic Zone** (see **Editions 34, 37, 39, 40** and **41**).

- **The importance of peat swamps and wetlands:** Edition [44](#) of Low Carbon Pulse reported on the publication of [Congo peat swamps store three years of global carbon emissions – imminent oil drilling could release it](#), providing a link to the nature geoscience publication of [Mapping peat thickness and carbon stocks of the central Congo Basin using field data](#). Both the article and the report are well-worth a read, providing a data and information rich assessment of the carbon trapped within the peatlands of the **Congo Basin**, and the possible consequences for the release of carbon into the climate system – it is stated that the **Congo Basin** contains close to 30% of the world's tropical peat carbon. Globally, peatlands cover around 3% of the landmass, and yet store around 600 giga-tonnes of carbon (this may be regarded as a conservative estimate). As noted in previous editions of Low Carbon Pulse, peatlands (and wetlands) are vulnerable to drainage and drying given climate change. We live in a world of unintended carbon consequences, and as such the mantra of do no harm, and do it quickly, is a sound one.

During the week commencing **July 25, 2022**, many more news items were published emphasising the risk of the extraction of hydrocarbons from the **Congo Basin**.

India and Indonesia:

- **Oil and Natural Gas Corporation (ONGC) and Greenko ZeroC aligned:** On **July 27, 2022**, [h2-view.com](#) reported that **ONGC** (state-owned leading oil and gas corporation) and **Greenko ZeroC** (see [Edition 37](#) and [39](#) of Low Carbon Pulse) had signed a memorandum of understanding (**MOU**) to provide a framework for them to pursue jointly opportunities for the production and procurement of Green Hydrogen and Green Ammonia, and other hydrogen-based fuels and feedstock.

The **MOU** is part of the mosaic of initiatives of **ONGC** for the purposes of delivering on its [Energy Strategy 2040](#) (which includes 10 GW of renewable electrical energy by 2040) and the [National Hydrogen Mission](#) (which includes targeting the production of **five million metric tonnes** of Green Hydrogen production annually by 2030).

- **Reserve Bank of India (RBI) publishes discussion paper:** On **July 27, 2022**, the **RBI** published a [discussion paper](#), including to address the results arising from [Climate Risk and Sustainable Finance Survey](#).

The discussion paper is well-worth a read, with its findings and themes being consistent with other publications, including the perspective of the **Council on Energy, Environment, and Water (CEEW)** outlined in [Edition 44](#) of Low Carbon Pulse. For India to produce **five million metric tonnes** of Green Hydrogen by 2030, this will require at least **100 GW** of installed renewable energy capacity and the development and deployment of **40 GW** of electrolyser capacity, at a cost of **USD 100 billion**. The perspective of the folk at **CEEW** is that Green Hydrogen can be used across the iron and steel and mobility sectors (using existing or repurposed natural gas pipelines), with the potential across these sectors equating to up to an **additional 3.5 million metric tonnes** of Green Hydrogen. The additional Green Hydrogen production will require at least **70 GW** of installed renewable energy capacity and the development and deployment of **28 GW** of electrolyser capacity, at a cost of **USD 78 billion**.

The folk at **CEEW** see **two challenges** with the development of the Green Hydrogen sector, **first**, the experience of financial institutions in India in lending on projects of this kind, and **secondly**, the rate at which funding may be made available (both debt and equity). As in other markets around the world, the cost and the efficiency, and utilisation, of electrolysers are regarded as factors that may affect the cost of debt funding, certainly where the Green Hydrogen produced is to be used in the mobility sector. The report is well-worth a read, providing other insightful commentary on the Indian market.

- **TERI provides a roadmap for 500 GW by 2030:** Previous editions of Low Carbon Pulse have reported on the challenges that will have to be overcome for India to achieve its target to develop 500 GW of non-fossil fuel electrical energy generating capacity by 2030 (**500 by 30**), in particular given the current rate of progress.

On **July 27, 2022**, **The Energy and Resources Institute (TERI)** published [Discussion Paper – Roadmap to India's 2030 Decarbonization Target](#). The **Discussion Paper** considers the pillars and strategies necessary to achieve India's **500 by 30** target. The **Discussion Paper** is well-worth a read (and a re-read): the Paper outlines the basis for both achieving the **500 by 30** target while at the same time ensuring energy security and allowing India to develop into a global manufacturing hub for hydrogen and hydrogen-based fuels.

- **Indonesian Geothermal Energy Sector:** On **July 28, 2022**, [aseanbriefing.com](#) published an article entitled [An Overview of Indonesia's Geothermal Energy Sector](#). The by-line is that: "*Indonesia is home to some 40 percent of the world's geothermal resources, and the sector will be key to the country's energy sustainability goals*". The article is well-worth a read, setting-out the stall for the broader development and use of geothermal resources as follows: "*Located by the Ring of Fire, the seismic activity surrounding Indonesia is extremely active, providing ample geothermal energy potential. Due to these features, Indonesia has an estimated 23.7 gigawatts in geothermal capacity across 300 sites*".

- **Production Linked Incentives Scheme (PLIS) up and running:** On **July 29, 2022**, [pv-magazine-india.com](#) reported that each of **Ola Electric Mobility**, **Rajesh Exports** and **Reliance New Energy Ltd** had signed agreements under the **PLIS**, having emerged as the preferred proponents under the Government of India **50 GWh PLIS** tender. As reported, the **PLIS** has allocated funding for **USD 2.3 billion**. Under the **PLIS** the preferred proponents must develop the manufacturing facility in respect of which funding has been allocated within two years, with the funding to be disbursed over a period of five years.

- **Jakarta to mobilise 1,000 electric battery buses:** On **July 29, 2022**, [sustainable-bus.com](#) reported that by the end of 2023 **Transjakarta** plans to run **1,000** electric battery buses within Jakarta, increasing to **3,000** electric battery buses by the end of 2025. While the scale of the task should not be underestimated, the ambition is achievable.

- **India Hydrogen Alliance - June 2022:** Attached is the link to the June edition of the [India H2 Monitor – June 2022](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link to, rather than to repeat the content of, the **India H2 Monitor**.

Japan and Republic of Korea (ROK):

Other than as reported elsewhere in this [Edition 45](#) of Low Carbon Pulse, during the period July 25, 2022, to July 31, 2022, the author of Low Carbon Pulse did not come across any news items sufficiently material or significant for inclusion in this section of this [Edition 45](#).

PRC and Russia:

Other than as reported elsewhere in this **Edition 45** of Low Carbon Pulse, during the period July 25, 2022, to July 31, 2022, the author of Low Carbon Pulse did not come across any news items sufficiently material or significant for inclusion in this section of this **Edition 45**.

Europe and UK:

- **UK calls for evidence on CCS / CCUS:** On **July 25, 2022**, the **UK Government** (under [Future policy framework for power with carbon capture, usage and storage \(CCUS\): call for evidence](#)) announced that it is seeking views and evidence on how to support the development of power capacity using carbon capture, usage and storage. The process seeks views and evidence on competitive allocation design for power using CCUS, the evolution of the business model used to support power using CCUS, the development of the power using CCUS sector supply chain, and how power using CCUS could operate under future market arrangements. For these purposes, power with CCUS is dispatchable gas-fired power generation with CCUS. Use of CCUS in bioenergy power capacity is the subject of separate engagement by the UK Government.
By way of reminder: **Edition 44** of Low Carbon Pulse (under [UK launches biggest electricity market reform in a generation](#)) reported on a major review of the electricity market design to ensure that cost benefits of cheaper energy are realised for the benefit of consumers. The announcement from the Department for Business, Energy & Industrial Strategy is fulsome, providing a clear rationale for reform.
- **Updated policy settings in the UK:** On **July 27, 2022**, the **UK Government** (Department for Business, Energy & Industrial Strategy) published the results of consultation in respect of the availability of green import exemptions for the Contract for Difference and Feed-in Tariff schemes, with each to cease from April 1, 2023. In addition, the EU Guarantees of Origin scheme will cease to be recognised from April 1, 2023. The full outcomes of the consultation process are detailed in [Feed-In Tariffs & Contracts for Difference schemes and Guarantees of Origin consultation: summary of responses and government response](#).
- **Infographic showing hydrogen projects progressing or proposed in the UK:** On **July 31, 2022**, the author of Low Carbon Pulse came across the following infographic:

Sample of potential hydrogen projects across the UK



Americas:

- **Inflation Reduction Act heads to Congress:** On **July 27, 2022**, a deal was struck between US Senator Mr Joe Manchin and US Senator and Senate Majority Leader, Mr Chuck Schumer (already named **the Manchin-Schumer Act**).

The democrats.senate.gov website provides a joint statement from the two senators, which itself attaches a [one page summary](#) of the **Inflation Reduction Act** of 2022.

On **July 28, 2022**, the [Inflation Reduction Act of 2022](#) was published.

QUICK SHORT FORM SUMMARY OF THE MANCHIN-SCHUMER ACT	
USD 369 billion for Energy Security and Climate Change over 10 years	"investing in domestic energy production and manufacturing and reduce carbon emissions by roughly 40 percent by 2030"
USD 9 billion consumer home energy rebate programs and 10 years of tax credits	This initiative is focused on lower-income customers to electrify home appliances and energy efficient retrofits
USD 4,000 tax credit (used) and USD 7,500 tax credit (new) clean vehicles	This initiative is focused on lower and middle income folk to buy used and new clean vehicles
USD 1 billion grant program	This initiative is to make affordable housing more energy efficient
Production tax credit scheme	This initiative is to accelerate US manufacturing of batteries, solar panels, and wind turbines, and extraction of critical materials, modelled to result in USD 30 billion investment
USD 10 billion investment tax credit scheme	This initiative is to accelerate the development of clean technology manufacturing facilities for batteries, solar panels, and wind turbines
USD 2 billion in grants to retool	This initiative is to accelerate the retooling of existing manufacturing facilities to manufacture clean vehicles
USD 20 billion in loans	This initiative is to accelerate the development of new clean vehicle manufacturing
USD 2 billion in funding	This initiative is to accelerate the development of breakthrough technologies

A fuller summary of the Energy Security and Climate Change provisions is [attached](#).

- **Loan Programs Office mobilised:**

- On **July 28, 2022**, the **DOE Loan Programs Office** [announced](#) that it is to lend **USD 102 million** to **Syrah Technologies LLC** to allow it to expand its **Syrah Valley processing facility**. The facility produces graphite derived active anode material, a critical element used in lithium-ion batteries for battery electric vehicles.

As announced, this is the first loan under the **Advanced Technology Vehicles Manufacturing Loan Program** since 2011, and the first ever for a supply chain manufacturing project.

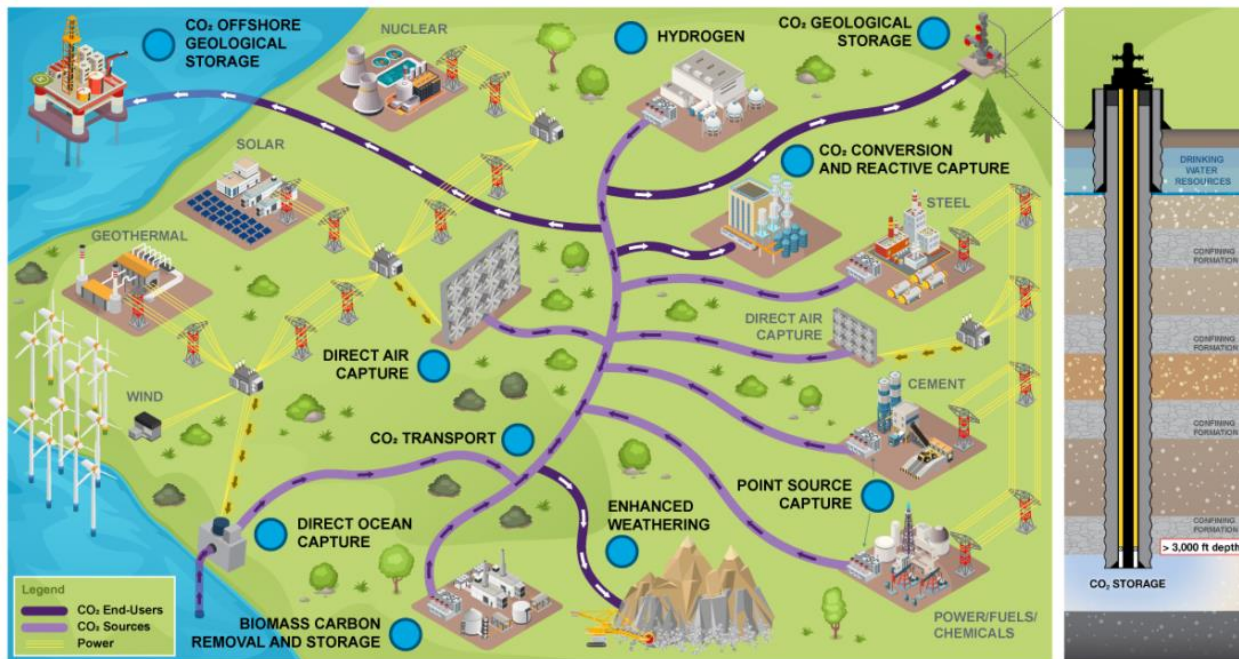
- On **July 26, 2022**, it was reported widely that the **DOE Loan Programs Office** is to lend **USD 2.5 billion** to a joint venture between **General Motors Co** and **LG Energy Solution (Ultium Cells LCC)** to support the development of lithium-ion battery **giga-factories** in **Michigan, Ohio** and **Tennessee**.

As reported, the commitment from the **DOE Loan Programs Office** is conditional, but is expected to the progress in the coming months under the **Advanced Technology Vehicles Manufacturing Loan Program**.

- **Cuban procurement:** On **July 28, 2022**, it was reported widely that **Union Electrica de Cuba (UNE)**, through Indian state-owned power generator, **NTPC Limited** (chosen by the Cuban Government as its preferred partner), is procuring, on a build-own-operate-transfer (**BOOT**) basis, the development of **1.15 GW** of **grid-connected photovoltaic solar** capacity and **150 MW / 150 MWh** of **BESS** projects across Cuba. Under the proposed **BOOT** scheme the photovoltaic solar and **BESS** capacity will be transferred to **UNE** after 25 years.

It is understood that this is part of a broader plan to procure **2.1 GW** of photovoltaic solar projects across Cuba.

- **Office of Fossil Fuel and Carbon Management:** On **July 28, 2022**, the author of Low Carbon Pulse came across the following interactive diagram.



Source: [Office of Fossil Energy and Carbon Management](#)

The interactive diagram is an on-line tool that outlines the carbon management provisions of the [Bipartisan Infrastructure Law](#) and other **US Department of Energy (DOE)** funding initiatives, and announcements and notices, including as provided by and under - **DOE Loan Programs Office, DOE Advanced Research Projects – Agency-Energy** and **DOE Small Business Innovation Research**.

For ease of reference we have included links to other materials that are of general application and hopefully of interest: [Strategic Vision: The Role of Fossil Energy and Carbon Management in Achieving Net-Zero Greenhouse Gas Emissions](#); [The Carbon Capture, Transport, and Storage Supply Chain Review: Deep Dive Assessment](#); [Infrastructure Investments and Jobs Act: Opportunities to Accelerate Deployment in Fossil Energy and Carbon Management Activities](#); [US Department of Energy Hydrogen Program Plan](#); and [NATCARB / ATLAS / netl.doc.gov](#).

- **Green Hydrogen Can Help Latin America's Energy Transition:** On **July 30, 2022**, the good folk at [oilprice.com](#) published an article entitled [Green Hydrogen Can Help Latin America's Energy Transition](#), authored by the **Oxford Business Group**. The article outlines the scope of the possible Green Hydrogen production, and the economic benefits across Latin America and the Caribbean. The article provides a detailed introduction to those seeking to get a sense of the level of activity, and the potential for production.

France and Germany:

- **German Government to lock in €177.5 billion on climate action:** On **July 27, 2022**, the German Federal Government adopted a draft finance plan, *Climate and Transformation Fund*, providing **€177.5 billion** for climate action which is now part of the German Federal budget, and subject to the parliamentary process to approve it.
- **French Government to tender 1 GW of offshore wind field capacity:** On **July 29, 2022**, it was reported widely that the French Government is to undertake an auction process (by tender) for the award of up to **1 GW** of offshore wind field capacity in the **Sud Atlantique** area later in 2022.

Australia:

- **South Australia joins Queensland: Edition 44** of Low Carbon Pulse (under Queensland **Launches Skills Development Roadmap**) reported that: "The Government of Queensland, Australia, launched the first dedicated workforce development plan for the hydrogen industry – [The Hydrogen Industry Workforce Development Roadmap 2022-2023](#). The initiative was flagged by the Government of Queensland nearly three years ago, and demonstrates the progressive thinking of the Government".

On **July 26, 2022** the Government of South Australia [announced](#) that it had received 60 proposals from organisations in respect of its **AUD 593 million Hydrogen Jobs Plan**.

- **Australia moves to formalise its NDC at 43%:** On **July 27, 2022**, Australia's Energy and Climate Minister, Mr Chris Bowen introduced [legislation](#) to the Australian Federal Parliament to formalise Australia's new nationally determined contribution (NDC) of a 43% reduction by 2030 compared to 2005, and **NZE** by 2050.

In addition to increasing the **NDC** and committing to **NZE**, the legislation provides for the establishment of a new independent agency, the **Climate Change Authority**, requires the Minister of Climate Change and Energy to issue an annual report to the Australian Federal Parliament, and incorporates the **NDC** and **NZE** targets into the objectives of key agencies, including the Australian Renewable Energy Agency (**ARENA**), the Clean Energy Finance Corporation (**CEFC**), Export Finance Australia, Infrastructure Australia, and the Northern Australia Infrastructure Facility (**NAIF**).

Blue and Green Carbon Initiatives and Biodiversity

- **International Day for the Conservation of the Mangrove Ecosystem:** As regular readers of Low Carbon Pulse will know, the author has long included background on the role that mangrove forests and swamps play, and the

increased role that they can play, as a nature based solution to mitigate the impact of climate change (see **Editions 29, 31, 32, 33** and **44** of Low Carbon Pulse).

Among the many facts and stats that were reported on **International Day for the Conservation of the Mangrove Ecosystem**, here are some of the more eye-catching: **first**, mangroves forests and swamps are highly adapted to their muddy and salty habitat, providing a natural barrier to protect coastal habitats; **secondly**, mangroves provide a habitat for thousands of species of fish and crustaceans, providing oxygenated and low to lower acidic sea-water for those species, and ideal nursery habitats – mangroves are good for fishery and crustacean stocks; **thirdly**, per hectare, mangrove forests and swamps up to 10 times the **CO₂** of terrestrial forests, and their rate of growth and the locations of their growth make them to many the unsung **front-line climate warriors**, and to others the **superhero ecosystems**, **fourthly**, while mangrove forests and swamps are to be found in 123 countries, they represent less than of tropical forests globally and less than 0.4% of the total area covered by forests.

The only threat to mangrove forests and swamps arise from their removal to allow invasive aquaculture and coastal development, with some estimates suggesting that in the last 50 years around 25% of mangroves forests and swamps have been lost as a result of removal.

By way of reminders: **Edition 29** reported that it is estimated that one mangrove tree will absorb 12.4 kg of **CO₂** a year on average. Taking the benchmark of the Kingdom of Saudi Arabia to plant 50 billion trees (see **Edition 13** of Low Carbon Pulse), 50 billion mangrove trees will absorb 620 million metric tonnes per annum. It is possible to plant 5,000 mangrove trees per hectare, with each hectare absorbing 62 metric tonnes per annum of **CO₂**. 50 billion mangrove trees could be planted on 10,000,000 hectares.

As reported in **Edition 41** of Low Carbon Pulse, conservation, preservation and restoration is a policy setting in many countries, and by way of a reminder, **Edition 41** (under **World Bank supports mangrove conversation and restoration in Indonesia**) that **The World Bank** announced its support for projects to conserve and to restore mangrove growth in Indonesia, under **The Mangrove for Coastal Resilience Project**. The Project is stated to "focus on strengthening the policy and institutions for mangrove management and rehabilitation, promoting sustainable mangrove management, as well as improving the livelihood opportunities for Indonesian coastal communities living around mangrove forests". As stated, Indonesia has around **3.4 million hectares** of mangrove growth, accounting for 20% of mangrove growth globally, and provides habitat for 40 of the 54 species of mangrove. The mangrove growth in Indonesia stores **3.14 giga-tonnes** (3.14 billion metric tonnes) of **CO₂**. As noted in previous editions of Low Carbon Pulse, mangrove growth improves the eco-system for marine life, and as such provides improved fishery opportunities. In Indonesia, around **55%** of the **fish catch** consists of **mangrove-dependent** marine life.

Edition 44 of Low Carbon Pulse (under **Global Mangrove Alliance and Wetlands International report on mangroves**) reported that the **Global Mangrove Alliance, Save Our Mangroves Now!** and **Wetlands International** published **The State of Mangroves in the West Indian Ocean**. The publication considers the state of the mangroves along the east coast of Africa, in particular Kenya, Madagascar, Mozambique and Tanzania. For those interested in Blue Carbon, the publication is rich in data and information, with a strong focus on the opportunities for restoration of mangrove forests and swamps within the West Indian Ocean region. (**Editions 23, 25, 29, 31, 32, 33, 34, 35, 37**, and **41** include news items mangroves and other Blue Carbon initiatives.)

- **Colombia conservation and preservation policy settings:** On **July 26, 2022**, [conservation.org](https://www.conservation.org) reported that Colombian President, Mr Ivan Duque Marquez announced that Colombia is to conserve and to protect **21% of its lands** and **37% of its waters**. The conserved and protected areas include areas that are conserved and protected formally under the UN Convention on Biological Diversity.
- **World Resources Institute (WRI) Five Reasons for Cities to include trees in climate action:** On **July 29, 2022**, the **WRI** (under **5 Reasons Cities Should Include Trees in Climate Action**) noted that while cities and communities around the world are focusing on **GHG** emissions from the building, energy, industrial, transportation and waste sectors a number of overlooking the benefits of forestry and trees. The **WRI** introduces its publication, **Global Protocol for Community Scale Greenhouse Gas Inventories: Supplemental Guidance for Forests and Trees**, and guides us to the **GHG Protocol for Cities – An Accounting and Reporting Standard for Cities**, which has been piloted in Jakarta, Mexico City, Mumbai and Salvador, and in respect of multiple US communities (through the **process of estimating annual emissions and removals by forests and trees**).

The **WRI** outlines the five reasons as follows: **1.** Forests and trees both emit (on degradation or removal) and remove carbon (on growth); **2.** Protecting urban forests is low-hanging fruit, even if the mitigation potential is small (in a global context, and in the context of other means and solutions); **3.** Urban forests and trees are important for climate adaptation; **4.** Expanding forest and tree coverage can address inequities; and **5.** The benefits of forests and trees go well beyond climate. The **WRI** publication is well-worth a read, providing links to many helpful sources of data and information, and providing a number of case studies. More worthwhile still is to spend an afternoon or evening with all of the materials to which links are provided, and the article itself.

- **Nature Based Solutions:** During the first part of July, the author of Low Carbon Pulse read the **European Commission** publication **The Vital Role of Nature-Based Solutions In a Nature Positive World**, which was released by the **Directorate-General for Research and Innovation**. The publication is an excellent primer for **Nature-Based Solutions (NBS)** and **Nature-Based Enterprises (NBE)**. It is hoped the resources and time are devoted to the development of the thinking contained in the publication in the near term.

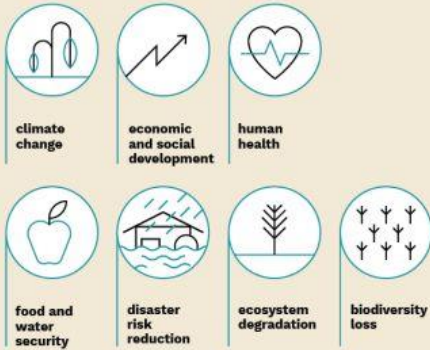
The author also read the **Asian Development Bank (ADB)** publication **Integrating Nature-Based Solutions for Climate Change Adaptation and Disaster Risk Management – A Practitioner's Guide**. The **ADB** publication, authored by John Matthews and Ernesto Ocampo Dela Cruz provides a wonderful addition to those active (or those interested) in the area of **NBS**. **NBS** are at the core of both Blue and Green Carbon Initiatives. One of the many good things about the **ADB** publication is that it applies a broader perspective as to what is an **NBS**.

On **July 26, 2022**, **UN Biodiversity** published an infographic describing Nature Based Solutions, which is set out at the top of the next page:

What are Nature-based Solutions (NbS)?

NbS are defined by IUCN as “actions to address societal challenges through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being.” They use the power of nature and functioning ecosystems as infrastructure to provide natural services to benefit society and the environment.

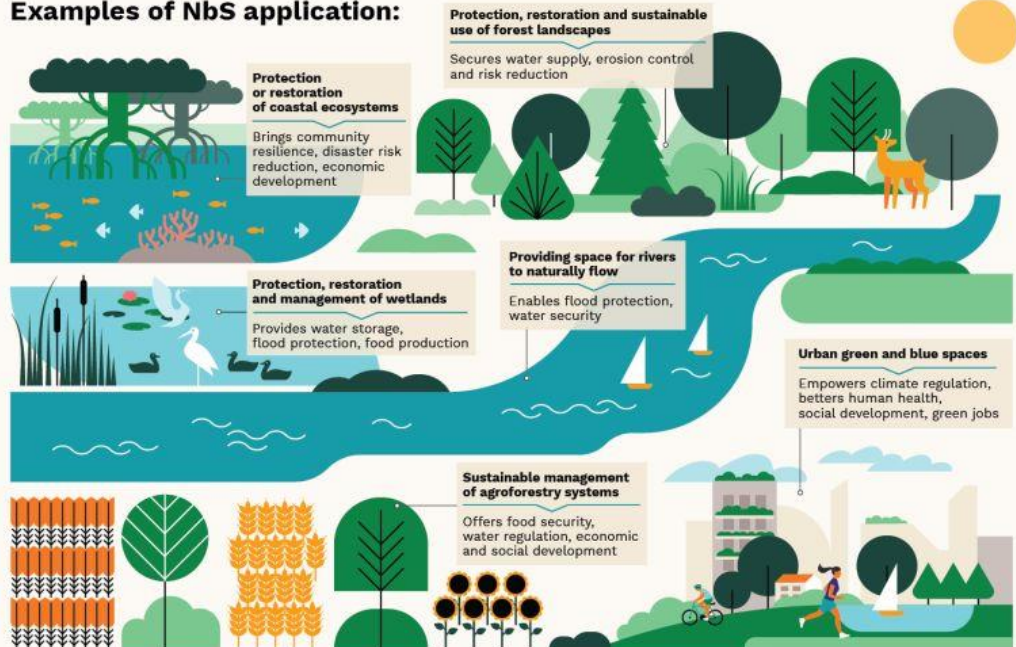
NbS have prime potential to help address global challenges such as:



NbS can provide long-term environmental, societal and economic benefits:



Examples of NbS application:



www.iucn.org/adapt

@theadaptproject



Bioenergy and heat-recovery:

- Fully covered wastewater treatment facility operation:** On July 26, 2022, State of Green Denmark announced that the first fully covered wastewater treatment facility had commenced operation, **Solrødgård**, located in **Hillerød**, north of Copenhagen. **Solrødgård** has been developed by the **Hillerød Utility**. As announced, the design of **Solrødgård** has been driven by developing a facility that is net-energy positive, and **CO₂** neutral.
- Biogas reading for those taking a vacation:** On July 20, 2022, the ever-excellent biogasworld.com published [Top 10 Biogas Reports To Add To Your Summer Reading List](#). The Top Ten Biogas reads listed are:
 - [Best Practices for Reducing Costs of Anaerobic Digestion of Organic Waste](#);
 - [Biomethane Production Potentials in the EU](#) – see below;
 - [Renewable Natural Gas as a Complementary Solution to Decarbonizing Transport](#);
 - [Fuelling Clean Mobility with Bio-LNG](#);
 - [Hitting Canada's Climate Targets with Biogas and RNG](#);
 - [Bioenergy Europe Statistical Report 2022](#);
 - [Green Gas: The Green Economy under our Feet](#);
 - [Turning Circle: How Bioenergy can Supercharge Australia's Circular Economy](#);
 - [The Landscape of Methane Abatement Finance](#);
 - [Anaerobic Digestion Deployment in the UK](#).

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "upgrading") so that it can be used as pipeline gas (i.e., complying with the specification for hauling through the applicable natural gas pipeline, including the removal of **CO₂**, and other compounds and elements, such that the gas hauled through the pipeline is **CH₄**). **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel (typically, as a gas that is combusted / oxidised to produce electrical energy or heat energy or both) or as a feedstock. Also, either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia:** being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;
- **Bio-butanol:** being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel:** being diesel (i.e., synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol:** being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene:** being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF)**, is a synthetic paraffinic kerosene. Currently, most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams (typically using some natural gas). As noted below, typically fatty acids and hydrogenated acids are used to produce synthetic paraffinic kerosene. If the feedstock is sourced from Biomass it is a Bio-kerosene;
- **Bio-LNG:** being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and
- **Bio-methanol:** being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

BESS and HESS (and energy storage):

Georgia Power granted approval: On **July 26, 2022**, [energy.storage.news](#) reported that **Georgia Power** had been granted approval (by the Public Service Commission of Georgia) for its **2022 Integrated Resource Plan** outlining how **Georgia Power** is to develop and to deploy renewable energy and energy storage over the coming three years. As reported, **Georgia Power** is to develop and to deploy **2.3 GW** of renewable energy (with a long-term plan of **6 GW** by 2030) and for up to **765 MW** of **BESS**.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

- **BECCS launched by Mitsubishi Heavy Industries:** On **July 26, 2022**, **CO₂ Value Europe** posted that **Mitsubishi Heavy Industries**, one its members, had deployed the **First Compact CO₂ Capture System** at a biomass power plant in **Hiroshima, Japan**. The **CO₂** captured will be used in greenhouses on-site to enhance the growth of vegetables.
- **The Week in Carbon Dioxide Removal:** On **July 31, 2022** Mr Wil Burns published his [Week 2 Edition](#). The **Week 2 Edition** is great and is commended to anyone interested in CCS / CCUS.

Carbon Credits and Hydrogen Markets and Trading:

Treasure Trove: On **July 29, 2022**, **Carbon Growth Partners'** Chief Impact Officer, Mr Charles Bedford, outlined the roles of compliance / regulated carbon markets, and voluntary carbon markets, in an article entitled [Carbon Credits 101, Episode 3: Less Harm, Or More Good?](#) The article is well-worth a read. For ease of reference, links are attached to **Episodes 1** and **2** ([Episode 1: Building A Better Cookstove](#), [Episode 2: Mongolia's Power of the Wind](#)) in the **101-series**.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

- **P2X Portugal's planned production:** On **July 25, 2022**, it was reported widely that a new joint venture had been established between **The Navigator Company** and **P2X-Europe, P2X-Portugal**, with plans to develop and to deploy a production facility to produce up to **80,000 metric tonnes** of renewable power-to-liquid fuels and feedstock. It is understood that the power-to-liquid fuel will be **SAF**: " *a world class production facility for industrial-scale production of ... carbon-neutral synthetic kerosene, based on green hydrogen and biogenic CO₂*". The planned capital cost of the development of **P2X-Portugal** is projected as **€600 million**.

A number of reports have pointed out that this means of the production of **SAF** requires around 770 MWh of renewable electrical energy generation to produce **SAF** to provide 100 MWh of energy for the power and propulsion of an aircraft.

- **Enel Brazil and Government of the State of Ceará aligned:** On **July 25, 2022**, it was reported widely **Enel Brazil** and the **Government of the State of Ceará** signed a memorandum of understanding to developed a Green

Hydrogen production facility within the State. As regular readers of Low Carbon Pulse will recall, 16 MOUs have been signed by the State to allow the development of Green Hydrogen production facilities.

By way of reminder: Edition 35 of Low Carbon Pulse (under **Cactus Energie Verde plans GH2 in Brazil**) reported that: "Cactus Energia Verde (**CEV**) plans to invest €5 billion in the development of a Green Hydrogen Project in Ceará, Brazil, to produce 126,000 metric tonnes of hydrogen and 63,000 metric tonnes of oxygen annually.

For these purposes, it is reported that **CEV** had signed a memorandum of understanding (**MOU**) with the Government of Ceará (**GOC**) to develop a Green Hydrogen production facility at the Pecém Port Complex. The renewable electrical energy to power the electrolyzers will be sourced from a photovoltaic solar project (the 2.4 GW Uruque Photovoltaic Park) and wind project (a 1.2 GW offshore wind field currently under construction).

The **MOU** with **CEV** is the 15th MOU signed by the Government of Ceará with prospective proponents (see **Editions 10** and **21** of Low Carbon Pulse): AES, Differential, EDP, Eneqix, Eneva, Engie, FFI, Green Energy Cactus, H2Helium, Hytron, Neoenergy, Qair, Total Eren, Transhydrogen Alliance, and White Martins / Linde have all signed **MOUs** with **GOC**".

- **Unigel plans green hydrogen plan in Brazil:** On **July 26, 2022**, [h2-view.com](https://www.h2-view.com) reported that **Unigel** (leading chemical corporation) had announced plans to develop a green hydrogen production facility in Brazil, to be located in the **Camaçari Industrial Complex, Bahia State**. As reported, the green hydrogen production facility will be developed in phases, with **phase 1** to produce **10,000 metric tonnes** of green hydrogen a year, from which **60,000 metric tonnes of green ammonia** will be produced, and **phase 2** to produce **40,000 metric tonnes** of green hydrogen from which **240,000 metric tonnes of green ammonia** will be produced. The first phase is to be operational by the end of 2023, with three electrolyzers to be supplied by **thyssenkrupp nucera**.
- **Enel Green Power (EGP) shares Green Hydrogen Factbook:** On **July 28, 2022**, **EGP** published [Green Hydrogen Factbook](#). The publication provides a good summary of key dynamics and issues.
- **MEA Energy Transition Readiness Index released:** On **July 28, 2022**, **Roland Berger** and **Siemens Energy** published [The MEA Energy Transition Readiness Index](#). The report is well-worth a read, with the key takeaways being the scale of capital investment required to realise the potential for **MEA** to exploit its renewable resources, and the need for laws and regulations to facilitate this exploitation (including to provide certainty for investors).
- **CF Industries and Mitsui aligned on ammonia:** On **July 29, 2022**, [fuelcellworks.com](https://www.fuelcellworks.com) reported that **CF Industries** (as 52% participant) and **Mitsui & Co., Ltd.**, (as 48% participant) had agreed to work together to develop jointly a clean ammonia production project in the US, Gulf of Mexico. As reported, the project is to produce at least **1 million** metric tonnes of clean ammonia annually, with **CF Industries** acting as the operational partner using CCUS*1 processes to reduce **CO₂** emissions by more than 60% compared to conventional ammonia production processes. The plan is to undertake jointly a FEED study with a view to taking a final investment decision in 2023.
- **Nuclear Hydrogen Initiative:** During the news-cycle for this **Edition 45** of Low Carbon Pulse there has been considerable coverage of the establishment of the **Nuclear Hydrogen Initiative** (a link to nuclear-hydrogen.org is attached detailing the corporations, governments, institutions and organizations that have signed up to date). The establishment of the **Nuclear Hydrogen Initiative** is a good thing: production of hydrogen from the steam arising from the production of nuclear energy provides an efficient and sustainable means of hydrogen production.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

Other than as reported elsewhere in this **Edition 45** of Low Carbon Pulse, during the period July 25, 2022, to July 31, 2022, the author of Low Carbon Pulse did not come across any news items sufficiently material or significant for inclusion in this section of this **Edition 45**.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

Ford Motor Company and Rio Tinto align: On **July 26, 2022**, [batteryindustry.tech](https://www.batteryindustry.tech) reported that the **Ford Motor Company** and **Rio Tinto** had signed a non-binding memorandum of understanding (**MOU**) to develop jointly more sustainable and secure supply chains for battery and low-carbon materials to be used in Ford vehicles. As reported, the multi-materials partnership will support the transition of the **Ford Motor Company** to net-zero, with the **MOU** covering critical materials aluminium, copper and lithium. In this context, **Ford Motor Company** will become a foundation customer for the **Rio Tinto Rincon lithium project in Argentina** (see **Edition 37** of Low Carbon Pulse).

Wind round-up, on-shore and off-shore:

- **California takes aim at 20 GW of off-shore wind:** On **July 25, 2022**, it was reported widely that the **Governor of the State of California, Mr Gavin Newsome** had called for a target of **20 GW** of off-shore wind field capacity to be installed by 2045. This represents an increase of **5 GW** in the previous target. The Governor is reported to have said: "The state's draft [carbon neutrality road map](#) does not go far enough or fast enough. That's why I am pushing state agencies to adopt more aggressive actions, from offshore wind to climate-friendly homes, and to make sure we never build another fossil fuel power plant in California again".
- **Empire State third round of off-shore wind field solicitation:** On **July 27, 2022**, the **Governor of the State of New York, Ms Kathy Hochul**, launched the third offshore wind solicitation seeking to grant leases for the development of around **2 GW** of off-shore wind field capacity (**NY3**). The procurement process will be administered by the New York State Energy Research and Development Authority (**NYSERDA**): attached is the link to [NYSERDA - 2022 Offshore Wind Solicitation](#). The procurement process is part of the continued progress being made by the **Empire State** towards its goal of the development of **9 GW** of off-shore wind field capacity by 2030 under the **Climate Leadership and Community Protection Act (Climate Act)**. The timeline for the submission of proposals for **NY3** is **December 22, 2022**.

In addition, the procurement of an additional **2 GW** of off-shore wind field capacity, the **NY3** includes procurement of ports for use by off-shore wind projects, manufacturing and supply chain infrastructure, and "meshed ready" off-shore transmission infrastructure development.

- **Republic of Ireland increases offshore wind field target:** On **July 29, 2022**, it was reported widely that the Government of the Republic of Ireland had increased the Republic's offshore wind field development target from **5**

GW to 7 GW by 2030. This increase will allow the Republic to realise the **Sectoral Emissions Ceilings** that have been introduced for the agricultural, building, electricity, industrial, and transport sectors by 2030 – with a reduction of 51% of GHG emissions being targeted by 2030.

Solar and Sustainability (including NZE Waste):

- **Air Products all in:** On **July 25, 2022**, it was reported widely that **Air Products** (one of the Big Three industrial gas producers globally) is to spend **USD 4 billion** over the next five years to reduce the **GHG** emissions arising from its activities. As part of broader plans to achieve **NZE** by 2050, **Air Products** has set itself a **Third by 30** goal in respect of its Scope 3 emissions, providing a clear carbon intensity goal in respect of those emissions.
- **bp and Iberdrola teaming with projects:** On **July 28, 2022**, **bp** announced that it is partnering with **Iberdrola** (under a strategic collaboration agreement) to contribute to the decarbonisation of the industrial and transport sectors, specifically, together to invest up to **€1 billion** to develop and to deploy **11,000 fast-charging points** by 2030 for battery electric vehicles, and developing hydrogen production capacity on a large scale (with up to **600,000 metric tonnes** of production a year across Portugal, Spain and the UK) and for these purposes boosting renewable electrical energy development.

Land Mobility / Transport:

- **Buses and coaches:** While there continued to be news items in respect for orders for electric battery and fuel cell technology buses during the period July 25 to 31, 2022, for the purposes of this **Edition 45** of Low Carbon Pulse the author has decided not to include, so as to manage the length of this **Edition 45**.
- **Cars:** During the news cycle of this **Edition 45** of Low Carbon Pulse, the author has not come across any news items sufficiently material or significant to merit inclusion.
- **Battery, Fuel Cell and ICE Technology:** During the news cycle of this **Edition 45** of Low Carbon Pulse, the author has not come across any news items sufficiently material or significant to merit inclusion.
- **Industrial Vehicles and Trucks:** During the news cycle of this **Edition 45** of Low Carbon Pulse, the author has not come across any news items sufficiently material or significant to merit inclusion.
- **Recharging and refuelling infrastructure:**
 - **bp opens charging / recharging island:** On **July 27, 2022**, **Daimler Truck** [announced](#) that **bp** (leading international energy corporation) had opened its first high-performance (and to many, ultra-fast) charging / recharging island for medium and heavy trucks in **Schweigenheim, Rheinland-Pfalz, Germany**, operating under the **bp** brand **Aral**. The **Daimler Truck** announcement notes that it had worked closely with **bp** to ensure that the site would meet the needs of European fleet operators.
 - **Shell to open its first hydrogen network in Asia:** On **July 29, 2022**, it was reported widely that **Shell New Energy Company Limited** and **Shanghai Shenergy Innovation and Development Co** had announced a joint venture to develop a network of hydrogen fuelling / refuelling stations in **Shanghai**, with between 6 and 10 stations to be developed and deployed in Shanghai and the Yangtze River Delta within the coming five years.
- **Trains:**
 - **First hydrogen powered and propelled passenger train enters service:** On **July 25, 2022**, it was reported widely that the first hydrogen powered and propelled passenger trains had entered into service on the German regional railway between **Bremervörde** and **Buxthude**, southwest of the city of Hamburg. The trains in service are 14 two-car Coradia iLINT trains manufactured by Alstom at Salzgitter, Germany (see **Editions 27** and **28** of Low Carbon Pulse). As reported the trains are owned by the German State of Lower Saxony and leased to the operator, **Eisenbahn und Verkehrsbetriebe Elbe-Weser** (itself owned by the German State of Lower Saxony).
 - **Romanian Railway Authority (AFR) procuring 12 160-seater trains:** On **July 27, 2022**, [hydrogen-central.com](#) reported that the **Government of Romania** had approved the procurement of 12 160-seater passenger trains powered and propelled by fuel-cell technology as part of a pilot project implemented by **AFR**. The procurement includes "long-term vehicle maintenance and repair services and hydrogen supply".

Ports Progress and Shipping Forecast:

- **Ferries and other craft:** During the news cycle of this **Edition 45** of Low Carbon Pulse, the author has not come across any news items sufficiently material or significant to merit inclusion.
- **Green shipping:**
 - **AiPs for GTT:** On **July 28, 2022**, [fuelcellworks.com](#) reported that **DNV** had granted to **GTT (Gaztransport & Technigaz)**, the giant French containment system technology provider) approvals in principle (**AiP**) for the design of a membrane containment system for liquid hydrogen and for the preliminary concept design of a liquid hydrogen carrier. (See **Edition 35** of Low Carbon Pulse for related reporting on **GTT**.)
 - **H2Ships project solid start:** On **July 29, 2022**, [offshore-energy.biz](#) reported that **Next Generation Shipyards** was to build a pilot vessel, the **Neo Orbis**, the first vessel in the world to be powered and propelled with hydrogen in solid form as an energy carrier – **sodium borohydride**. The advantage of hydrogen as an energy carrier in solid form is that it has a high-energy-density, and that it is bunkered safely.

Airports and Aviation:

Other than as reported elsewhere in this **Edition 45** of Low Carbon Pulse, during the period July 25, 2022, to July 31, 2022, the author of Low Carbon Pulse did not come across any news items sufficiently material or significant for inclusion in this section of this **Edition 45**.

Low Carbon Pulse – July 2022

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to the **consolidated July version** of Low Carbon Pulse – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Friday July 1, 2022 to Sunday July 31, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1 to 28**, covering October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29 to 38**, covering October 7, 2021 to March 31, 2022), and click [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39, 40 and 41** of Low Carbon Pulse, covering **April, May and June 2022**).

Welcome to the consolidated July 2022 Low Carbon Pulse:

During July 2022 we trialled a weekly news-cycle for Low Carbon Pulse. As regular readers of Low Carbon Pulse will know, for the three months prior to July 2022 (April, May and June 2022) we trialled a monthly news-cycle, having previously applied a two week news-cycle. Both the monthly and two weekly news-cycles resulted in long publications, not ideal for those seeking a "quick-read". It is hoped that the weekly news-cycle will provide the right balance / length (between 8,000 and 10,000 words, and 12 to 15 pages in length – in general terms this was achieved).

In moving to trialling the weekly news-cycle for Low Carbon Pulse, we promised a monthly consolidation edition. This is the consolidated **July 2022 Low Carbon Pulse** edition, comprising news items covered in **Editions 42 to 45** of Low Carbon Pulse.

Bigger news stories, and themes of July 2022:

- On **Tuesday July 12, 2022**, the **European Union (EU)** committed **€1.8 billion** in funding support for **17 clean-tech projects** across the **EU**.

On **Friday July 15, 2022**, the **European Commission (EC)** approved **€5.4 billion** of funding support for an **EU-wide hydrogen research and innovation project** involving **15 of 27 Member States** of the **EU**. The approval from the **EC** permits **EU Member States** to provide up to **€5.4 billion** of funding support to **35 corporations** in one or more **Member State**, support that otherwise would have been proscribed as contrary to State Aid rules.

The section headed **Europe and UK** (see pages 18 to 23) outlines the basis for, and the spread of, funding support across industry sectors and countries in the **EU**. The level of funding support and the spread of industry sectors is consistent with the **EU** policy settings, and is wonderful to see.

- During the weekend of **July 17 and 16, 2022**, the author of Low Carbon Pulse caught up on a back-log of reading. A key axiom re-emerged - all activities, and all goods and services, have a carbon impact / implication. While this is axiomatic and one knows this intuitively, it is helpful to be reminded, and to reflect on it, including that all activities are interconnected.
- **July 26, 2022:**
 - **International Day for the Conservation of the Mangrove Ecosystem:** As regular readers of Low Carbon Pulse will know, the author has long included background on the role that mangrove forests and swamps play, and the increased role that they can play, as a nature based solution to mitigate the impact of climate change (see **Editions**

[31](#), [37](#) and [41](#) of Low Carbon Pulse). In 2015, the **General Conference** of **UNESCO** adopted **July 26, 2022** as the International Day for the Conservation of the Mangrove Ecosystem raising awareness of the importance of mangroves as a "unique, special and vulnerable ecosystem". The **Blue and Green Carbon Initiatives and Biodiversity** section below of Low Carbon Pulse details the importance of the mangrove ecosystem.

- **Passing of James Lovelock:** One of the first books that sparked the consciousness of the author of Low Carbon Pulse about the environment was James Lovelock's **Gaia**. On **July 26, 2022**, James Lovelock passed away on his 103rd birthday. In addition to authoring **Gaia** (laying the foundations of earth science), Mr Lovelock promoted global awareness of ozone-depleting fluorocarbons, the dangers of pollution (including lead in motor spirit), having been concerned about these (and other) matters since the 1960s, and advocated for nuclear power. Vale James Lovelock.
- On **July 27, 2022** the State of New York released the **Request for Proposals** for its **2022 Offshore Wind Solicitation**, the third offshore wind solicitation (**NY3**) for a further **2 GW** of off-shore wind capacity. **NY3** is covered in detail in the **Wind round-up, on-shore and off-shore** section below.
- On **July 27, 2022**, the **Manchin-Schumer Act** took shape, and breathed life back into the decarbonisation agenda of the Biden Administration. If the **Manchin-Schumer Act** becomes law, it is estimated that it will provide a clear pathway for the US to reduce its **GHG** emissions by 40% by 2030.
- On **July 31, 2022**, the death of Bill Russell was reported. For regular readers of Low Carbon Pulse, the author's love of basketball will be well-known (**Editions 32** and **33** were named for Magic Johnson and Larry Bird). Bill Russell was sports star and social activist, and all time legend. Vale Bill Russell.

Publications very much worth a read:

- On **July 14, 2022**, the **Mission Possible Partnership** published [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](#). Whether your day job involves aviation or not, the publication is excellent and well-worth a read (see the [Airports and Aviation](#) section below on pages 18 and 19).
- The **American Bureau of Shipping (ABS)** publication [Setting the Course to Low Carbon Shipping – Zero Carbon Outlook](#) is excellent, and is well-worth a read, whether your day job involves shipping or not (see page 4).

Climate consequences of hydrogen emissions:

Previous editions of Low Carbon Pulse reported on research in respect of the impact on the climate system of the release of hydrogen emissions as the production, and use, of hydrogen becomes everyday over the coming years. The headline was that hydrogen emissions need to be avoided because on release, hydrogen will compound with other elements, to produce **GHG** emissions.

On **July 20, 2022**, [copernicus.org](#) published [Climate consequences of hydrogen emissions](#). The article is compulsory reading for all. The abstract provides a clear sense of the need to understand and not to overlook or to underestimate the impact of hydrogen emissions, and part of it is quoted below:

"While zero- and low-carbon hydrogen hold great promise ... [hydrogen] is an indirect greenhouse gas whose warming impact is both widely overlooked and underestimated. This is largely because hydrogen's atmospheric warming effects are short-lived – lasting a couple of decades – but standard methods of characterising climate impacts of gases consider only the long-term effect from a one-time pulse of emissions. For gases whose impacts are short-lived, like hydrogen, the long-term framing masks a much stronger warming potency in the near- to medium term".

We live in a world of unintended consequences, but the mantra must be do no harm, and do it quickly.

100 days to COP-27:

As of **July 29, 2022**, there were **100** days to go to the commencement of **COP-27** to be held in **Sharm El-Sheikh, Egypt** between **November 6** and **18, 2022**. As was the case in 2021 (see **Editions 23, 25, 26, 27** and **28**) ahead of **COP-26** held in Glasgow, Scotland, ahead of **COP-27** Low Carbon Pulse will commence coverage of key issues in respect of which progress needs to be made at **COP-27**.

In this context, it is noted that by **September 23, 2022**, countries that are parties to the Paris Agreement are scheduled to submit their updated nationally determined contributions (**NDCs**). Progress at **COP-27** will be more likely, and more viable, by being informed by updated **NDCs**, providing a basis to an informed assessment of any gap between the reductions in **GHG** emissions required to achieve the Paris Agreement goals, and the aggregate of the **NDCs** to which countries have committed. There remains a gap, both in headline aggregate **NDCs** and in the implementation of policy settings at a country level necessary to achieve **NDCs**. Picking up on a theme identified some time ago in Low Carbon Pulse, **GHG** emission reduction commitments are required at an increased rate and at a faster rate.

The assessments of climate change, and its impact, are becoming increasingly stark, and the depictions of climate catastrophe, ever more startling. The alarm bells have been ringing for some time. It is hoped that folk are not getting used to the alarm bells, or, worse, that they have become background noise.

Vale those lost:

Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced. Our condolences to the family and friends, and the people of Japan, for the cruel and untimely loss of Mr Shinzo Abe.

Enquiry made of author during the last week of July:

During the first three days of the last week-of July, 2022, the author of Low Carbon Pulse was in Jakarta, Indonesia, to present to the Indonesian Petroleum Association on CCS / CCU and CCUS. While in Jakarta, the author was asked to outline the process for the development of each edition of Low Carbon Pulse.

The answer to the enquiry was as follows: each morning the author reads from 3 am to 6 am, and on each Saturday and Sunday morning the author writes and edits from 4 am to 7 am, so that by Monday morning the current edition is ready to have links and graphics added by Florence Chan and Vanessa Wu. The author proofs each edition from 5 am to 8 am each Tuesday morning, and Florence and Vanessa finalise each edition in time for publication on Tuesday afternoon. From 6 am to 9 pm Monday to Friday (and 10 am to 6 pm on Sunday), the author does his day job.

Balance of the content of this consolidated July 2022 Low Carbon Pulse:

Clicking on the contents list will take the reader to the section clicked:

LIST OF CONTENTS: CONSOLIDATED JULY VERSION OF LOW CARBON PULSE			
Pages 3 to 10:	Legal, Policy Setting and Regulatory highlights	Pages 34 to 35:	Carbon Credits, Hydrogen Markets and Trading
Pages 10 to 11:	Climate change reported and explained	Pages 35 to 38:	E-fuels / Future Fuels / Now Fuels
Page 12:	Middle East including GCC Countries	Pages 39 to 41:	Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories
Pages 13 to 17:	Africa, India and Indonesia; Japan & ROK	Pages 41 to 42:	Green Metals / Minerals, Mining and Difficult to Decarbonise Industries
Page 18:	PRC and Russia	Pages 43 to 45:	Wind round-up, on-shore and off-shore
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Pages 31 to 32:	Bioenergy and heat-recovery	Pages 55 to 56:	NZE Publications
Pages 32 to 33:	BESS and HESS (and other energy storage)	Page 57:	The Ashurst Team
Pages 33 to 34:	Carbon Accounting, Carbon Capture, Carbon Capture and Use and CDR		

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

This section considers news items that have arisen within the July 2022 news cycle in respect of laws and regulation, and broader policy settings, in each case describing substance, progress and impact. Also this section details Helpful Publications that have been read during the month.

- Taxonomy Delegated Act to go live on January 1, 2023:** On the basis that neither the European Council nor the European Parliament objected to the [Taxonomy Complementary Climate Delegated Act](#) by July 11, 2022, the **Taxonomy Delegated Act** will enter into force on January 1, 2023. The [Taxonomy Complementary Climate Delegated Act](#) provides the [EU Taxonomy](#) for what constitute **sustainable** activities. The action plan for financing sustainable growth noted the need for a clear definition of **sustainable** in the context of prescribed activities, being activities eligible for funding support under the **Green Deal**. Attached is the link to the first [Taxonomy Climate Delegated Act](#) that was published on December 2021 and has been applicable since January 2022.

One of the matters debated from late 2021 to July 11, 2022 was the inclusion of **natural gas** and **nuclear energy** as sustainable, and the funding that accompanies green energy transition. The [EU Taxonomy](#) includes **natural gas** and **nuclear** activities as eligible for funding support in certain circumstances.

By way of background: The [EU Taxonomy](#) is a classification system, establishing a list of environmentally sustainable activities, providing corporations, financiers and policy makers with clear definitions as to activities that are environmentally sustainable. The [Taxonomy Regulation](#) entered into force on **July 12, 2020**, establishing that basis for the [EU Taxonomy](#), and in this context stating four overarching conditions that an activity has to achieve to be treated as environmentally sustainable. Under the [Taxonomy Regulation](#) the **European Commission (EC)** was responsible for the development of the [EU Taxonomy](#).
- Nature Based Solutions:** During the first week of July, the author of Low Carbon Pulse read the **European Commission** publication [The Vital Role of Nature-Based Solutions In a Nature Positive World](#), which was released by the **Directorate-General for Research and Innovation**.

The publication is an excellent primer for **Nature-Based Solutions (NBS)** and **Nature-Based Enterprises (NBE)**. It is hoped the resources and time are devoted to the development of the thinking in the publication in the near term.
- Cities Climate Finance Leadership Alliance:** On **July 11, 2022**, the **Cities Climate Finance Leadership Alliance** published [Financing Net Zero Carbon Buildings – A background and scoping paper](#). The publication provides an excellent overview of the dynamics of new building construction, driven by population growth, and increased urbanisation, and increased prosperity of a growing middle-class. The publication notes that achieving net-zero across the building sector will require changes to each element of every building, including materials, thermal envelopes, passive heating and cooling design, active heating and cooling, appliances, lighting and electrical energy generation. As might be expected, the publication notes that the: "*greatest opportunities lie in reducing embodied carbon in construction materials and clearer and more efficient heating and cooling, including through passive design*".
- UK Net-Zero Strategy not sufficiently detailed:** On **July 18, 2022**, it was reported widely that **Justice Holgate** found that the UK Government had not complied with the UK **Climate Change Act** because its Net-Zero Strategy to achieve **NZE by 2050** was not sufficiently detailed and quantified. Justice Holgate ordered the UK Government to publish a revised Net-Zero Strategy compliant with the Climate Change Act by March 2023. A link to the case is [attached](#).
- House of Lords Economic Affairs Committee warns of disorderly transition:** The judgment of Justice Holgate may be regarded as being consistent with the perspective of the House of Lords Economic Affairs Committee. On **July 21, 2022**, the Committee published [Investing in energy: price, security and the transition to net zero](#). At the core of the findings of the Committee is a lack of granularity, expressed in practical terms, providing a disconnect or

gap between the ambitious targets and the practical plans to realise those targets. Also, the Committee notes the need to adopt a pragmatic medium term approach to natural gas to ensure energy security.

- **ABS Sets Course:** In the first couple of weeks of July the author finished reading the **American Bureau of Shipping (ABS)** published [Setting the Course to Low Carbon Shipping – Zero Carbon Outlook](#). As might be expected, the publication is data and information rich, and technology neutral, as to the transition in fuel use across the shipping industry.

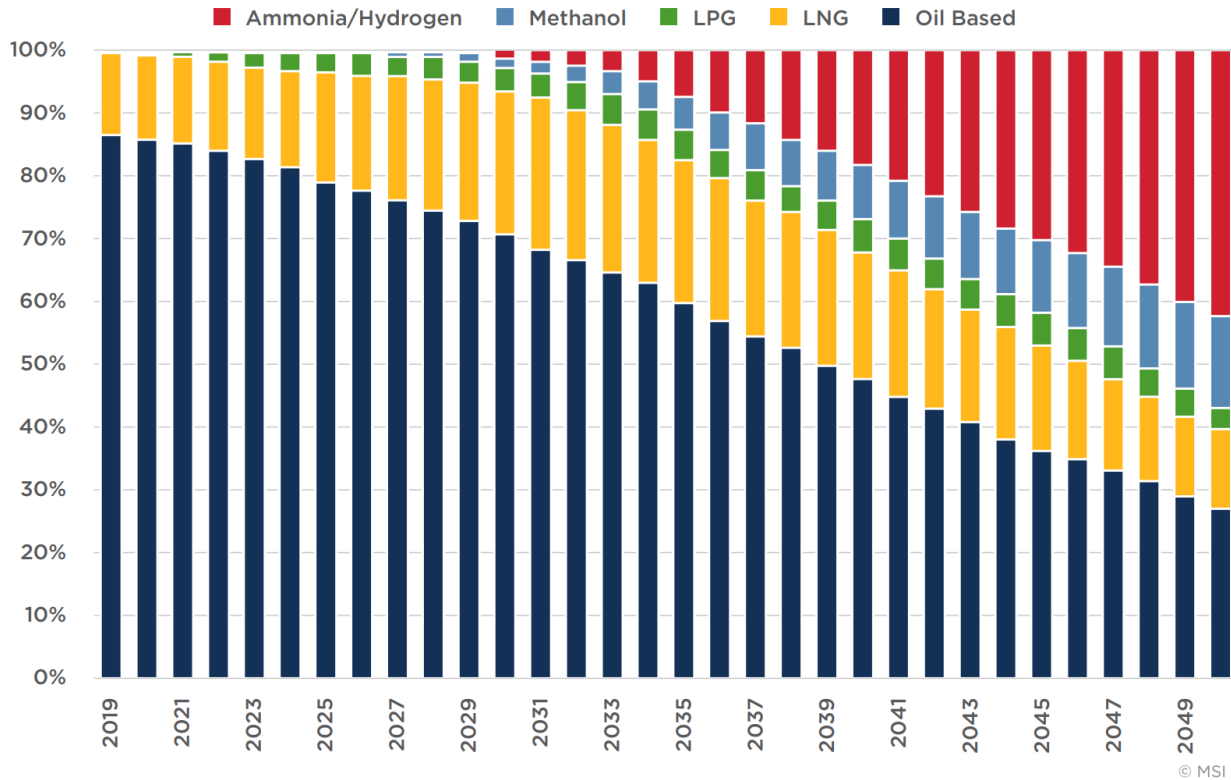
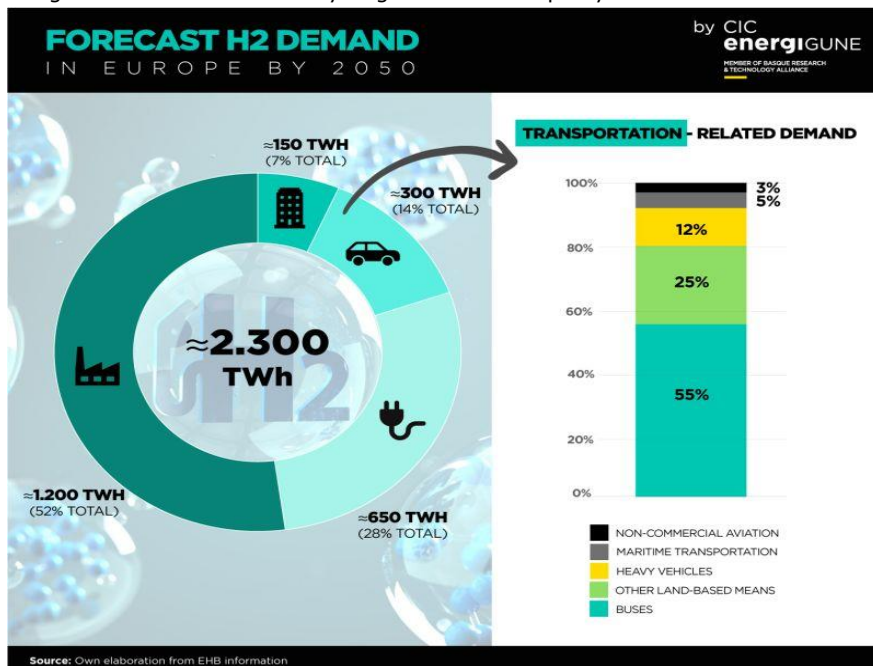


Figure 71: Fuel mix forecast.

Source: [American Bureau of Shipping](#)

While the publication will be of considerable interest to those active (or interested) in the shipping industry, the report is to be commended in the same as the **Mission Possible Partnership** publication [Making Net-Zero Aviation Possible – An industry-backed, 1.5 °C aligned transition strategy](#). The quality of both publications is outstanding.

- **Forecast H2 Demand across Europe:** On **July 27, 2022**, the good folk at **CIC energigUNE** published an infographic forecasting estimated demand for hydrogen across Europe by 2050.



As explained by **CIC energigUNE** the forecast has been developed in the round, taking account of plans, roadmaps and strategies, and a range of estimates for long- term demand for hydrogen as an energy carrier / vector, and

having regard to the thinking of The **European Hydrogen Backbone** (see **Editions 13, 14, 20, 37, 39** and **40** of Low Carbon Pulse).

- **CSIRO Our Future World Report drops:** On **July 27, 2022**, the **CSIRO** (Commonwealth Scientific and Industrial Research Organisation, Australia's National Science Agency) published [*Our Future World – Global megatrends impacting the way we live over coming decades*](#). While the publication focuses on the impact on the megatrends for Australia, the megatrends are global, and as such the publication is well-worth a read by folk wherever they are located.

The graphic below provides an overview of the subject matter and content of the publication.



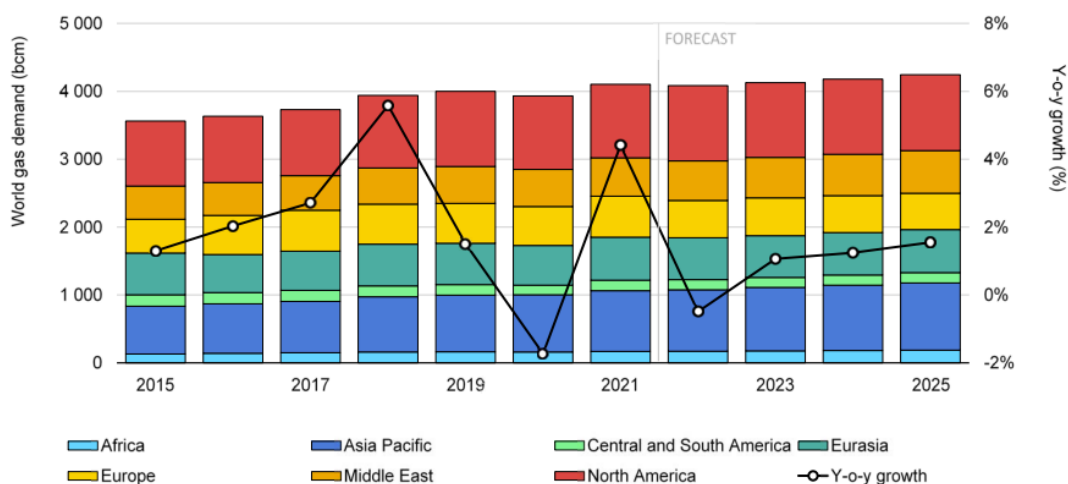
- **The Economic of Direct Air Carbon Capture and Storage:** On **July 26, 2022**, the **Global CCS Institute** published [*The Economics of Direct Air Carbon Capture and Storage*](#).

The key findings of the publication are:

- 1. DACCS** plays a unique role among climate mitigation options, functioning as a back-stop technology, potentially avoiding climate catastrophe if other lower or low cost pathways to avoiding, reducing and removing **CO₂** do not eventuate; **2.** If low-cost **DACCS** is realised, it would reduce the total cost of decarbonisation and the achievement of Paris Agreement goals and **NZE**; **3.** If low-cost **DACCS** is not realised, and as a result its deployment is limited, the main decarbonisation pathways for the industrial and the transport sectors (other than cars and light vehicles) is hydrogen; **4.** Building, electrical energy, and cars and light vehicles sector will be largely unaffected by the deployment of **DACCS**, with decarbonisation achieved through the use of renewable electrical energy; and **5.** The challenge for Governments is that the implementation of policy settings that incentivise the use of mitigation pathways that are available immediately, while supporting the development and deployment of **DACCS**. The publication is worth reading.
- **Historic day for human rights and healthy planet:** On **July 28, 2022**, the **UN General Assembly** adopted a resolution to recognise that everyone, everywhere, has a human right to live in an environment that is clean, healthy and sustainable. A link to the UN [press release](#) is attached. As at August 2, 2022, the text of the official resolution had not been updated.
 - **International Energy Agency (IEA) publications during July 2022:**
 - On **July 5, 2022**, the **IEA** published its [*Gas Market Report Q3-2022*](#). The publication is excellent, providing a good sense of the multi-faceted dimensions of current global gas markets. The headline is that natural gas demand is expected to decline in 2022, and to remain subdued through 2025.
The pursuit of LNG by Europe is likely to result in prolonged tighter markets.
Faster development and implementation of clean energy transition policy settings in mature gas markets would ease price pressure, and help emerging market access to natural gas suppliers that will allow them to achieve near to medium term improvements in carbon intensity and air quality.

Global gas demand growth dips in 2022 after a strong 2021, with a modest increase expected in the following years

Global natural gas demand by region, 2015-2025



IEA 2022. All rights reserved.

- On **July 6, 2022**, the **IEA** published its [Solar PV Global Supply Chains \(An IEA Special Report\)](#). The publication is excellent, providing an **A-to-Z** guide to the photovoltaic solar supply industry, and policy setting recommendations. The key forward looking findings from the publication include:

- the need to diversify photovoltaic solar supply chains to ensure that the energy transition progress at the rate required to progress to **NZE**; and
- Government policy settings are critical to ensuring that diversified and secure photovoltaic solar supply chains are realised.

As usual with the **IEA**, recommendations are made:

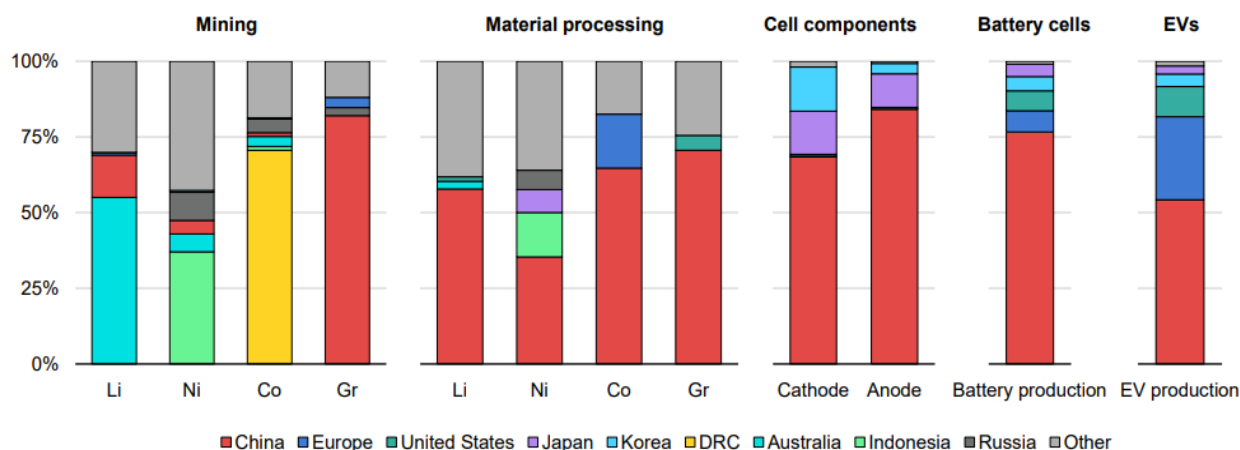
- diversify raw material supplies, and manufacturing capacity;
- de-risk investment, in particular in the development of manufacturing capacity;
- ensure environmental and social sustainability;
- continue to foster innovation; and
- develop and strengthen recycling capabilities.

All of these recommendations are sound and of broad application to most, if not all, countries.

- On **July 12, 2022**, the **IEA** published [Securing Clean Energy Technology Supply Chains](#). The publication was prepared for the **Sydney Energy Forum** that took place on **July 12 and 13, 2022**. The forum was co-hosted by the **Australian Federal Government**, the **Business Council of Australia** and the **IEA**. The publication is a pre-cursor to the 2023 edition of the **IEA** flagship publication, [Energy Technology Perspectives](#), which will provide a detailed analysis of what is needed to develop and to expand the required range of clean-energy technologies to achieve **NZE**.
- On **July 13, 2022**, the **IEA** published its [Oil Market Report July 2022](#). While the oil and natural gas markets are not the focus of Low Carbon Pulse (sibling publications focus on those markets), this month's publication is well-worth a read, providing a good sense of the state of markets.
- On **July 20, 2022**, the **IEA** published its [Electricity Market Report – July 2022 Update](#). As with all **IEA** publications, this publication is well worth a read. The key findings of the report may be regarded as follows: **1.** Electricity demand growth is slowing significantly during 2022, slowing to 2.4%; **2.** Tight natural gas markets are favouring the use of coal-fired power plants in the near-term; **3.** The development and deployment of renewable energy capacity is growing at a faster rate than demand; **4.** The **GHG** emissions from the electricity sector are set to decline slightly; **5.** Wholesale electrical energy prices are skyrocketing in many countries; **6.** The **EU** is gearing up to reduce its reliance on Russian fossil fuel imports by accelerating its clean energy transition; and **7.** There remains uncertainty around estimates for 2023, both electrical energy demand and the supply side generation mix to match demand. Current forecasts are that electrical energy demand will increase by around 2.5% in 2023, with strong growth in the development and deployment of renewable electrical energy capacity.
- On **July 19, 2022**, Ukraine joined the **IEA** as an Associate country.
- International Energy Agency (IEA) publications:** On **July 29, 2022**, the **IEA** published its [Global Supply Chains for EV Batteries](#). As with all **IEA** publications, this publication is well worth a read. The headlines from the report are as follows:
 - As electric cars sales continue to break sales records, supply considerations move to the fore;
 - The **PRC** dominates the entire EV battery supply chain. The following bar-chart illustrates this dynamic:

China dominates the entire downstream EV battery supply chain

Geographical distribution of the global EV battery supply chain



IEA. All rights reserved.

Notes: Li = lithium; Ni = nickel; Co = cobalt; Gr = graphite; DRC = Democratic Republic of Congo. Geographical breakdown refers to the country where the production occurs. Mining is based on production data. Material processing is based on refining production capacity data. Cell component production is based on cathode and anode material production capacity data. Battery cell production is based on battery cell production capacity data. EV production is based on EV production data. Although Indonesia produces around 40% of total nickel, little of this is currently used in the EV battery supply chain. The largest Class 1 battery-grade nickel producers are Russia, Canada and Australia.

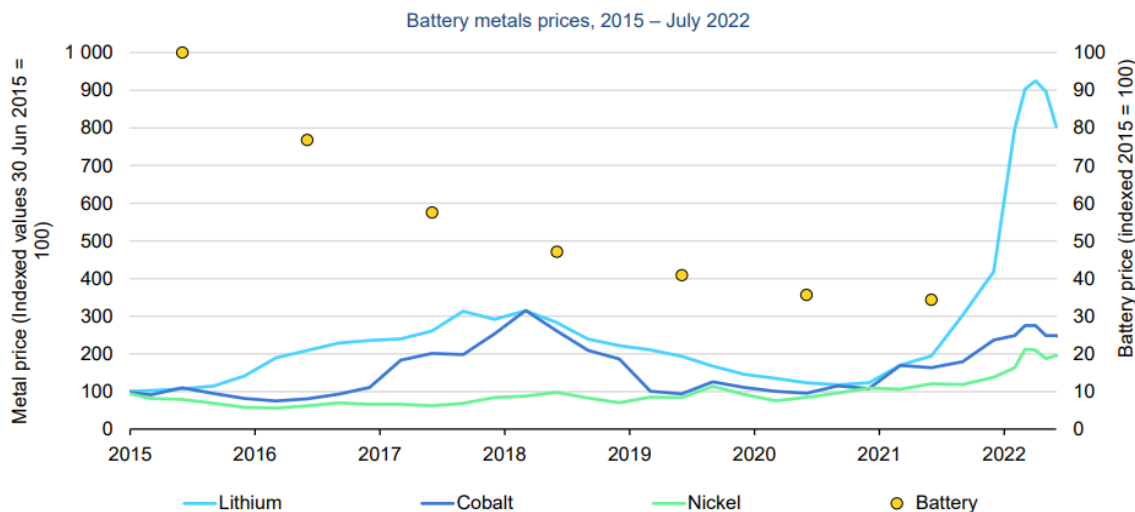
Sources: IEA analysis based on: [EV Volumes](#); [US Geological Survey \(2022\)](#); [Benchmark Mineral Intelligence](#); [Bloomberg NEF](#).

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3. Battery metal prices increased dramatically in early 2022, posing a significant challenge to the EV industry. The following graph illustrates this in respect of cobalt, lithium and nickel.

Battery metal prices increased dramatically in early 2022, posing a significant challenge to the EV industry



IEA. All rights reserved.

Sources: IEA analysis based on [S&P Global](#)

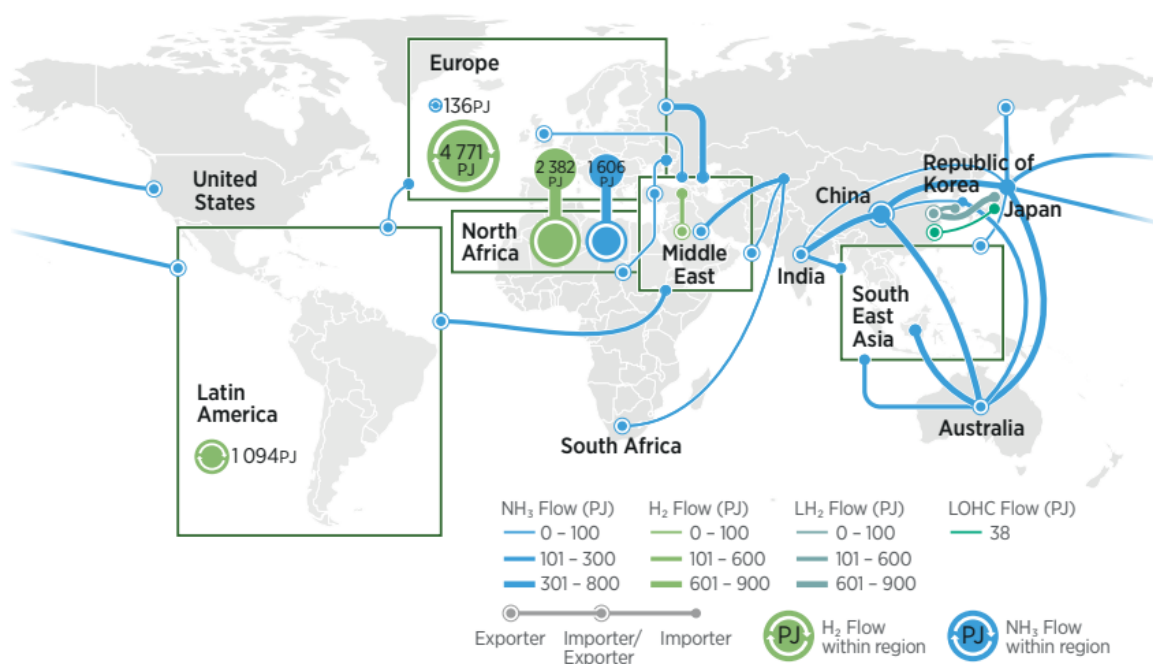
Notes: Lithium prices are from June 2022. Cobalt and Nickel from July 2022

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- **International Renewable Energy Agency (IRENA)** publications during July 2022:
 - On **July 8, 2022**, **IRENA** published [Global Hydrogen Trade to Meet the 1.5°C Climate Goal – Part I – Trade Outlook for 2050 and Way forward](#). (**Edition 40** of Low Carbon Pulse included links and a brief analysis of **Parts I** and **II**: links to those publications are included for ease of reference.)
- The following infographic includes a summary of the suggested trade activity by 2050. The publication is excellent.

FIGURE 0.1. Global hydrogen trade flows under *Optimistic* technology assumptions in 2050



Source: [IRENA](#)

One of the key findings from the publication is that international trade in hydrogen and ammonia will amount for about 25% of the total mass of hydrogen and ammonia produced.

"To make trade cost-effective, the cost of producing green hydrogen must be sufficiently less expensive in the exporting region than in the importing region to compensate for the transport cost. This cost differential will become larger as the scale of projects increases and technology develops to reduce transport costs".

The report goes on to make the more telling point:

"As the operating cost of renewables are very low, having a low weighted average cost of capital (WACC) is critical to the cost-effectiveness of trade. Absolute levels of country differences in WACC both significantly affect the trade outlook and determine whether a country becomes an exporter or an importer. If WACC remains roughly as it is today, countries that have good-quality resources [i.e., renewable energy resources] and low WACC would become the largest green hydrogen exporters and would be responsible collectively for almost 40% of the global trade".

- On **July 8, 2022**, **IRENA** published [China's route to carbon neutrality: Perspectives and the role of renewables](#). The publication takes as its starting point the announcement by **President Xi Jinping** (in September 2020 (see **Edition 1** of Low Carbon Pulse) at the 75th Session of the United Nations General Assembly that the **PRC** would aim to achieve peak **GHG** emissions before 2030.

The publication notes that for the **PRC** to peak before 2030 (and achieve its **NZE** goal by 2060), it will have to **maximise** the development and deployment of **renewable-based power** generation. This maximisation needs to be **combined** with direct and indirect **electrification** of **end-use sectors** (critically, the building, industrial and transport sectors), supplemented by the **sustainable use of bioenergy, hydrogen** and **synthetic fuels**. This is a common theme, not specific to the **PRC**. Under the **PRC and Russia** section (at **page 5** below) the 13 recommendations of the publication are outlined.

- On **July 13, 2022**, **IRENA** published [Renewable Power Costs in 2021](#) and an [Executive Summary](#). The headlines from the publication are that: "renewables are by far the cheapest form of power today". As a result: "Low cost renewables provide the most compelling pathway to decarbonisation in pursuit of climate-safe 1.5°C target and the goals of the Paris Agreement".

For the author of Low Carbon Pulse, the following table provides a telling summary of the progress over the last ten years of so.

Table ES.1 Global weighted average total installed cost, capacity factor and levelised cost of electricity trends by technology, 2010 and 2021

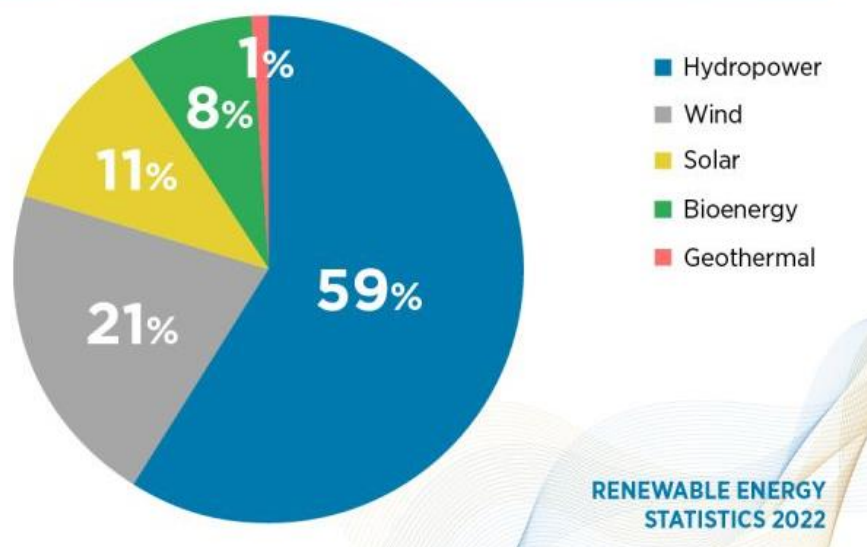
	Total installed costs			Capacity factor			Levelised cost of electricity		
	(2021 USD/kW)			(%)			(2021 USD/kWh)		
	2010	2021	Percent change	2010	2021	Percent change	2010	2021	Percent change
Bioenergy	2 714	2 353	-13%	72	68	-6%	0.078	0.067	-14%
Geothermal	2 714	3 991	47%	87	77	-11%	0.050	0.068	34%
Hydropower	1 315	2 135	62%	44	45	2%	0.039	0.048	24%
Solar PV	4 808	857	-82%	14	17	25%	0.417	0.048	-88%
CSP	9 422	9 091	-4%	30	80	167%	0.358	0.114	-68%
Onshore wind	2 042	1 325	-35%	27	39	44%	0.102	0.033	-68%
Offshore wind	4 876	2 858	-41%	38	39	3%	0.188	0.075	-60%

Source: [IRENA](#)

While there is little to surprise in the publication, the publication provides a valuable up-to-date assessment of the levelized cost of electricity (LCOE) from renewable energy sources.

- On **July 18, 2022**, **IRENA** published [Renewable Energy Statistics 2022](#). The headline from the publication is that during 2020 "the amount of electricity generated from renewables reached 7,468 TWh". The publication provides details, country by country, of the renewable electrical energy generated, and as such is data and information rich. The following pie-chart provides a global view of the renewable sources from which electrical energy was generated.

Renewable electricity generation by energy source in 2020



Source: [IRENA](#)

Attached is a two page summary prepared by **IRENA** entitled [Renewable energy highlights](#) which will avoid the need to plough through the full report.

- On **July 20, 2022**, **IRENA** published [Scenarios for the Energy Transition – Experience and good practice in Latin America and the Caribbean](#). The publication is well-worth a read, providing great examples of long-term scenario and energy planning tools for the purposes of developing and implementing national energy planning and strategies.

Climate change reported and explained:

This section considers news items within the news cycle of July 2022 relating to climate change and its impact. The intention is to monitor significant and material data points and information, and to explain them.

- **CO₂ levels:** Recent editions of Low Carbon Pulse have reported on the elevated levels of **CO₂** in the atmosphere, in particular it was reported that:

"On **May 14, 2022** it was reported widely that a new daily record of **421.37 ppm** had been recorded by the **Scripps Institution of Oceanography** at the **University of California, San Diego**, with similar record levels confirmed by the US **National Oceanic & Atmospheric Administration (NOAA)** of **421 ppm**".

As reported in **Forbes**, in May 2022 the **CO₂** measured at **NOAA's** Mauna Loa Atmospheric Baseline Observatory (Hawaii) peaked at **420.99 ppm**, consistent with the **420 ppm** reported in **Edition 40**.

During **June 2022**, the levels of **CO₂** in the atmosphere were at a slightly lower level than the peak of May. As explained in **Edition 40** of Low Carbon Pulse, **CO₂** levels tend to peak during April and May each year as a result of increased decomposition of vegetation.

The underlying trend however remains upwards, and increasingly so.

- **Extreme weather events:** Recent editions of Low Carbon Pulse have reported on the elevated levels of **CO₂** and **CH₄** in the climate system. **Edition 25** of Low Carbon Pulse reported on extreme weather events during the northern hemisphere summer of 2021.

The **International Panel on Climate Change (IPCC)** defines an extreme weather event as follows:

"An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme".

It is fair to say that North America, North Africa, India and Europe, and increasingly the **PRC**, have been experiencing **extreme weather events**, and in many instances those extreme weather events, having persisted, may be characterised as **extreme climate events**. The climate system has changed, and continues to change.

- **NOAA June Report:** On **July 14, 2022**, the US National Oceanic and Atmospheric Administration (**NOAA**) published its June Report. The headline from the June Report is that: "*June's average global temperature continued 2022's remarkably warm trend, as the both the month and the year so far ranked as the sixth warmest on record June 2022 marked that 46th consecutive June and the 450th consecutive month with temperatures above the 20th century average. The ten warmest Junes on record have all occurred since 2010*".

Selected Significant Climate Anomalies and Events: June 2022

GLOBAL AVERAGE TEMPERATURE

June 2022 average global surface temperature was the sixth highest for June since global records began in 1880.

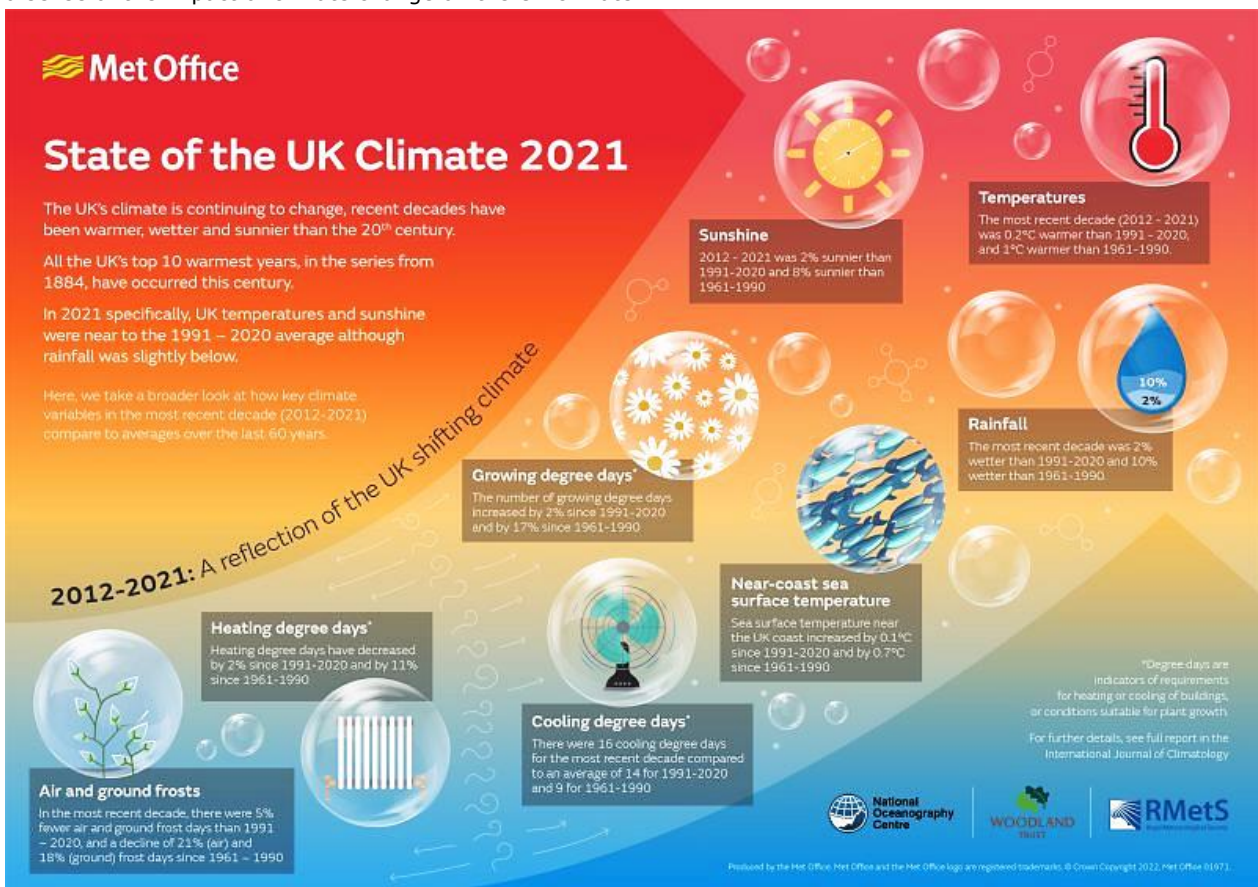


Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <http://www.ncei.noaa.gov/access/monitoring/>

- **Record-breaking fire season across Europe:** On **July 27, 2022**, the ever-excellent, **Ms Roberta Boscolo** (Lead of Climate and Energy at the UN World Meteorological Organization) shared an infographic providing an over-view of the spread of fire activity across Europe, so far affecting around **515,000 hectares** of land. As outlined in previous editions of Low Carbon Pulse, fires reduce **CO₂** absorption capacity and increase the mass of **CO₂** released to the climate system, each exacerbating climate change.



- **The State of the UK Climate 2021 report:** On **July 28, 2022**, the [metoffice.gov.uk](https://www.metoffice.gov.uk) published ***The State of the UK Climate 2021*** report. The report outlines the impact of average global temperature increases, reaffirming that climate change is not a problem for the future, rather climate change is upon us. The following infographic provides a sense of the impact of climate change on the UK climate.



- **State of the Climate in Latin America and the Caribbean:** On **July 31, 2022**, the author of Low Carbon Pulse read the **World Meteorological Organization (WMO)** publication ***State of the Climate in Latin America and the Caribbean 2021***. The publication makes for salutary, but essential, reading. Links to other publications in the **WMO** series are provided: ***The State of the Global Climate 2021***; ***State of the Climate in Africa 2020***; ***State of the Climate in Asia 2020***; ***State of the Climate in the South-West Pacific 2020***.

Middle East including GCC Countries:

This section of *Low Carbon Pulse* considers news items within the news cycle of July 2022 relating to the Gulf Cooperation Council (GCC) Countries, being countries that are leading the way in the development of Blue Hydrogen and Green Hydrogen capacity for own use and for export.

- **UAE approves circular economy policies:** On **July 3, 2022**, thenationalnews.com reported that the **UAE** had approved 22 policies intended to accelerate the transition of the **UAE** to a circular economy. The 22 policies focus on the food, infrastructure, manufacturing and transport sectors.
- **73 GW of renewable projects planned across MENA:** On **July 3, 2022**, renewablesnow.com reported on the current planned development of renewable electrical energy projects across **MENA**.

Capacity in MW	Wind operating capacity	Wind prospective capacity	Solar operating capacity	Solar prospective capacity
Oman	50	0	130	15,300
Morocco	1,165	963	702	13,430
Algeria	10	5,030	434	4,982
Kuwait	10	132	20	9,500
Iraq	0	0	0	5,755
Saudi Arabia	400	500	376	4,590
UAE	0	30	2,600	3,970
Egypt	1,641	2,350	1,882	904

Source: renewablesnow.com

- **DEWA increases photovoltaic capacity:** On **July 5, 2022**, it was reported widely that the **Dubai Electricity and Water Authority (DEWA)** had installed **100 MW** of **additional photovoltaic solar** capacity at the **5 GW Mohammed bin Rasid Al Maktoum Solar Park** as part of the fifth phase of the development of the project. The project comprises both photovoltaic solar and concentrated solar power.
- **UAE aligns with Linde:** On **July 11, 2022**, it was reported widely that the **UAE Ministry of Energy and Infrastructure** and **Linde** (one of the three global industrial gas giants) had signed a memorandum of understanding (MOU) under which the **UAE** and **Linde** are to work together to identify and to develop projects that will contribute to the achievement of the [Energy Strategy 2050](https://www.moe.gov.ae/en/energy-strategy-2050) of the **Ministry of Energy and Infrastructure**.
- **UAE Undersecretary for Energy and Petroleum Affairs, HE Sharif Al Olama** said: "*The UAE recognises Clean Energy as the main pillar of sustainability and a priority in the country. In line with our Net-Zero ambitions and the UAE Hydrogen Leadership roadmap, the UAE seeks to accelerate the adoption of the latest innovations to face climate change and accelerate the energy transition. Partnerships with the private sector are key in helping us achieve this*".
- **UAE aligns with France:** On **July 19, 2022**, it was reported widely that the **UAE** and **France** had signed a memorandum of understanding to establish a **Comprehensive Strategic Energy Partnership**. As reported, the partnership provides for the enhancement of energy security and affordability, decarbonisation and progressive action on climate change ahead of COP-28 to be held in the UAE in 2023. There has been considerable positive coverage of the **Comprehensive Strategic Energy Partnership** in both the UAE and France.
- **UAE aligns with France:** On **July 20, 2022**, it was reported widely that **ADNOC** (Abu Dhabi National Oil Company) and **TotalEnergies** had signed a **strategic partnership agreement** to ensure cooperation between the two energy giants, including in respect of CCS and natural gas (and product supply and trading). As with the **Comprehensive Strategic Energy Partnership**, this **strategic partnership agreement** has received positive coverage.
- **The 170 km long city-building:** Throughout the week beginning **July 25, 2022**, tens of news-feeds reported on the planned development by the **Kingdom of Saudi Arabia** of a **170 km, 500 metre high**, long city-building – to many news-feeds the mirrored-mega-city or the Mirror Line, and officially **The Line**. As planned, **The Line** would accommodate up to **9 million** people.
- **ADNOC and K-EXIM:** On **July 29, 2022**, it was reported widely that **ADNOC (Abu Dhabi National Oil Company)** and the **Export-Import Bank of Korea (K-EXIM)** had agreed **USD 3 billion** in long-term financing. It is understood that **BBVA, MUFG, Santander** and **SMBC** participated in the covered facility, with **K-EXIM** providing direct lending.

Africa:

*This section considers news items within the news cycle of July 2022 relating to Africa. Africa remains the continent with the most developing countries, the most **Least Developed Countries** and the most countries vulnerable to climate change, and the continent with some of the lowest levels of electrification.*

- **Gabon to create 187 million carbon credits:** On **July 1, 2022**, [bloomberg.com](https://www.bloomberg.com) reported that **Gabon** (the second-most forested nation after Suriname) intends to create **187 million carbon credits**, almost half of which may be sold in voluntary carbon markets. As reported, the creation of **187 million carbon credits** (representing **187 million metric tonnes of CO₂-e** emissions) would be the largest single creation of carbon credits to date. It is understood that the Government of Gabon is working with United Nations Framework Convention on Climate Change's **REDD+** mechanism to create the carbon credits.
- **Djibouti a thing of beauty for FFI:** On **July 5, 2022**, **Fortescue Future Industries (FFI)** announced that it had signed a **Framework Agreement** with the **Government of the Republic of Djibouti** to undertake studies to assess the prospects for the development of Green Hydrogen production capacity. As noted by **FFI**, **Djibouti** has excellent geothermal, photovoltaic solar and wind renewable resources, and good access to ports to allow the development of Green Hydrogen production facilities (and associated renewable electrical energy generation facilities), and to export the Green Hydrogen produced.
- **Green Hydrogen for sustainable growth and a low-carbon economy in Tunisia (h2Vert.TUN)** was launched published in late June 2022. The **h2Vert.TUN** was commissioned by the German Federal Ministry for Economic Cooperation and Development (**DMZ**). During the first couple of weeks of July, the author of Low Carbon Pulse spent time reading into **h2Vert.TUN**, and reading the publication **[Study on the opportunities of Power-to-X in Tunisia](#)** (published by **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH**). As with all **GIZ** publications, the publication is excellent, and well-worth a read, with supply and demand are assessed and dissected.
- **Egypt updates Nationally Determined Contribution:** In **June 2022**, it was reported widely that Egypt had submitted its updated **Nationally Determined Contribution (NDC)** for the purposes of the **Paris Agreement – [Egypt's First Updated Nationally Determined Contribution](#)**. Over the last week or so, the author of Low Carbon Pulse has had the opportunity to read (and to re-read) the updated **NDC** for Egypt.
Beyond the headlines, the **updated NDC** provides an excellent insight into the many factors that have to be considered for the purposes of considering, and settling upon, an **NDC**. While these factors are known, they are different for each country. The **updated NDC** is well-worth a read because it covers all factors, critically, it covers what is needed, and the cost of what is needed, including the means, and the cost, of adaptation and mitigation.
- **Gabon and TotalEnergies partner:** On **July 13, 2022**, **TotalEnergies** [announced](#) that it was to work together with **Compagnie des Bois du Gabon** to manage **600,000** hectares of forest in **Gabon**, to develop a new balance for these forest areas, by harvesting and local processing of sustainable wood and production of carbon credits through agroforestry, low-impact logging, and reforestation, so as to preserve natural forests.
- **The importance of peat swamps and wetlands:** On **July 21, 2022**, theconversation.com published **[Congo peat swamps store three years of global carbon emissions – imminent oil drilling could release it](#)**, providing a link to the nature geoscience publication of **[Mapping peat thickness and carbon stocks of the central Congo Basin using field data](#)**. Both the article and the report are well-worth a read, providing a data and information rich assessment of the carbon trapped within the peatlands of the **Congo Basin**, and the possible consequences for the release of carbon into the climate system – it is stated that the **Congo Basin** contains close to 30% of the world's tropical peat carbon. Globally, peatlands cover around 3% of the landmass, and yet store around 600 giga-tonnes of carbon (this may be regarded as a conservative estimate). As noted in previous editions of Low Carbon Pulse, peatlands (and wetlands) are vulnerable to drainage and drying given climate change. We live in a world of unintended carbon consequences, and as such the mantra of do no harm, and do it quickly, is a sound one.
During the week commencing **July 25, 2022**, many more news items were published emphasising the risk of the extraction of hydrocarbons from the **Congo Basin**.
- **Construction commences on El-Dabaa Nuclear Power Plant (ENNP):** On **July 22, 2022**, energy-utilities.com reported that concrete has been poured for **Unit 1** of the **ENNP**, located 300 kms north-west of **Cairo, Egypt**. **Unit 1** is the first of four planned units, each with nameplate generating capacity of **1.2 GW**. The development agreement for **ENNP** was signed around five years ago, but it took time for approvals to be obtained. The developer of the **ENNP** is **Rosatom** (the Russian state-owned nuclear energy corporation).
- **Egypt / EGAS and Wintershall Dea alignment:** On **July 26, 2022**, energy-utilities.com reported that **EGAS** (Egyptian Natural Gas Holding Company) and **Wintershall Dea** (oil and gas corporation headquartered in Germany) had signed a memorandum of understanding (**MOU**) to provide a framework to assess the technical feasibility of **CCS**, having identified suitable geological formations / structures and the production of Blue and Turquoise hydrogen production in Egypt (with the carbon arising from production being captured and stored). As reported, the **MOU** puts "weight behind Egypt's recently announced **National Climate Change Strategy 2050**, which calls for reducing CO₂ emissions. It also adds a focus on blue hydrogen to the country's green hydrogen ambitions".
- **Egypt and India alignment:** On **July 27, 2022**, it was reported widely that **Egyptian key state organisations** (well-known by now to regular readers of Low Carbon Pulse as the General Authority for the Suez Canal Economic Zone, The Sovereign Fund of Egypt, The Egyptian Electricity Transmission Company, and The New and Renewable Energy Authority) and **ReNew Power (ReNew Power Private Limited)**, an Indian corporation) had signed a memorandum of understanding (**MOU**) to provide a framework for the development of a **USD 8 billion Green Hydrogen** production facility in the **Suez Canal Economic Zone**, with the production facility to produce up to **220,000 metric tonnes** annually: as reported, among other things, the **MOU** provides for studies to be undertaken to assess the feasibility of the proposed facility.

As regular readers of Low Carbon Pulse will know, during 2022 there has been considerable activity in respect of the development of Green Hydrogen and Green Ammonia and clean and low carbon hydrogen, and other Future Fuel, production facilities in the **Suez Canal Economic Zone** (see Editions [34](#), [37](#), [39](#), [40](#) and [41](#)).

India and Indonesia:

*This section considers news items within the news cycle of July 2022 relating to India and Indonesia, two countries with increasing populations and urbanisation, attendant increased levels of electrification, and being the countries with the third and seventh most **GHG** emissions.*

- **Tata Power and Government of Tamil Nadu do well:** On **July 4, 2022**, [pv-magazine-india](#) reported that **Tata Power** (leading Indian integrated power corporation) and the Government of the **state of Tamil Nadu** had signed a memorandum of understanding to invest **USD 380 million** to develop a **4 GW photovoltaic giga-factory**. The giga-factory will integrate mono-**PERC** (passivated emitter and rear contact) bifacial technology with future n-type technology of **TOPCON** (tunnel oxide passivated contacts), and will produce high-wattage modules.
- **Websol to produce PERCs and TOPCONs:** On **July 4, 2022**, it was reported widely that **Websol Energy Systems Limited** (leading manufacturer of photovoltaic cells and modules) had announced plans to develop a **1.8 GW** giga-factory manufacturing **PERCs** and **TOPCONs**.
- **First grid-scale storage tenders:** On **July 4, 2022**, [pv-magazine-india](#) reported that **NTPC Limited** (state-run power producer, and India's largest energy corporation) and **Solar Energy Corporation of India Limited** or **SECI** (state-owned renewable energy corporation) are to procure **500 MW / 3,000 MWh** and **500 MW / 1,000 MWh** of **BESS** respectively, which on procurement and installation will be added to the 1 GW / 4 GWh of current **BESS**.
This may be regarded as a great start of the development and deployment of **BESS** across India with the Central Electricity Authority of India predicting that India will have to develop and to deploy 27 GW / 108 GWh of grid-scale **BESS** and around 10.1 GW of pumped hydro-electric pumped storage (**PHES**) within the current decade to meet its non-fossil fuel goals for 2030.
- **Ministry of Steel seeks time-bound action plans:** On **July 4, 2022**, [The Economic Times](#) reported (under **Govt directs steel industry to draw time-bound action plan to lower CO2 emissions**) that the Government of India Ministry of Steel had asked stakeholders to develop time-bound action plans to reduce **GHG** emissions arising from the iron and steel industry.
The Economic Times notes that the iron and steel industry in India is responsible for 12% of the total **GHG** emissions arising across India, and the Minister of Steel, Ram Chandra Prasad Singh is seeking commitments from the iron and steel industry consistent with the nationally determined contribution of India under the **Paris Agreement**.
As might be expected, the use of green hydrogen and the use of CCS and CCUS technologies are being considered and discussed as the means to reduce **GHG** emissions arising from the iron and steel industry.
- **ACME Group announces Green Hydrogen production facility:** On **July 5, 2022**, **ACME Group** [announced](#) plans to develop further **Green Hydrogen** and **Green Ammonia** production capacity in India with the development of a **USD 6.6 billion Green Hydrogen and Green Ammonia** production facility in the state of **Tamil Nadu**. (This follows the announcement in June to develop **USD 6.7 billion** production facilities in the state of **Karnataka**.)
ACME Group has stated that it has signed an agreement with the Government of the state of **Tamil Nadu** for these purposes. As announced, the Green Hydrogen and Green Ammonia production facility will comprise **1.5 GW of electrolyser capacity**, and will be able to produce up to **1.1 million metric tonnes** of Green Ammonia a year.
- **NTPC Renewable Energy Ltd (NTPCREL) and Gujarat Alkalies and Chemicals Limited (GACL) team:** On **July 6, 2022**, it was report that **NTPCREL** and **GACL** had signed a memorandum of understanding providing a basis for them to work together on Green Hydrogen and Green Ammonia and Methanol and renewable energy projects, including development of a production facility for captive / own-use by **GACL** at its Dahej and Vadorara complexes.
- **DNV and PIL blending project:** On **July 14, 2022**, **DNV** [announced](#) that it was working with **Pipeline Infrastructure Limited (PIL)** on the integration of blending hydrogen with natural gas to be hauled across **PIL's** gas network (including transmission, interconnectors, and spur-lines).
In the context of hydrogen broadly, the **CEO** and **MD** of **PIL**, **Mr Akhil Mehrota**, said: "*The hydrogen industry in India is still in its infancy, and has a huge scope to supplement the growing energy needs while supporting the shift to a cleaner environment. Backed by strong governmental support for clean energy and significant renewable energy potential, India has the unique opportunity to become a major producer and exporter of hydrogen*".
- **National Geographic sets the scene:** On **July 14, 2022**, **National Geographic Magazine** published [India is reinventing its energy strategy – and the climate may depend on it](#). The article is excellent, taking the reader through the everyday activities that need to be addressed by energy strategy, i.e., energy efficiency, the abundance of solar resources, abundance and the brilliance of the human capital resources, and the innovation that arises from them, all placed in the context of the continued growth and urbanisation of the population, and the attendant economic growth and prosperity, with the middle class in India expected to number 800 million people by 2030.
As the author of Low Carbon Pulse has noted in many presentations (in response to questions about what might be the greatest challenge in progress to **NZE**), the scale and scope of energy transition in India, and what needs to be done to decarbonise India, at the same time as the continued growth and urbanisation, and prosperity, of the population, is where the focus needs to be, both within India, and with the support from countries and economic blocs more progressed in **GHG** emission reduction than India. Even if the **EU** achieves **NZE** by 2050, or sooner, **NZE** in Europe will be for nought unless India is able to reduce its **GHG** emissions and progress to **NZE**.

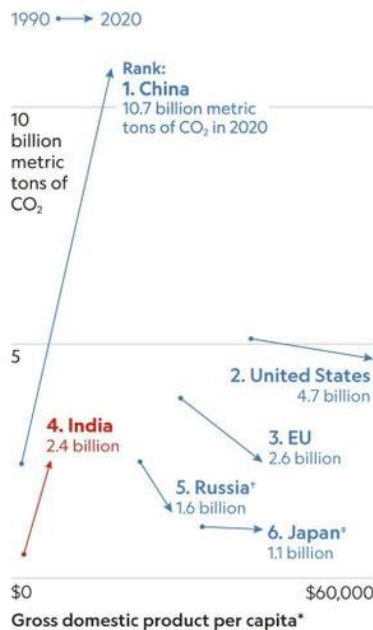
Top Emitters

Greenhouse gas emissions have climbed as countries, many without strong carbon-curbing regulations, have grown wealthier. China and India have low per capita emissions compared with such high-consuming nations as the United States. But they're home to a combined one-third of the world's population, elevating both into the list of top polluters.

Global population share, 2020



Annual carbon emissions by country, top six emitters



Source: [National Geographic Magazine](#)

China and India rising

An urbanization boom has caused China's emissions to surge. As the populations of both developing countries moved out of poverty, fossil fuel use increased.

Annual CO₂ emissions per capita, 2020



*GDP data is based on purchasing power parity in constant 2017 international dollars.

*1990 data is FOR the Russian republic of the U.S.S.R.

*2019 data

Taylor Maggiamo, NGM Staff
Sources: Hannah Ritchie, Our World in Data; The World Bank

The **National Geographic Magazine** article is well-worth a read. The scale and scope of the decarbonisation of India continues to be subject to comment. For example, on July 13, 2022, it was reported widely that if the pace of roll-out of renewable energy capacity continues at its current rate across India (recognising that the policy setting is to increase renewable energy capacity to 500 GW by 2030) this is likely to result in up to a 104 GW shortfall. This perspective is helpful, because it illustrates the need for policy settings that will ensure the achievement of the 500 GW target.

- **REMC Limited procuring up to 2.6 GW of renewable electrical energy:** On **July 18, 2022**, it was reported widely that **REMC Limited** (a corporation within the Indian Railways group) has issued documents to procure up to **2.6 GW** of electrical energy from renewable sources, with the electrical energy to match the load across a number of areas of the Indian rail network. It is understood that the renewable energy projects will be developed using a build-own-operate development model.
- **Ola announces battery innovations centre in Bengaluru:** On **July 18, 2022**, [batteriesnews.com](#) reported that it was to develop a **USD 500 million** battery innovations centre (**BIC**) in Bengaluru, India, providing an advanced cell research and development (**R&D**) facility.
- **Scale and size of hydrogen supply and demand in India:** On **July 18, 2022**, [energyworld.com](#) (under [Green hydrogen demand in steel, mobility, natural gas sectors to require \\$78-bn funding in India](#)) reports on an interview with folk from the **Council on Energy, Environment, and Water (CEEW)**. For India to produce **5 million metric tonnes** of Green Hydrogen by 2030, this will require at least **100 GW** of installed renewable energy capacity and the development and deployment of **40 GW** of electrolyser capacity, at a cost of **USD 100 billion**. The perspective of the folk at **CEEW** is that Green Hydrogen can be used across the iron and steel and mobility sectors (using existing or repurposed natural gas pipelines), with the potential across these sectors equating to up to an **additional 3.5 million metric tonnes** of Green Hydrogen. The additional Green Hydrogen production will require at least **70 GW** of installed renewable energy capacity and the development and deployment of **28 GW** of electrolyser capacity, at a cost of **USD 78 billion**.

The folk at **CEEW** see **two challenges** with the development of the Green Hydrogen sector, **first**, the experience of financial institutions in India in lending on projects of this kind, and **secondly**, the rate at which funding may be made available (both debt and equity). As in other markets around the world, the cost and the efficiency, and utilisation, of electrolysers are regarded as factors that may affect the cost of debt funding, certainly where the Green Hydrogen produced is to be used in the mobility sector. The report is well-worth a read, providing other insightful commentary on the Indian market.

- **GUNVL procuring up to 1.5 GW of photovoltaic solar:** On **July 19, 2022**, [pv-magazine-india.com](#) reported that **Gujarat Urja Vikas Nigam Ltd (GUNVL)** has issued documents to procure up to **1.5 GW** of electrical energy from grid-connected photovoltaic solar projects located within the state of Gujarat.
- **Mumbai Climate Action Plan:** During the week-beginning **July 18, 2022**, the 240 page [Mumbai Climate Action Plan 2022, Towards A Climate Resilient Mumbai](#) was published (as part of the [C40 Cities](#) initiative) by **WRI**

India. The publication is excellent, and may be regarded as compulsory reading. The publication identifies 24 action tracks under six priority areas. The following slides illustrate the six priority areas.



- **BHP and Tata Steel align:** On **July 20, 2022**, **BHP** [announced](#) that it and **Tata Steel** had signed a memorandum of understanding (**MOU**) to undertake jointly the assessment and study of the use of lower and low carbon iron and steel making technologies. As announced, under the **MOU BHP** and **Tata Steel** intend to work together to reduce the **GHG** emissions intensity of blast furnace iron and steel making via two priority areas, first, the use of biomass as a source of bioenergy and secondly the use of CCU in iron and steel making.
- **RPO Order to apply through 2029-30:** On **July 22, 2022**, the **Ministry of Power Government of India** released [Renewable Purchase Obligation \(RPO\) and Energy Storage Obligation Trajectory till 2029-30](#).

Year	Wind RPO	HPO	Other RPO	Total RPO
2022-23	0.81%	0.35%	23.44%	24.61%
2023-24	1.60%	0.66%	24.81%	27.08%
2024-25	2.46%	1.08%	26.37%	29.91%
2025-26	3.36%	1.48%	28.17%	33.01%
2026-27	4.29%	1.80%	29.86%	35.95%
2027-28	5.23%	2.15%	31.43%	38.81%
2028-29	6.16%	2.51%	32.69%	41.36%
2029-30	6.94%	2.82%	33.57%	43.33%

Source: [Ministry of Power](#)

- **Oil and Natural Gas Corporation (ONGC) and Greenko ZeroC aligned:** On **July 27, 2022**, [h2-view.com](#) reported that **ONGC** (state-owned leading oil and gas corporation) and **Greenko ZeroC** (see [Edition 37](#) and [39](#) of Low Carbon Pulse) had signed a memorandum of understanding (**MOU**) to provide a framework for them to pursue jointly opportunities for the production and procurement of Green Hydrogen and Green Ammonia, and other hydrogen-based fuels and feedstock.
The **MOU** is part of the mosaic of initiatives of **ONGC** for the purposes of delivering on its [Energy Strategy 2040](#) (which includes 10 GW of renewable electrical energy by 2040) and the [National Hydrogen Mission](#) (which includes targeting the production of **five million metric tonnes** of Green Hydrogen production annually by 2030).
- **Reserve Bank of India (RBI) publishes discussion paper:** On **July 27, 2022**, the **RBI** published a [discussion paper](#), including to address the results arising from [Climate Risk and Sustainable Finance Survey](#).
The discussion paper is well-worth a read, with its findings and themes being consistent with other publications, including as outline above under **Scale and size of hydrogen supply and demand in India**.

- **TERI provides a roadmap for 500 GW by 2030:** Previous editions of Low Carbon Pulse have reported on the challenges that will have to be overcome for India to achieve its target to develop 500 GW of non-fossil fuel electrical energy generating capacity by 2030 (**500 by 30**), in particular given the current rate of progress. On **July 27, 2022**, **The Energy and Resources Institute (TERI)** published [Discussion Paper – Roadmap to India's 2030 Decarbonization Target](#). The **Discussion Paper** considers the pillars and strategies necessary to achieve India's **500 by 30** target. The **Discussion Paper** is well-worth a read (and a re-read): the Paper outlines the basis for both achieving the **500 by 30** target while at the same time ensuring energy security and allowing India to develop into a global manufacturing hub for hydrogen and hydrogen-based fuels.
- **Indonesian Geothermal Energy Sector:** On **July 28, 2022**, [aseanbriefing.com](#) published an article entitled [An Overview of Indonesia's Geothermal Energy Sector](#). The by-line is that: "*Indonesia is home to some 40 percent of the world's geothermal resources, and the sector will be key to the country's energy sustainability goals*". The article is well-worth a read, setting-out the stall for the broader development and use of geothermal resources as follows: "*Located by the Ring of Fire, the seismic activity surrounding Indonesia is extremely active, providing ample geothermal energy potential. Due to these features, Indonesia has an estimated 23.7 gigawatts in geothermal capacity across 300 sites*".
- **Production Linked Incentives Scheme (PLIS) up and running:** On **July 29, 2022**, [pv-magazine-india.com](#) reported that each of **Ola Electric Mobility, Rajesh Exports** and **Reliance New Energy Ltd** had signed agreements under the **PLIS**, having emerged as the preferred proponents under the Government of India **50 GWh PLIS** tender. As reported, the **PLIS** has allocated funding for **USD 2.3 billion**. Under the **PLIS** the preferred proponents must develop the manufacturing facility in respect of which funding has been allocated within two years, with the funding to be disbursed over a period of five years.
- **Jakarta to mobilise 1,000 electric battery buses:** On **July 29, 2022**, [sustainable-bus.com](#) reported that by the end of 2023 **Transjakarta** plans to run **1,000** electric battery buses within Jakarta, increasing to **3,000** electric battery buses by the end of 2025. While the scale of the task should not be underestimated, the ambition is achievable.
- **India Hydrogen Alliance - June 2022:** Attached is the link to the June edition of the [India H2 Monitor – June 2022](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link to, rather than to repeat the content of, the **India H2 Monitor**.

Japan and Republic of Korea (ROK):

This section considers news items within the news cycle of July 2022 relating to Japan and ROK, being the countries with the fifth and tenth most GHG emissions, and the greatest dependence on imported energy carriers.

- **Hanwha out and about:** On **July 1, 2022**, **Hanwha** [announced](#) the establishment of **Q Energy**. Based in Berlin, Germany, **Q Energy** business comprises photovoltaic solar and wind farm and field development, with **Q Energy** to play a role along the entire supply / value chain as a technology provider, a developer, and as an EPC and O&M contractor. As announced, **Q Energy** intends to participate beyond its well-recognised strength in photovoltaic solar, including on off-shore wind field developments and hydrogen production.
- **K-Hydrogen Council establishes fund for the hydrogen industry:** On **July 8, 2022**, [hydrogen-central.com](#) reported that at the **Korea H2 Business Summit**, the **K-Hydrogen Council** established a fund to promote the hydrogen industry. The fund was established with **₩ 500 billion** (USD 380 million). As reported, the hydrogen fund "will establish domestic and overseas hydrogen production, distribution and storage infrastructure and make investments to develop core hydrogen technology".
By way of reminder: **Edition 19** reported that: "On June 10, 2021, Hyundai, Hyosung, and POSCO announced the launch of an industry wide body - the Korean Hydrogen Council. The Council will be launched officially in September 2021 as the K-Hydrogen Council. The Chair of Hyundai Motor Group, Mr Chung Euisun, stated that the goal of the K-Hydrogen Council is "to foster the widespread use of clean energy across industries and advance a hydrogen-based society".
- **Japanese steel makers aligned:** On **July 18, 2022**, [asia.nikkei.com](#) reported that leading Japanese steelmakers have unveiled a detailed timeline through fiscal 2030 for the development and deployment of investment of up to **USD 70 billion** to use **hydrogen** and **electric arc furnaces (EAF)** to decarbonise iron and steel production in Japan.
- **ACWA and POSCO forge hydrogen tie-up:** On **July 19, 2022**, [renews.biz](#) reported that **ACWA Power** and **POSCO Holdings** had signed a Memorandum of Understanding under which the two leading corporations are to develop jointly Green Hydrogen, and Green Hydrogen derived-fuel, production capacity to decarbonise the activities of the **POSCO Group**. As reported, the Green Hydrogen, and Green Hydrogen derived-fuel, will be used across all activities undertaken by the **POSCO Group**, including the generation of electrical energy and the production of iron and steel, and will provide supply to other off-takers in the **ROK**.
The **CEO of ACWA Power, Mr Paddy Padmanathan** said: "*With tangible project commitments in Saudi Arabia and Oman, ACWA Power is at the forefront of scaling up green hydrogen – whose output – ammonia – will lead to the outcome of decarbonising entire industries, including hard to abate industrial activities like steel manufacturing*".
- **Hyundai Motor Group and Rolls-Royce up in the air:** On **July 19, 2022**, [hydrogen-central.com](#) reported that **Hyundai Motor Group** and **Rolls-Royce** have signed a memorandum of understanding under which they plan to work together to develop all-electric propulsion and hydrogen fuel cell technology to the **Advanced Air Mobility (AAM)** market, working to develop power and propulsion technology systems for **Hyundai's AAM** division, to commercialise / industrialise **Rolls-Royce** power and propulsion systems, to develop electric propulsion systems based on fuel-cells, to work together to bring to market a fuel-cell propulsion system to the wider **AAM** market, and to develop a fuel-cell electric demonstration aircraft by 2025.

PRC and Russia:

This section considers news items that have arisen within the news cycle of July 2022 relating to the PRC and Russia, being countries that give rise to the most and the fourth most GHG emissions.

- **PRC and IRENA - [China's route to carbon neutrality: Perspectives and the role of renewables](#)**: As noted above, on **July 8, 2022**, as part of the strategic partnership between IRENA and the PRC, IRENA published [China's route to carbon neutrality: Perspectives and the role of renewables](#).

The publication contains a **13-Point Plan** for the PRC (being 13 recommendations for the PRC to consider and to explore), as the largest producer and consumer of energy, to reach **peak emissions by 2030**, and **NZE by 2060**.

The **13-Point Plan** makes the following recommendations:

1. Developing and implementing an integrated long-term energy plan; **2.** Maintaining energy efficiency improvements as a priority; **3.** Accelerating the phase-down of coal consumption; **4.** Accelerating the transition toward renewable power; **5.** Reforming power networks; **6.** Increasing the electrification of the end-use sector; **7.** Expanding the direct use of renewables, particularly biomass for energy purposes; **8.** Scaling up the production and use of hydrogen and synthetic fuels; **9.** Supporting cities as champions of low carbon living; **10.** Continuing progress in light-duty transport and broadening to heavy-duty and long-haul modes; **11.** Laying the groundwork for industrial sectors to achieve net-zero emissions; **12.** Continuing to support technology RD&D and broader systemic innovation; and **13.** Deepening global engagement.

These recommendations (and sub-recommendations) are to be found on **pages 7 to 16** of the publication, and, along with the rest of the publication, are well-worth a read.

We have included for completeness an earlier IRENA report on the PRC: [Net-Zero Pathways for Cities: The Case Study of Wuzhong District, Suzhou, China](#).

- **BEVS in PRC**: On **July 5, 2022**, **S&P Global Commodity Insights** published an info-graphic detailing the dynamics of the development of the battery electric vehicle market in the PRC.

We have included a [link](#) to the info-graphic. In passing, it is noted that the info-graphic tends to indicate that the PRC is ahead of the recommendations outlined above.

- **Green Steel in PRC**: On **July 14, 2022**, [greensteelworld.com](#) published an article [The positive reality of Chinese green steel](#) providing a perspective on the GHG emissions arising from economic activity in the PRC, including as a result of the production of iron and steel.

The article notes that in 2021, the PRC produced around **1.033 billion metric tonnes** of iron and steel, representing around **53%** of total production globally, contributing around **15%** of GHG emissions arising from economic activity in the PRC. The rate of growth in iron and steel production is said to be slowing, and the percentage of iron and steel production using scrap metal is stated as likely to increase. The level of production of iron and steel production is assessed as likely to stay at about **1 billion metric tonnes** a year, with increased use of scrap metal over time such that by 2060 around 70% of iron and steel produced will be sourced from scrap metal, up from around 20% in 2021.

In addition to the dynamics outlined in the article, there is an increasing focus the need to decarbonise the iron and steel industry, recognising the importance of iron and steel to the economy of the PRC and the relatively short period of time available to reduce GHG emissions arising from the production of iron and steel. While the recycling of scrap metal is an element of this, so is the transition to electric arc furnace (EAF) technology, particularly for scrap metal, and the need to develop and to deploy low to no carbon technologies.

- **Air Liquide to develop two hydrogen production units**: On **July 19, 2022**, it was reported widely that **Air Liquide** (one the three global industrial gas giants) is to develop two hydrogen production units within the **Shanghai Chemical Industry Park**, each equipment with **CO₂** capture capacity. As reported, the development will require a capital investment of around **€200 million**. The return of, and return on capital, will be realised under long-term contracts with Covestro China and Shanghai Lianheng Isocyanate Company, both located within the **Shanghai Chemical Industry Park**.

- **PRC adds 30 GW of photovoltaic solar in the first half of 2022**: On **July 22, 2022**, [pv-magazine](#) reported that during the first six months of 2022, the PRC installed **30 GW** of photovoltaic solar capacity (the PRC now having **340 GW** of photovoltaic capacity installed cumulatively). The information is sourced from the **China Photovoltaic Industry Association**, which expects between **85** and **100 GW** of new photovoltaic solar capacity to be installed during 2022.

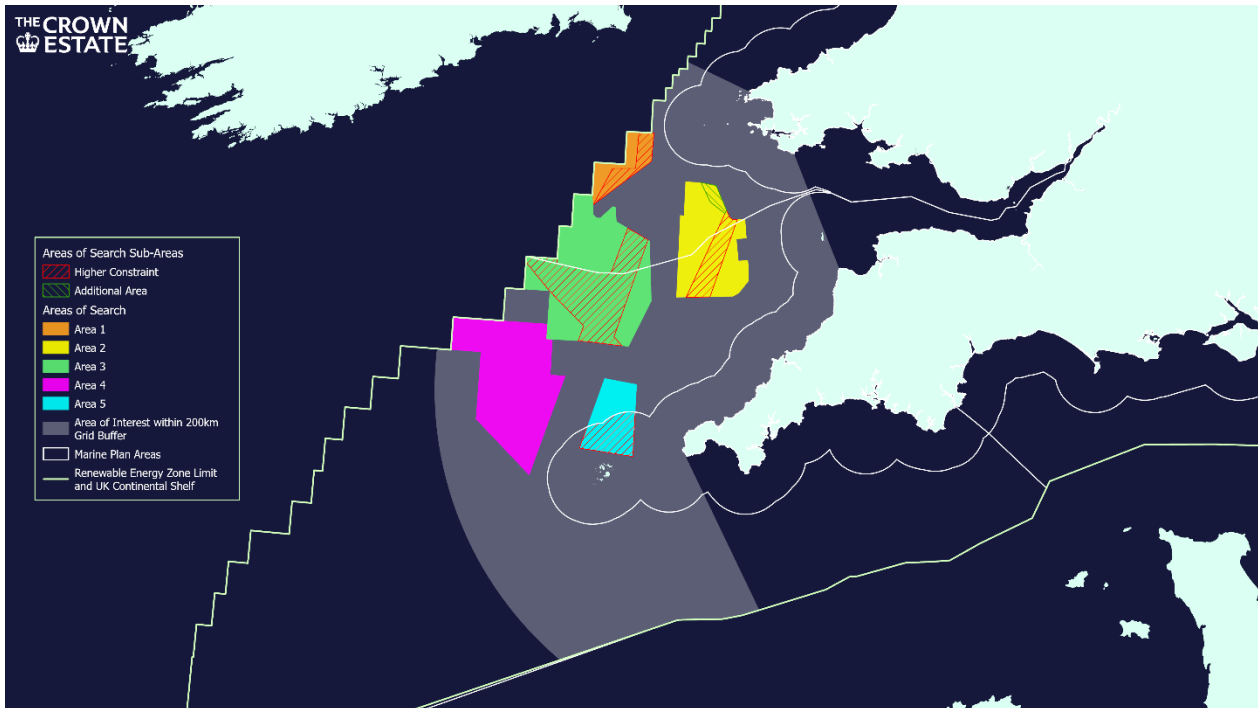
Europe and UK:

This section considers news items that have arisen within the news cycle of July 2022 relating to countries within the European Union (EU) and the EU itself (as an economic bloc) and the UK given geographical proximity, and similar policy settings and progress towards NZE. In combination, countries comprising the EU give rise to the most GHG emissions after the Peoples Republic of China (PRC) and the US. The UK is a top-twenty GHG emitter, but has been a front-runner in progress towards NZE.

- **The Crown Estate announces Celtic Sea Floating Off-shore Wind areas**: On **July 5, 2022**, **The Crown Estate** [announced](#) that it had identified five **Areas of Search**, being "areas of potential opportunity that have been highlighted".

The next step in **The Crown Estate** process is to undertake further stakeholder engagement and technical analysis, and Plan-level Habitats Regulations Assessment (HRA) will start, bringing forward the HRA process before auction in 2023: this will narrow down the Areas of Search into more defined Project Development Areas.

The Crown Estate notes that bringing forward the HRA process will accelerate development timelines and reduce risk for developers. It is expected that up to **4 GW** of Project Development Areas will be auctioned in the Celtic Sea.



- GRR models and awards:** On **July 5, 2022**, the UK **Department for Business, Energy & Industrial Strategy** announced the commencement of an open consultation process in respect of its business model for greenhouse gas removal (GRR) technologies: [Business models for engineered greenhouse gas removals: accelerating investment in engineered carbon removals](#). The consultation period closes at 11.45 pm on September 27, 2022. On **July 8, 2022**, the UK **Department for Business, Energy & Industrial Strategy** announced the [Projects selected for Phase 2 of the Direct air capture and greenhouse gas removal programme](#), with 15 projects awarded funding: each project and its funding is outlined in the attached link.
- Energy Security Bill introduced:** On **July 6, 2022**, the UK **Energy Security Bill** was introduced into the UK Parliament by the **Business and Energy Secretary, Mr Kwasi Kwarteng**. On enactment, the **Energy Security Bill** will effect the "biggest reform of [the UK] energy system in a decade". The **Department for Business, Energy & Industrial Strategy** published background to the **Energy Security Bill** under [Plans to bolster UK energy security set to become law](#), contains key points in the following publication: [Energy Security Bill – Building a clean, affordable, home-grown energy system](#).
- Contracts for differences awarded:** On **July 7, 2022**, the UK **Department for Business, Energy & Industrial Strategy** announced the results of its renewables auction scheme for contracts for differences (CfDs), with CfDs awarded in respect of **10.8 GW** of clean energy. As announced, CfDs were awarded in respect of nearly **7 GW** off-shore wind field capacity, **1.5 GW** of onshore wind capacity, and **2.2 GW** of photovoltaic solar capacity. Attached is a [link](#) to the full list of the successful applicants for CfDs.

The awards on **July 7, 2022**, were made under the fourth round of the **CfD scheme**. The CfDs awarded under the scheme provide revenue certainty to those developing and financing clean energy projects. The award of CfDs in respect of **10.8 GW** in the fourth round is only a little less than **11.26 GW** awarded across the first three rounds combined.

On **July 7, 2022**, **Ørsted** announced that it had been awarded a CfD for the world's single biggest off-shore wind field – its **2.85 GW Hornsea 3** off-shore wind field project. In addition to the CfD for **Hornsea 3**, CfDs were awarded as follows for off-shore wind fields: **1.396 GW Norfolk Boreas (Phase 1)**, **1.372 GW East Anglia Three**, **1,080 Inch Cape (Phase 1)** and **294 MW Moray West**.
- FSRU arrives at Eemshaven:** Edition [40](#) of Low Carbon Pulse reported on the activity around Europe to procure Floating Storage and Regasification Units (FSRU) to allow the regasification of imported liquified natural gas (LNG). On **July 5, 2022**:

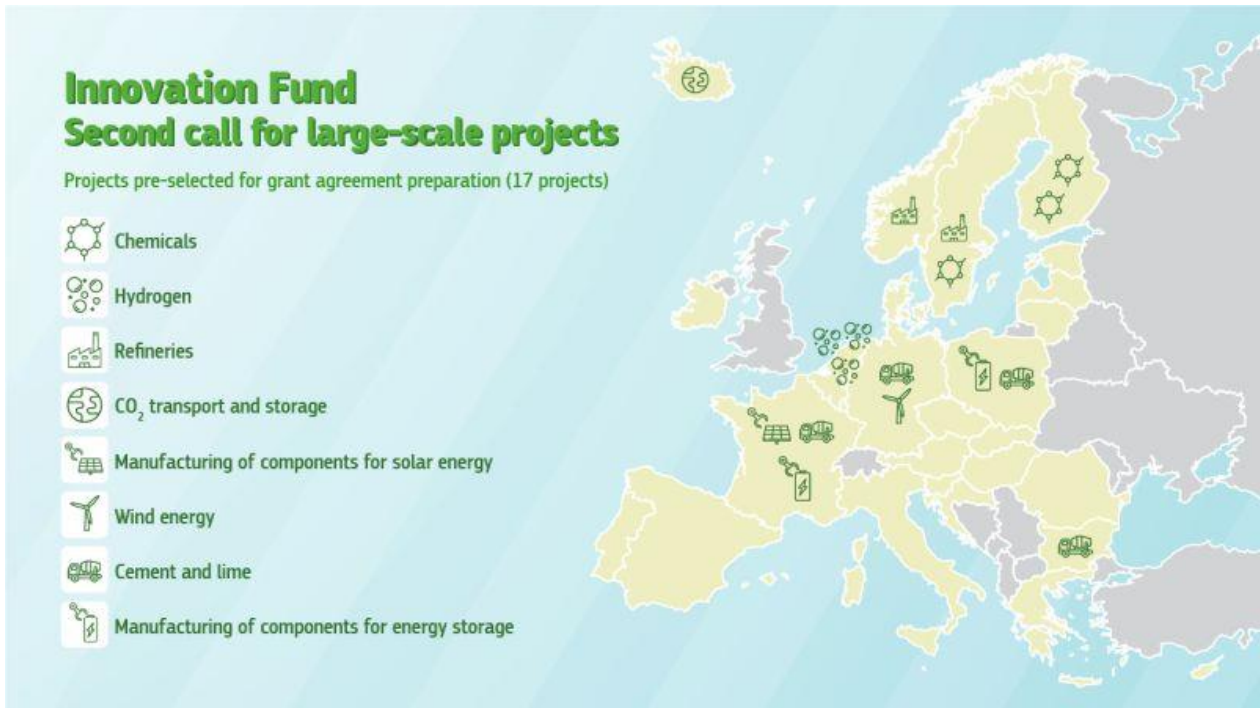
 - Exmar announced** its floating **FSRU EEMSHAVEN LNG** is being prepared to commence operation at the **Gasunie**-operated Dutch LNG terminal in **Eemshaven**. The rate at which a number of countries across Europe have mobilised to import LNG has been marked, and it seems unlikely that this rate of progress will slow.
 - Uniper announced** that it had commenced construction of the **LNG Receiving Terminal** at **Wilhelmshaven**, to be located at the **Voslapper Groden trans-shipment facility**. As reported in previous editions of Low Carbon Pulse, **Uniper** is developing the **LNG Receiving Terminal** with the support of the German Federal Government. Once constructed, the **LNG Receiving Terminal** will be able to import and re-gasify LNG to supply around 8.5% of the current natural gas demand of Germany.

On **July 7, 2022**, **Shell Western LNG** was reported to have joined **ČEZ** in booking regasification capacity with **Gasunie** to allow it to import LNG at the **Eemshaven LNG hub** – the **EemsEnergy Terminal**.

An earlier progress check on FSRUs: The long form versions of Editions [37](#) and [39](#) of Low Carbon Pulse reported on the procurement of floating storage regasification units (FSRUs) across Europe so as to address energy security concerns by allowing the import of liquified natural gas (LNG), as follows:

- **Germany chartering four FSRUs:** On **May 5, 2022**, German Federal Government Economic Minister, Mr Robert Habeck announced that the **German Federal Government** had committed to charter **four FSRUs**, a commitment of **€2.04 billion (USD 3 billion)** to allow the import of sufficient LNG to provide 20% of the demand for natural gas in Germany. As noted below in the **France and Germany** section, under **Fifth FSRU for Germany**, the four became five.
- **Gasunie chartering FSRUs:** On **May 10, 2022**, it was reported widely that **Gasunie** had agreed to charter an FSRU from **New Fortress Energy** to allow the import of LNG at the **EEM Energy Import Terminal**.
- **Gasrid chartering FSRU:** On **May 20, 2022**, marinelink.com reported that **Gasgrid Finland Oy** had entered into a 10 year charterparty with **Excelerate Energy** to allow the import of LNG for regasification to provide natural gas to the **Baltic Sea Region**, including **Finland** and **Estonia**. In addition, Estonia plans to develop an on-shore LNG receiving and re-gasification terminal at Paldiski; and
- **Lithuania Klaipeda FSRU:** **Latvenergo** has indicated that hopes to import LNG through the **Klaipeda FSRU**. In addition, Latvia has indicated an intention to develop an on-shore LNG receiving and re-gasification terminal at the Port of Skulte.
- **EU Innovation Fund awards:** On **July 12, 2022**, the **European Union** [awarded](#) around **€1.8 billion** in funding support to **17** projects in the second round of large-scale funding for clean-tech projects under the **EU Innovation Fund** funding support initiative (and the third round of funding under the **EU Innovation Fund**).
The **EU Innovation Fund** is intended to promote, and to scale-up, the development of renewable hydrogen projects. As reported on the europa.eu.com [link](#) **12** of the **17** projects awarded funding support are for energy intensive projects: four cement projects, three chemical projects, three hydrogen projects, and two refinery projects. In addition, three projects providing clean tech solutions were awarded funding for energy storage and renewable energy. The final two projects involve an off-shore wind field with innovative solutions for wind turbines and the production of hydrogen, and a carbon capture and storage project deploying a highly scalable on-shore carbon capture mineral storage terminal (with an estimated storage capacity of 880 million metric tonnes)
A link detailing each of the **17** projects successful in the second round of large-scale funding for clean tech projects is [attached](#), and are summarised below.
 - 1. Holland Hydrogen** – see below under **Shell takes FID on Maasvlakte Green Hydrogen Project**;
 - 2. Project Pulse** - covered in previous editions of Low Carbon Pulse, and at [E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks](#) below;
 - 3. Nordsee Two Offshore Windfield Innovation Project** - a 450 MW off-shore wind field and 4 MW electrolyser project;
 - 4. FUREC** - covered in previous editions of Low Carbon Pulse and at [E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks](#) below;
 - 5. ReLieVe** - ERAMET SA's battery recycling project;
 - 6. Carbon2Business** - the Holcim Deutschland GmbH project deploying oxyfuel carbon capture at Holcim's **Lägerdorf, Germany**, cement plant;
 - 7. BIOZIN** - the Biozin Holding AS, Bergene Holm AS and Norske Shell AS commercial-scale drop-in biofuel production facility in **Åmli, Norway**;
 - 8. RISE** - a 2 GW a year photovoltaic solar module manufacturing plant developed by REC Solar Pte. Ltd;
 - 9. ANRAV** - a full-chain CCS project linking **CO₂** capture facilities at **Denya, Bulgaria**, cement plant, though an on-shore and off-shore pipeline system with off-shore storage;
 - 10. Coda Terminal** - covered in previous editions of Low Carbon Pulse and at [Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR](#) below;
 - 11. Project Air** - first-of-a-kind large-scale methanol plant using CCS processes to derive **CO₂** from residue streams to derive renewable hydrogen and biogas to methanol, being developed by Fortum Sverige AB, Perstrop Oxo AB and Sydkraft AB;
 - 12. HySkies** - a large-scale synthetic sustainable aviation fuel production facility in Sweden, being developed by Lanzatech Inc, Shell New Energies, and Vattenfall AB;
 - 13. ELYGATOR** - a 200 MW electrolyser project in **Terneuzen, the Netherlands**, to produce up to **15,500 metric tonnes** of Green Hydrogen a year using its "flexible electrolyser dispatch" concept, being developed by Air Liquide NL;
 - 14. NorthSTOR Plus** - covered in previous editions of Low Carbon Pulse, and at [BESS and HESS \(and energy storage\)](#) below;
 - 15. IONFibre** - Metsa Spring OY will produce a new fibre substitute for existing textile fibres;
 - 16. GO4ECOPLANT** - is a Lafarge Cement SA project, creating an end-to-end **CO₂** capture and liquefaction facility at its **Kujaway, Poland**, cement plant, transporting the liquefied **CO₂** to **Gdansk, Poland**, for shipping into off-shore storage; and
 - 17. CalCC** is a **CO₂** capture project, capturing exhaust gases arising during lime production, using Air Liquide Cryocap technology, and storing the **CO₂**, being developed by Air Liquide France Industrie and Chaux et Dolomies du Boulonnais).

The following map indicates the spread of the **17** projects across the **EU**.



Source: [European Commission](https://ec.europa.eu/innovation/en/fund/index_en.htm)

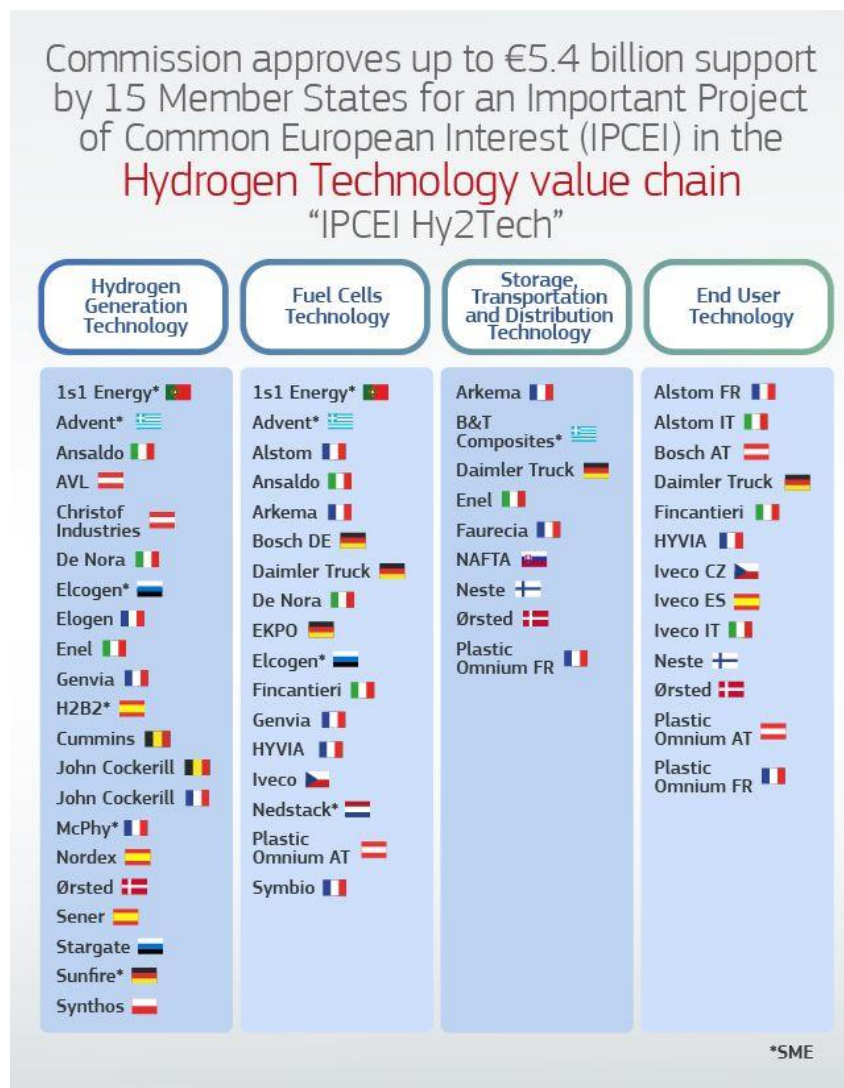
- **South Wales Cluster:** On **July 14, 2022**, the following infographic was shared providing an overview of the proposed South Wales Cluster.



- **Best prepared countries to achieve net-zero emissions:** On **July 14, 2022**, futurenetzero.com reported on new analysis by **Utility Bidder** (an energy advisory corporation) which found that the five best prepared countries to achieve net-zero emissions are Norway, the UK, Sweden, Denmark and Germany.
- **Important Project of Common European Interest across the EU:** On **July 15, 2022** the **European Commission (EC)** approved a hydrogen research and innovation project, involving **15** of the **27 EU Member States** (Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, the Netherlands,

Poland, Portugal, Slovakia and Spain) as an **Important Project of Common European Interest (IPCEI)** under the name "**IPCEI HyTech**", with 41 projects to be undertaken across the **EU**.

The approval of a project as an **IPCEI** means that the project will have access to funding support (and regulatory benefits, critically in respect of State-Aid rules). The approval for the hydrogen research and innovation project as an **IPCEI** brings with it up to **€5.4 billion** in funding support for project development (to be provided by EU Member States), with an estimated **€8.8 billion** of accompanying private sector funding: effectively the **HyTech-programme** will promote investment of **€14.2 billion** across the **EU**.



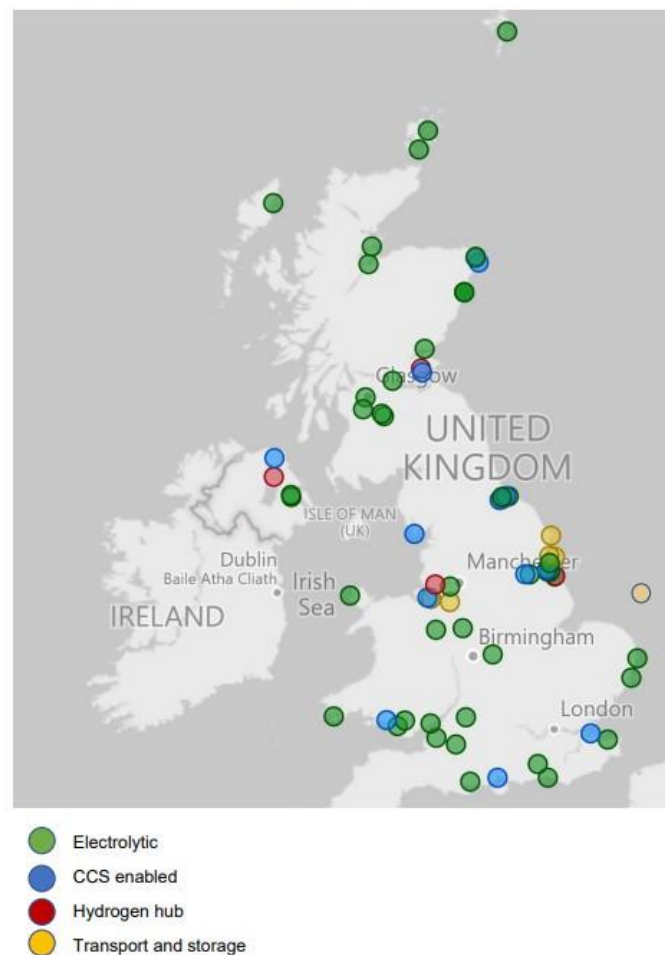
Source: [European Commission](https://european-council.europa.eu/media/en/press-room/default.aspx?id=14122)

For full coverage of this news item please click on the following link [europa.eu](https://european-council.europa.eu/media/en/press-room/default.aspx?id=14122), titled **[State Aid: Commission approves up to €5.4 billion of public support by fifteen Member States for an Important Project of Common European Interest in the hydrogen technology value chain.](https://european-council.europa.eu/media/en/press-room/default.aspx?id=14122)**

- **UK launches electricity market reform:** On **July 18, 2022**, the UK Government (under **UK launches biggest electricity market reform in a generation**) announced a major review of the electricity market design to ensure that cost benefits of cheaper energy are realised for the benefit of consumers. The announcement from the Department for Business, Energy & Industrial Strategy is fulsome, providing a clear rationale for reform. The announcement is well-worth a read.
- **The Crown Estate green lighted in respect of six projects under derogation:** On **July 19, 2022**, **The Crown Estate announced** that the **Secretary of State for Business, Energy and Industrial Strategy** has agreed that **The Crown Estate** can proceed to enter into leases, thereby proceeding with the implementation of the **Offshore Wind Leasing Round 4** under a derogation: as reported in **Edition 33** of Low Carbon Pulse (early February 2022), a number of applicants in the **Offshore Wind Leasing Round 4** process were awarded preferred bidder status, providing a basis to undertake further work to allow progress towards development, at which time an agreement for lease would be entered into with **The Crown Estate**. The derogation allows **The Crown Estate** to enter into agreements to lease in respect of each of the lease areas comprising the **Offshore Wind Leasing Round 4** process. As noted above under **The Crown Estate announces Celtic Sea Floating Off-shore Wind areas**, on **July 5, 2022**, **The Crown Estate** has announced plans to develop floating off-shore wind fields in the Celtic Sea, with the potential to install a further 4 GW of off-shore wind field capacity.

- **UK launches first clean-hydrogen subsidy scheme:** On **July 20, 2022**, it was reported widely that the UK Government is seeking expressions of interest by September 7, 2022, from those wishing to participate in a funding support initiative to help fund an initial **1 GW of Green Hydrogen** and **1 GW of Blue Hydrogen** (consistent with the dual track approach of the UK Government). On **July 20, 2022**, the **Department for Business, Energy and Industrial Strategy** published [UK public sector support for hydrogen research and innovation](#), providing an overview of the bodies supporting public sector hydrogen research and innovation in the UK, how this support can be accessed, and case studies to demonstrate the type of support that is available.
- **UK calls for evidence on CCS / CCUS:** On **July 25, 2022**, the **UK Government** (under [Future policy framework for power with carbon capture, usage and storage \(CCUS\): call for evidence](#)) announced that it is seeking views and evidence on how to support the development of power capacity using carbon capture, usage and storage. The process seeks views and evidence on competitive allocation design for power using CCUS, the evolution of the business model used to support power using CCUS, the development of the power using CCUS sector supply chain, and how power using CCUS could operate under future market arrangements. For these purposes, power with CCUS is dispatchable gas-fired power generation with CCUS. Use of CCUS in bioenergy power capacity is the subject of separate engagement by the UK Government.
- **Updated policy settings in the UK:** On **July 27, 2022**, the **UK Government** (Department for Business, Energy & Industrial Strategy) published the results of consultation in respect of the availability of green import exemptions for the Contract for Difference and Feed-in Tariff schemes, with each to cease from April 1, 2023. In addition, the EU Guarantees of Origin scheme will cease to be recognised from April 1, 2023. The full outcomes of the consultation process are detailed in [Feed-In Tariffs & Contracts for Difference schemes and Guarantees of Origin consultation: summary of responses and government response](#).
- **Infographic showing hydrogen projects progressing or proposed in the UK:** On **July 31, 2022**, the author of Low Carbon Pulse came across the following infographic:

Sample of potential hydrogen projects across the UK



Americas:

This section considers news items that have arisen within the news cycle of July 2022 relating to the US, Brazil, Canada, and Mexico (and beyond), being countries that give rise to the second, sixth, ninth and eleventh most **GHG** emissions.

- **Biden Administration opens applications for USD 2.3 billion grid funding:** On **July 6, 2022**, the **US Department of Energy (DOE)** opened the application period for State, Tribal nations and territories to apply for the **USD 2.3 formula grant program** intended to modernise and to strengthen the US power grid against extreme weather, wild fires, and other natural disasters ([Preventing Outages and Enhancing the Resilience of the Electric Grid Program](#)), administered through the DOE's [Building a Better Grid Initiative](#).
- **Photovoltaic and wind out generate nuclear:** On **July 7, 2022**, [solarpowerworldonline](#) reported that during the first four months of 2022 electrical energy generation from renewable energy sources accounted for over 25% of the electrical energy generated across the US, and for the first time, in April 2022, renewable energy sources generated more electrical energy than nuclear generation power stations.
- **Canada and US (and Russia) leads in trees gained (and lost):** On **July 11, 2022**, the **University of Maryland** and the **World Resources Institute** published [The Global 2000-2020 Land Cover and Land Use Change Dataset Derived From the Landsat Archive: First Results](#). The publication analyses data on tree growth and loss, concluding that the world gained nearly 131 million hectares of new growth from 2020 to 2020, with 36 countries gaining more trees than they lost.
The critical point from the publication (and noted in Low Carbon Pulse previously) is that new growth does not make-up for the loss of carbon rich "old growth", with "old growth" areas providing ideal ecosystems for other flora and for fauna to thrive.
- **Methane reduction funding:** On **July 12, 2022**, the **US DOE** announced its intent to issue a funding notice for research and development projects to help to reduce methane emissions across the US. The announcement notes that: "After carbon dioxide, methane is the most abundant ... GHG warming our planet, and methane emissions contribute significantly to the GHG intensity of natural gas".
The funding for methane reduction research and development supports the Biden Administration [US Methane Emission Reduction Action Plan](#), which in turn reflects the [Global Methane Pledge](#) to reduce methane emissions by 30% from 2020 levels by 2030.
- **Biden Administration opens USD 2.6 billion CCS funding:** On **July 13, 2022**, the **US DOE** issued notices of intent to fund two programs to advance carbon capture demonstration projects, and to expand regional pipeline networks for the haulage of **CO₂** for storage permanently or for use.
The two programs are the [Carbon Capture Demonstration Projects Program](#) and the [Carbon Dioxide Transport / Front-End Engineering Design \(FEED\) Program](#). As announced, the two programs build on the Biden Administration actions to catalyse investments in clean energy any industrial innovation and advance the goal of a net-zero **GHG** emissions economy by 2050.
- **Ceres and Clean Air Task Force report published:** On **July 14, 2022**, the **Clean Air Task Force** [announced](#) the publication of [Benchmarking Methane and other GHG Emissions of Oil and Natural Gas Production in the United States](#). The publication provides analysis from **Ceres** and **Clean Air Task Force** benchmarking the relative emissions intensity and total reported carbon dioxide (**CO₂**), methane (**CH₄**) and nitrous oxide (**N₂O**) emissions of more than 300 US oil and gas producers. As noted in previous editions of Low Carbon Pulse, **CO₂**, **CH₄** and **N₂O** (the three well-mixed **GHGs**) emitted to the climate system are responsible for the majority of the increase in average global temperature, and as such climate change. The publication is well-worth a read.
- **Wyoming hydrogen roadmap:** During the first week of July the **Wyoming Energy Authority** and **Cheyenne-Laramie County Corporation for Economic Development** published the [Roadmap to Build a Hydrogen Economy](#). The principle purpose of the implementation of the Roadmap is for the State of Wyoming to commence the production of hydrogen, both Blue Hydrogen and Green Hydrogen. At the moment, the States of California, Louisiana and Texas lead the way in hydrogen production in the US.
- **Biden Administration Executive Action:** On **July 20, 2022**, **The White House, Briefing Room**, released **FACT Sheet: President Biden's Executive Actions on Climate to Address Extreme Heat and Boost Offshore Wind**. In respect of offshore wind, the release outlined that the Department of the Interior is proposing the first Wind Energy Areas in the Gulf of Mexico, covering 700,000 acres, and stated that President Biden had directed the Department to advance wind energy development in the waters offshore the mid and southern Atlantic Coast and Florida Coast.
- **Inflation Reduction Act heads to Congress:** On **July 27, 2022**, a deal was struck between US Senator Mr Joe Manchin and US Senator and Senate Majority Leader, Mr Chuck Schumer (already named **the Manchin-Schumer Act**).

The [democrats.senate.gov](#) website provides a joint statement from the two senators, which itself attaches a [one page summary](#) of the **Inflation Reduction Act** of 2022.

On **July 28, 2022**, the [Inflation Reduction Act of 2022](#) was published.

QUICK SHORT FORM SUMMARY OF THE MANCHIN-SCHUMER ACT

USD 369 billion for Energy Security and Climate Change over 10 years

"investing in domestic energy production and manufacturing and reduce carbon emissions by roughly 40 percent by 2030"

USD 9 billion consumer home energy rebate programs and 10 years of tax credits

This initiative is focused on lower-income customers to electrify home appliances and energy efficient retrofits

USD 4,000 tax credit (used) and USD 7,500 tax credit (new) clean vehicles	This initiative is focused on lower and middle income folk to buy used and new clean vehicles
USD 1 billion grant program	This initiative is to make affordable housing more energy efficient
Production tax credit scheme	This initiative is to accelerate US manufacturing of batteries, solar panels, and wind turbines, and extraction of critical materials, modelled to result in USD 30 billion investment
USD 10 billion investment tax credit scheme	This initiative is to accelerate the development of clean technology manufacturing facilities for batteries, solar panels, and wind turbines
USD 2 billion in grants to retool	This initiative is to accelerate the retooling of existing manufacturing facilities to manufacture clean vehicles
USD 20 billion in loans	This initiative is to accelerate the development of new clean vehicle manufacturing
USD 2 billion in funding	This initiative is to accelerate the development of breakthrough technologies

A fuller summary of the Energy Security and Climate Change provisions is [attached](#).

• **Loan Programs Office mobilised:**

- On **July 28, 2022**, the **US DOE Loan Programs Office** [announced](#) that it is to lend **USD 102 million** to **Syrah Technologies LLC** to allow it to expand its **Syrah Valley processing facility**. The facility produces graphite derived active anode material, a critical element used in lithium-ion batteries for battery electric vehicles.

As announced, this is the first loan under the **Advanced Technology Vehicles Manufacturing Loan Program** since 2011, and the first ever for a supply chain manufacturing project.

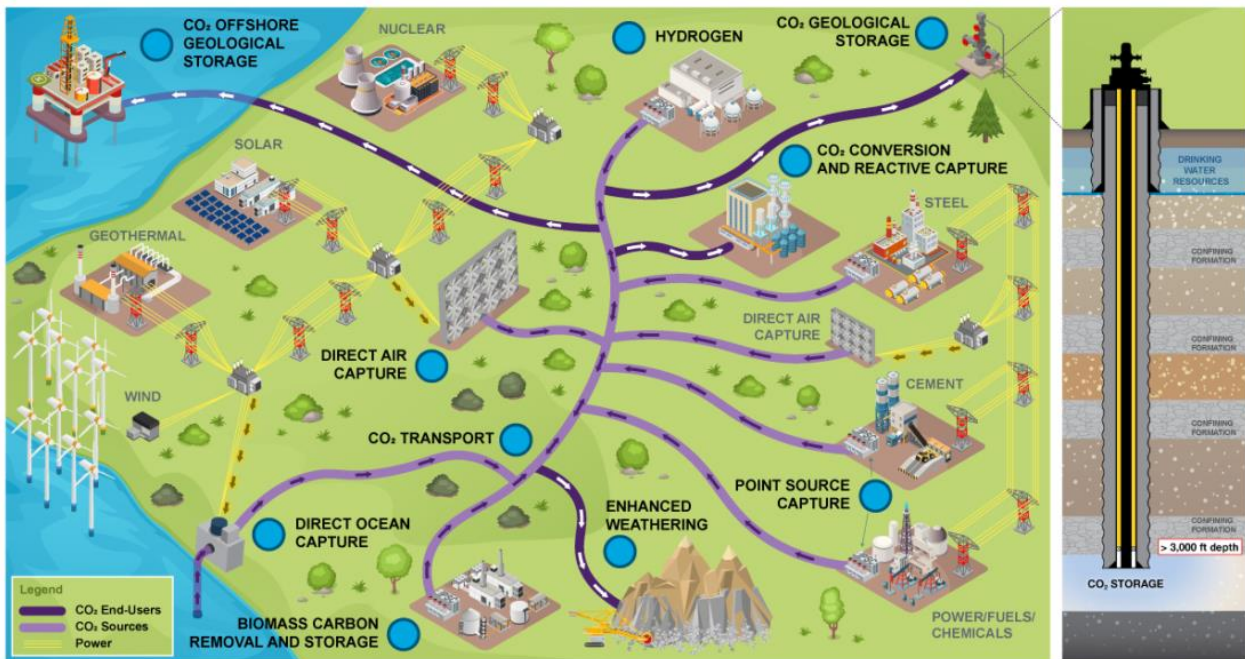
- On **July 26, 2022**, it was reported widely that the **US DOE Loan Programs Office** is to lend **USD 2.5 billion** to a joint venture between **General Motors Co** and **LG Energy Solution (Ultium Cells LCC)** to support the development of lithium-ion battery **giga-factories** in **Michigan, Ohio** and **Tennessee**.

As reported, the commitment from the **DOE Loan Programs Office** is conditional, but is expected to the progress in the coming months under the **Advanced Technology Vehicles Manufacturing Loan Program**.

- **Cuban procurement:** On **July 28, 2022**, it was reported widely that **Union Electrica de Cuba (UNE)**, through Indian state-owned power generator, **NTPC Limited** (chosen by the Cuban Government as its preferred partner), is procuring, on a build-own-operate-transfer (**BOOT**) basis, the development of **1.15 GW** of **grid-connected photovoltaic solar** capacity and **150 MW / 150 MWh** of **BESS** projects across Cuba. Under the proposed **BOOT** scheme the photovoltaic solar and **BESS** capacity will be transferred to **UNE** after 25 years.

It is understood that this is part of a broader plan to procure **2.1 GW** of photovoltaic solar projects across Cuba.

Office of Fossil Fuel and Carbon Management: On **July 28, 2022**, the author of Low Carbon Pulse came across the following interactive diagram (Source: [Office of Fossil Energy and Carbon Management](#)).



The interactive diagram is an on-line tool that outlines the carbon management provisions of the [Bipartisan Infrastructure Law](#) and other **US Department of Energy (DOE)** funding initiatives, and announcements and notices, including as provided by and under - **DOE Loan Programs Office, DOE Advanced Research Projects – Agency-Energy** and **DOE Small Business Innovation Research**.

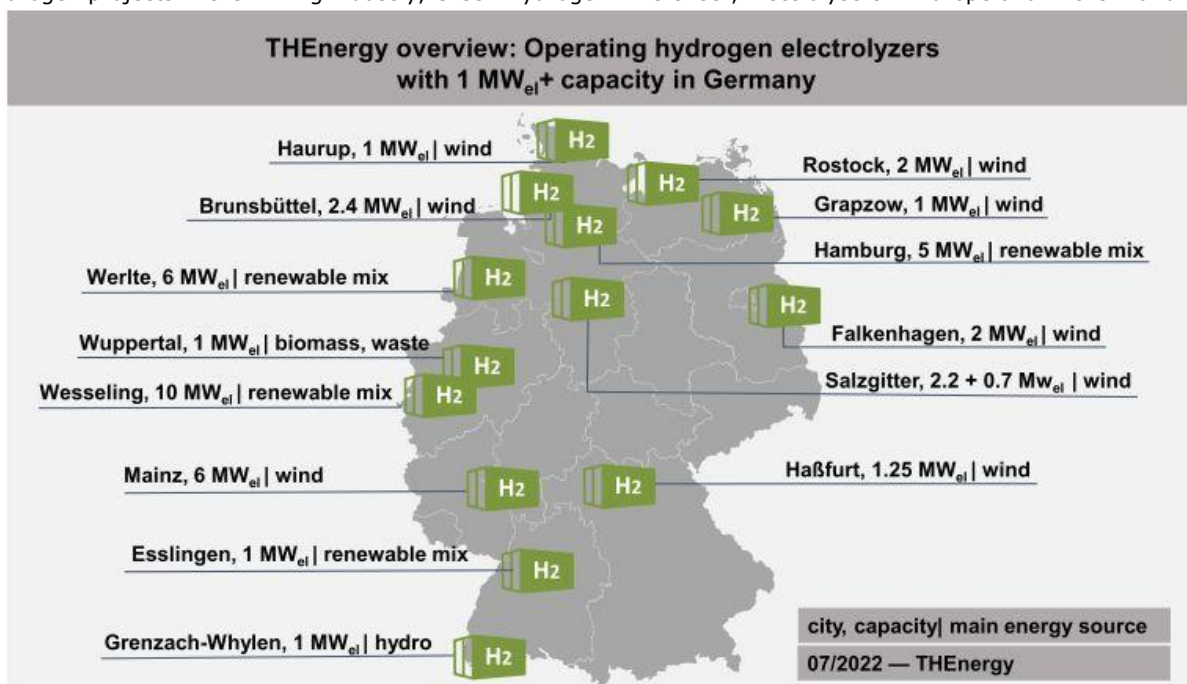
For ease of reference we have included links to other materials that are of general application and hopefully of interest: [Strategic Vision: The Role of Fossil Energy and Carbon Management in Achieving Net-Zero Greenhouse Gas Emissions](#); [The Carbon Capture, Transport, and Storage Supply Chain Review: Deep Dive Assessment](#); [Infrastructure Investments and Jobs Act: Opportunities to Accelerate Deployment in Fossil Energy and Carbon Management Activities](#); [US Department of Energy Hydrogen Program Plan](#); and [NATCARB / ATLAS / netl.doc.gov](#).

- **Green Hydrogen Can Help Latin America's Energy Transition:** On **July 30, 2022**, the good folk at [oilprice.com](#) published an article entitled [Green Hydrogen Can Help Latin America's Energy Transition](#), authored by the **Oxford Business Group**. The article outlines the scope of the possible Green Hydrogen production, and the economic benefits across Latin America and the Caribbean. The article provides a detailed introduction to those seeking to get a sense of the level of activity, and the potential for production.

France and Germany:

This section considers news items within the news cycle of July 2022 relating to France and Germany.

- **Germany publishes draft off-shore wind development plan:** On **July 1, 2022**, [offshorewind.biz](#) reported that the German Federal Government Maritime and Hydrographic Agency (**BSH**) had published a draft of the offshore wind area development plan and environmental reports for the North Sea and the Baltic Sea.
As reported, area development plan covers areas with capacity for **60 GW** of installed capacity **by 2038**.
As reported in recent editions of Low Carbon Pulse, **Germany is committed** to the installation of at least **30 GW** of off-shore wind field capacity **by 2030**, at least **40 GW by 2035**, and at least **70 GW by 2045**.
- **German Bundestag approves green energy law reforms:** On **July 8, 2022**, [renewablesnow.com](#) reported that on **July 7, 2022**, the German Federal Parliament approved the **Easter Package** (see **Edition 39** of Low Carbon Pulse) and with **Easter Package** given effect through amendment to **Renewable Energies Act**.
The key amendments increase the target for installed photovoltaic solar from **60 GW to 210 GW by 2030** (requiring an additional **22 GW** of photovoltaic solar to be developed and deployed annually), **115 GW** of on-shore wind **by 2030** (requiring an additional 10 GW annually), and, as noted above, for off-shore wind field installed capacity **30 GW by 2030, 40 GW by 2035**, and at least **70 GW by 2045**.
- **Electrolysers mapped:** On **July 14, 2022**, **Dr Thomas Hillig** posted a map of the Green Hydrogen electrolysers across Germany. The post from **Dr Hillig** promises maps on hydrogen pilot projects in the iron and steel industry, hydrogen projects in the mining industry, Green Hydrogen in fertiliser, Electrolysers in Europe and in the World.



- **Fifth FSRU for Germany:** Since March 2022, Low Carbon Pulse has reported on the procurement of four floating storage and regasification units (**FSRUs**) to be located in German ports. **FSRUs** allow the import of liquified natural gas (**LNG**), and its storage and regasification, and send out. The procurement of the **FSRUs** has been in response to providing energy security. On **July 18, 2022**, **TotalEnergies** announced plans to procure an **FSRU** to be located in the port of **Lubmin, Germany**, with operation planned to commence in December 2022. **TotalEnergies** is to procure the **FSRU** and **Deutsche ReGas** is designing the shoreside facilities (including top-sides and send out) and connection to the **EUGAL** natural gas network to allow the send-out of natural gas to ultimate users.

- **Germany's bi-lateral relationships:** Previous editions of Low Carbon Pulse have reported on the bi-lateral relationships that Germany has established to develop hydrogen supply / value chains. The 23 bi-lateral relationships include 11 within the carriage of Deutsche Gesellschaft für Internationale Zusammenarbeit (**GIZ**), GmbH for the German Federal Government. **GIZ** has published [Hydrogen Business Guide – Bilateral energy partnerships in development countries and emerging markets](#).
- **German Government to lock in €177.5 billion on climate action:** On **July 27, 2022**, the German Federal Government adopted a draft finance plan, **Climate and Transformation Fund**, providing **€177.5 billion** for climate action which is now part of the German Federal budget, and subject to the parliamentary process to approve it.
- **French Government to tender 1 GW of offshore wind field capacity:** On **July 29, 2022**, it was reported widely that the French Government is to undertake an auction process (by tender) for the award of up to **1 GW** of offshore wind field capacity in the **Sud Atlantique** area later in 2022.

Australia:

This section considers news items that have arisen within the news cycle of July 2022 relating to Australia, a top-twenty GHG emitting country, and a developed country with the highest GHG emissions per capita. Australia is however progressing to NZE at a faster rate than many other developed countries, and, along with the GCC Countries, is one of four countries rich in solar resources (and wind resources) that appear likely to lead in the development of the hydrogen economy over the next five years (and beyond): Australia, Chile, the PRC and Spain.

- **ARENA shortlisted for funding support:** On **July 6, 2022**, the **Australian Renewable Energy Agency (ARENA)** announced that it had invited **12 BESS** projects to submit full applications for the purposes of the **Large Scale Battery Storage Round**. The aim of the **Large Scale Battery Storage Round** is to support grid-scale batteries to be equipped with advanced inverter technology.
The **12 BESS** projects invited by **ARENA** to submit full applications (drawn from 54 expressions of interest reported to have been received by **ARENA**) have an aggregate storage capacity of **3.05 GW / 7 GW**.
- **Quinbrook Infrastructure plans data storage precinct:** On **July 8, 2022**, it was reported widely that **Quinbrook Infrastructure** plans to develop a **AUD 2.5 billion** data storage precinct in Brisbane, Queensland. The data storage precinct will source electrical energy to power the data storage precinct from renewable energy sources, and will develop and deploy a **2 GWh BESS**.
The project has been christened the **Supernode project**. The **Supernode project** is to be located in the vicinity of the South Pine substation at Brendale (around 30 kms from Brisbane's central business district). The South Pine substation being the central node of the Queensland Electricity Network, ideal for the data storage precinct.
- **Prime Minister Albanese sets out Australian stall:** On **July 12, 2022**, the **Prime Minister of Australia, Mr Anthony Albanese** spoke at the **Sydney Energy Forum** (as noted above co-hosted by the **Australian Federal Government**, the **Business Council of Australia**, and **IRENA**). **Prime Minister Albanese** stated that investment in clean energy projects had stalled previously, but there was a "once-in-a-generation opportunity, and .. government policies are designed to seize that opportunity ...".
- **South Australia closing in on 100% renewable dispatch:** On **July 15, 2022**, [pv-magazine.com](#) reported that the latest **OpenNEM** (National Energy Market) report shows that during financial year 1 July 2020 to 30 June 2021 more than two-thirds of the dispatched electrical energy in South Australia was from a renewable energy source. The report shows that on average 68.3% of the daily load across the State of South Australia were matched by electrical energy dispatched from renewable energy sources.
- **Queensland Launches Skills Development Roadmap:** On **July 20, 2022**, the Government of Queensland, Australia, launched the first dedicated workforce development plan for the hydrogen industry – [The Hydrogen Industry Workforce Development Roadmap 2022-2023](#). The initiative was flagged by the Government of Queensland nearly three years ago, and demonstrates the progressive thinking of the Government.
- **Renewable natural gas on its way:** On **July 20, 2022**, [pv-magazine-australia](#) reported that Sydney is progressing to the first flow of renewable natural gas with biogas from wastewater upgraded to produce biomethane for injection into the pipeline network. The biogas is to be derived from the Sydney Water Wastewater Resource Recovery Facility with the biogas then upgraded to produce up to 95,000 GJ of biomethane. It is to be hoped that this project will blaze a trail along the East Coast of Australia.
- **South Australia joins Queensland:** On **July 26, 2022** the Government of South Australia [announced](#) that it had received 60 proposals from organisations in respect of its **AUD 593 million Hydrogen Jobs Plan**.
- **Australia moves to formalise its NDC at 43%:** On **July 27, 2022**, Australia's Energy and Climate Minister, Mr Chris Bowen introduced [legislation](#) to the Australian Federal Parliament to formalise Australia's new nationally determined contribution (**NDC**) of a 43% reduction by 2030 compared to 2005, and **NZE** by 2050.
In addition to increasing the **NDC** and committing to **NZE**, the legislation provides for the establishment of a new independent agency, the **Climate Change Authority**, requires the Minister of Climate Change and Energy to issue an annual report to the Australian Federal Parliament, and incorporates the **NDC** and **NZE** targets into the objectives of key agencies, including the Australian Renewable Energy Agency (**ARENA**), the Clean Energy Finance Corporation (**CEFC**), Export Finance Australia, Infrastructure Australia, and the Northern Australia Infrastructure Facility (**NAIF**).

Blue and Green Carbon Initiatives and Biodiversity

This section considers news items that have arisen within the news cycle of July 2022 relating to the Blue Carbon and Green Carbon initiatives and Biodiversity.

- **UN Ocean Conference – key takeaways:** Edition **41** of Low Carbon Pulse reported on the **UN Ocean Conference** (under **Continued emphasis on the Burning Platform**), that ended on **July 1, 2022**, and included a link to the [communiqué / new political declaration \(Lisbon Declaration\)](#).

The **key themes** that **emerged** include: the need to address the cumulative impacts of a warming planet and the degradation of eco-systems: "We are committed to halting and reversing the decline in the health of the ocean's ecosystems and biodiversity, and to protecting and restoring its resilience and ecological integrity".

At the **UN Ocean Conference** more than 150 Member States made voluntary commitments to conserve or to protect or both, at least 30% of the global ocean within Marine Protected Areas.

- **Blue Economy Financing Guidelines:** On the side-lines of **UN Ocean Conference, UNEP F1, Asian Development Bank, (ADB), International Capital Markets Association (ICMA), International Finance Corporation (IFC), and UN Global Compact** announced that they are to work together to develop a guide for bonds to finance the **sustainable blue economy**. As announced, the guide will provide clear criteria, examples and practices for blue bond lending and issuance. The guide is expected to be published in Q3 of 2022.
- **International Institute for Sustainable Development (IISD) score-card:** On **July 4, 2022**, the ever-excellent **IISD** published its [Ocean Conference Final: Earth Negotiations Bulletin](#). **Pages 3 to 7** of the Bulletin outline the substance of the key debates at the **Ocean Conference**. While the balance of the Bulletin is helpful the text covering the key debates is both informative and succinct.
- **IPBES 9 held in Berlin:** From **July 3 to July 9, 2022**, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (**IPBES 9**) was held in Bonn, Germany.
On **July 8, 2022**, the **IPBES Secretariat** issued a media release. The media release includes a [Summary for Policymakers of the thematic assessment of the sustainable use of wild species of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services](#). The summary for policymakers provides key messages as follows: Sustainable use of wild species is critical for people and nature, status and trends in the use of wild species, key elements and conditions for the sustainable use of wild species, and pathways and levers to promote sustainable use and enhance the sustainability of the use of wild species in a dynamic future. For those interested in biodiversity, this is an excellent publication.
On **July 11, 2022**, the [Values of Biodiversity Assessment Report](#) was published.

BIODIVERSITY

In the broadest sense, **biodiversity** describes the variety of the fauna and flora globally, and in any particular area. The preservation of **biodiversity** is a key policy setting. In this context, human activities and the clearing of land to undertake agricultural, forestry or other land use (**AFOLU**) is a key focus of policy settings. Desertification and deforestation are key concerns (both as a result of **AFOLU**), as is the broader impact of climate change on habitats, critically, the impact on change in temperature on land and in the ocean.

There is a balance in habitats, with eco-systems that have developed overtime, and that continue to develop. The balance of habitats and their eco-systems are impacted by **AFOLU** and climate change. There are many examples, but a consistent example (that many will recognise) is the need to preserve the habitats of bees and other pollinators, and to avoid loss of bees and other pollinators. As a policy setting, the rewilding of habitats is one element of preservation, and, in some cases, restoration of eco-systems. As a broad statement, preserving wilderness areas, and rewilding of areas, and reducing old growth forestry, and afforestation and reforestation, are key to the preservation and restoration of **biodiversity**. These are policy settings over which we have control in the near, medium and long term. In addition, overtime, policy settings may extend to addressing optimal use of land, optimal in the sense of preserving or restoring **biodiversity** while at the same time addressing climate change. As always, what is needed is known. As always, the challenge is acting upon it.

Climate change will impact the effectiveness of these policy settings (in particular coastal habitats, and areas of increased drought and desertification, driven by rising sea-levels and changes in weather patterns, as a result of climate change), but they are policy settings that are necessary and need to be progressed in the near term. In addition, acting to preserve and to restore **biodiversity** is likely to yield benefits, economic and social.

- **Global Mangrove Alliance and Wetlands International report on mangroves :** On **July 20, 2022**, the **Global Mangrove Alliance, Save Our Mangroves Now! and Wetlands International** published [The State of Mangroves in the West Indian Ocean](#). The publication considers the state of the mangroves along the east coast of Africa, in particular Kenya, Madagascar, Mozambique and Tanzania. For those interested in Blue Carbon, the publication is rich in data and information, with a strong focus on the opportunities for restoration of mangrove forests and swamps within the West Indian Ocean region. (**Editions 23, 25, 29, 31, 32, 33, 34, 35, 37, and 41** include news items mangroves and other Blue Carbon initiatives.)
- **Nature Based Solutions:** During the first week of July, the author of Low Carbon Pulse read European Commission publication [The Vital Role of Nature-Based Solutions In a Nature Positive World](#), which was released by the **Directorate-General for Research and Innovation**. The publication is an excellent primer for **Nature-Based Solutions (NBS)** and **Nature-Based Enterprises (NBE)**. It is hoped the resources and time are devoted to the development of the thinking contained in the publication in the near term.
During the second week of July the author read the **ADB** publication [Integrating Nature-Based Solutions for Climate Change Adaptation and Disaster Risk Management – A Practitioner's Guide](#). The **ADB** publication, authored by John Matthews and Ernesto Ocampo Dela Cruz provides a wonderful addition to those active (or those interested) in the area of **NBS**. **NBS** are at the core of both Blue and Green Carbon Initiatives. One of the many good things about the **ADB** publications is that it applies a broader perspective as to what is an **NBS**.
- **Land-Based Climate Solutions for the United States:** On **July 11, 2022**, [carbon.direct.com](#) published an article that introduced [Land-Based Climate Solutions for the United States](#) by Messrs Robertson, Hamilton, Paustian and Smith. The article and the publication are both excellent, with a key point being that **NBS** are constrained by the time taken for carbon accrual in forest biomass and soils.

- **UN Biodiversity Conference:** As reported in **Edition 41** of Low Carbon Pulse, **Part 2 of the UN Diversity Conference** (fifteenth meeting of the Conference of Parties (**COP-15**) to the Convention on Biological Diversity) is to take place between **December 5 and 17, 2022**, in **Montreal, Canada**.
- **COP-15** is intended to adopt the **post-2000 global biodiversity framework**, which provides a strategic vision and global roadmap for the conservation, protection, preservation, restoration and sustainable management of biodiversity and ecosystems for the next decade. **Draft 1** of the **post-2000 global biodiversity framework** was released in July 2021.
- **International Day for the Conservation of the Mangrove Ecosystem:** As regular readers of Low Carbon Pulse will know, the author has long included background on the role that mangrove forests and swamps play, and the increased role that they can play, as a nature based solution to mitigate the impact of climate change (see **Editions 29, 31, 32**, and **33** of Low Carbon Pulse).

Among the many facts and stats that were reported on **International Day for the Conservation of the Mangrove Ecosystem**, here are some of the more eye-catching: **first**, mangroves forests and swamps are highly adapted to their muddy and salty habitat, providing a natural barrier to protect coastal habitats; **secondly**, mangroves provide a habitat for thousands of species of fish and crustaceans, providing oxygenated and low to lower acidic sea-water for those species, and ideal nursery habitats – mangroves are good for fishery and crustacean stocks; **thirdly**, per hectare, mangrove forests and swamps up to 10 times the **CO₂** of terrestrial forests, and their rate of growth and the locations of their growth make them to many the **front-line climate warriors**, and to others the **superhero ecosystems**, **fourthly**, while mangrove forests and swamps are to be found in 123 countries, they represent less than of tropical forests globally and less than 0.4% of the total area covered by forests.

The only threat to mangrove forests and swamps arise from their removal to allow invasive aquaculture and coastal development, with some estimates suggesting that in the last 50 years around 25% of mangroves forests and swamps have been lost as a result of removal.

By way of reminder: **Edition 29** reported that it is estimated that one mangrove tree will absorb 12.4 kg of **CO₂** a year on average. Taking the benchmark of the Kingdom of Saudi Arabia to plant 50 billion trees (see **Edition 13** of Low Carbon Pulse), 50 billion mangrove trees will absorb 620 million metric tonnes per annum. It is possible to plant 5,000 mangrove trees per hectare, with each hectare absorbing 62 metric tonnes per annum of **CO₂**. 50 billion mangrove trees could be planted on 10,000,000 hectares.

As reported in **Edition 41** of Low Carbon Pulse, conservation, preservation and restoration is a policy setting in many countries, and by way of a reminder, **Edition 41** (under **World Bank supports mangrove conversation and restoration in Indonesia**) that **The World Bank** announced its support for projects to conserve and to restore mangrove growth in Indonesia, under **The Mangrove for Coastal Resilience Project**. The Project is stated to "focus on strengthening the policy and institutions for mangrove management and rehabilitation, promoting sustainable mangrove management, as well as improving the livelihood opportunities for Indonesian coastal communities living around mangrove forests". As stated, Indonesia has around **3.4 million hectares** of mangrove growth, accounting for 20% of mangrove growth globally, and provides habitat for 40 of the 54 species of mangrove. The mangrove growth in Indonesia stores **3.14 giga-tonnes** (3.14 billion metric tonnes) of **CO₂**. As noted in previous editions of Low Carbon Pulse, mangrove growth improves the eco-system for marine life, and as such provides improved fishery opportunities. In Indonesia, around **55%** of the **fish catch** consists of **mangrove-dependent** marine life.

- **Colombia conservation and preservation policy settings:** On **July 26, 2022**, [conservation.org](https://www.conservation.org) reported that Colombian President, Mr Ivan Duque Marquez announced that Colombia is to conserve and to protect **21% of its lands** and **37% of its waters**. The conserved and protected areas include areas that are conserved and protected formally under the UN Convention on Biological Diversity.
- **World Resources Institute (WRI) Five Reasons for Cities to include trees in climate action:** On **July 29, 2022**, the **WRI** (under **5 Reasons Cities Should Include Trees in Climate Action**) noted that while cities and communities around the world are focusing on **GHG** emissions from the building, energy, industrial, transportation and waste sectors a number of overlooking the benefits of forestry and trees. The **WRI** introduces its publication, **Global Protocol for Community Scale Greenhouse Gas Inventories: Supplemental Guidance for Forests and Trees**, and guides us to the **GHG Protocol for Cities – An Accounting and Reporting Standard for Cities**, which has been piloted in Jakarta, Mexico City, Mumbai and Salvador, and in respect of multiple US communities (through the **process of estimating annual emissions and removals by forests and trees**).

The **WRI** outlines the five reasons as follows:

1. Forests and trees both emit (on degradation or removal) and remove carbon (on growth);
 2. Protecting urban forests is low-hanging fruit, even if the mitigation potential is small (in a global context, and in the context of other means and solutions);
 3. Urban forests and trees are important for climate adaptation;
 4. Expanding forest and tree coverage can address inequities; and
 5. The benefits of forests and trees go well beyond climate. The **WRI** publication is well-worth a read, providing links to many helpful sources of data and information, and providing a number of case studies. More worthwhile still is to spend an afternoon or evening with all of the materials to which links are provided, and the article itself.
- On **July 26, 2022**, **UN Biodiversity** published an infographic describing Nature Based Solutions, which is set out at the top of the next page.

What are Nature-based Solutions (NbS)?

NbS are defined by IUCN as “actions to address societal challenges through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being.” They use the power of nature and functioning ecosystems as infrastructure to provide natural services to benefit society and the environment.

NbS have prime potential to help address global challenges such as:

- climate change
- economic and social development
- human health
- food and water security
- disaster risk reduction
- ecosystem degradation
- biodiversity loss

NbS can provide long-term environmental, societal and economic benefits:

- adaptation to climate change
- green jobs
- community resilience
- health benefits
- healthy and accessible food
- clean air and water
- disaster risk reduction
- ecosystem integrity
- biodiversity net gain

Examples of NbS application:

- Protection, restoration and sustainable use of forest landscapes**
Secures water supply, erosion control and risk reduction
- Protection or restoration of coastal ecosystems**
Brings community resilience, disaster risk reduction, economic development
- Protection, restoration and management of wetlands**
Provides water storage, flood protection, food production
- Providing space for rivers to naturally flow**
Enables flood protection, water security
- Urban green and blue spaces**
Empowers climate regulation, better human health, social development, green jobs
- Sustainable management of agroforestry systems**
Offers food security, water regulation, economic and social development



www.iucn.org/adapt

[@theadaptproject](https://www.facebook.com/theadaptproject)



Bioenergy and heat-recovery:

This section considers news items that have arisen within the news cycle of July 2002 relating to bioenergy, being energy, whether in gaseous, liquid or solid form, derived or produced from biomass. **Bioenergy** includes any energy derived or produced from biomass (organic matter arising from the life-cycle of any living thing, flora or fauna, including from organic waste streams), whether in gaseous, liquid or solid form. In addition, recovered heat and waste heat (derived from any source, including waste water) has been added to this section.

From recent activity and reporting, it appears likely that the avoidance of waste heat energy, and the recovery of waste heat energy will become a priority under the first pillar as a part of Energy Efficiency (**IEA**) and Energy conservation and efficiency (**IRENA**). By some estimates, up to 67% of energy arising is wasted. The increased awareness of sourcing heat reflects increased awareness of the energy used to heat buildings, and its source: heating buildings results in around 25% of total final energy demand, with around 75% of the feedstock used to satisfy that energy demand derived from fossil fuels.

- **CMA CGM and Engie plan biomethane production:** On **July 4, 2022**, it was reported widely that **CMA CGM** (French shipping corporation) and **Engie** (leading international energy corporation) plan to develop a **biomethane** production project (**Project Salamander**), with a final investment decision contemplated in Q4 of 2022. Project Salamander will derive biogas and upgrade that biogas to produce **200,000 metric tonnes of biomethane** a year, with that **biomethane** (renewable natural gas) then liquified to produce renewable liquified natural gas (aka **Bio-LNG**) to be used by **CMA CGM** on its **E-methane-ready-vessels**.
- **A Gas for Climate report:** On **July 8, 2022**, the **Gas for Climate** consortium published an update [Biomethane production potentials in the EU](#). The updated publication builds on the previous publication from **Gas for Climate** to take into account the acceleration of the use of biomethane now contemplated by the **EU** – see **Editions 37** and **40** of Low Carbon Pulse.
The **key findings** of the publication are: **1.** There is enough sustainable feedstock in the **EU** to achieve the **EU REPowerEU** target of **35 bcm by 2030**, with up to **41 bcm by 2030** and **151 bcm by 2050**; **2. Anaerobic digestion** is regarded as having the potential to derive up to **38 bcm by 2030**, and up to 91 bcm by 2050. In the **EU** context, France, Germany, Italy, Poland and Spain will be the top five producers of **biogas** derived **biomethane** using anaerobic digestion technologies. The **key feedstocks** for these purposes **to 2030** being **manure** (33%), **agricultural residues** (25%) and **sequential cropping** (21%); and **3. Thermal gasification** is regarded as having the potential to derive up to **2.9 bcm by 2030**, and **60 bcm by 2050**. In the **EU** context, France, Germany, Italy, Spain and Sweden will be the top five producers of biomethane using thermal gasification. The **key feedstocks** for these purposes **to 2030** are **forestry residues** and **wood waste**, together having 60% of the feedstock source.
- **Air Liquide PRC biomethane project:** On **July 12, 2022**, **Air Liquide** (one of the three industrial gas giants globally) [announced](#) that its first **biomethane production facility** in the **PRC** is to open by the end of 2022. The **biomethane production facility** is located in **Huai'an City, Jiangsu Province**. **Air Liquide** has deep expertise across the **biomethane** supply / value chain, including deriving **biogas**, upgrading **biogas** to produce **biomethane**, and the storage and transportation of **biomethane** in compressed or liquified form. **Air Liquide** has **21 biomethane** projects globally.
The **biomethane production facility** will derive **biogas** from agricultural and livestock waste from local farms and upgrade that **biogas** to produce **biomethane**. The digestate arising from deriving **biogas** will be processed and pasteurised to produce **bio-fertilisers** that will be used by local farms. It is apparent that **biomethane** production is highly prospective across the **PRC**.
- **Biogas reading for those taking a vacation:** On **July 20, 2022**, the ever-excellent [biogasworld.com](#) published **Top 10 Biogas Reports To Add To Your Summer Reading List**.
The Top Ten Biogas reads listed are: **1. Best Practices for Reducing Costs of Anaerobic Digestion of Organic Waste**; **2. Biomethane Production Potentials in the EU** – see below; **3. Renewable Natural Gas as a Complementary Solution to Decarbonizing Transport**; **4. Fuelling Clean Mobility with Bio-LNG**; **5. Hitting Canada's Climate Targets with Biogas and RNG**; **6. Bioenergy Europe Statistical Report 2022**; **7. Green Gas: The Green Economy under our Feet**; **8. Turning Circle: How Bioenergy can Supercharge Australia's Circular Economy**; **9. The Landscape of Methane Abatement Finance**; and **10. Anaerobic Digestion Deployment in the UK**. To the surprise of the author of Low Carbon Pulse, a number of the publications sit in the "read-pile", with an equal number in the "to-read pile".
- **Fully covered wastewater treatment facility operation:** On **July 26, 2022**, **State of Green Denmark** [announced](#) that the first fully covered wastewater treatment facility had commenced operation, **Solrødgård**, located in **Hillerød**, north of Copenhagen. **Solrødgård** has been developed by the **Hillerød Utility**. As announced, the design of **Solrødgård** has been driven by developing a facility that is net-energy positive, and **CO₂** neutral.

BIOENERGY

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "**upgrading**") so that it can be used as pipeline gas. **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel or as a feedstock. Also either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia:** being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;
- **Bio-butanol:** being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel:** being diesel (i.e. synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol:** being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene:** being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF)**, is a synthetic paraffinic kerosene. Currently most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams (typically using some natural gas). (It is a drop-in fuel.);

- **Bio-LNG:** being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and
- **Bio-methanol:** being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

BESS and HESS (and energy storage, including CAES and PHES):

*This section considers news items that have arisen within the news cycle of July 2022 relating to battery electric storage systems (BESSs) and hydrogen energy storage systems (HESSs). In addition to BESSs and HESSs, other forms of energy storage systems are covered, including use of compressed air energy storage (CAES) and pumped hydro energy storage (PHES). In this context, long duration energy storage (LDES) is considered, being energy technology that is able to allow the off-take electrical energy out of storage for a duration of more than four hours. In the brave new world described in **Edition 13** of Low Carbon Pulse: "BESS storage of 10/12/24 hours is being contemplated for business users, and up to 72 hours for telecommunications companies, including to guard against the consequences of land-borne weather events".*

- **Stanwell Power Station Big BESS:** On **July 1, 2022**, it was reported widely that **Stanwell Power Station** (owned by Stanwell Corporation, a State of Queensland, Australia Government Owned Corporation) is to develop **1.45 GW / 2.9 GWh BESS** to be co-located with the existing coal-fired power station. The **BESS** is to be developed and deployed on a staged basis, with **stage 1** comprising **150 MW / 300 MWh** lithium-ion battery deployment, and **stage 2** to comprise **1,330 GW / 2.6 GWh** the deployment of either flow battery or lithium-ion technology.
- **Wärtsilä and Clearway Energy Group contract for BESS:** On **July 11, 2022**, **Wärtsilä** announced that it had contracted with **Clearway Energy Group** for the supply of a **500 MW / 2 GW** portfolio of **BESSs**. The portfolio of **BESSs** will be located in the US States of **California** and **Hawaii**, and will include one of the world's largest combined **BESS** and photovoltaic solar facilities.
- **Northvolt energy storage system plant is a winner:** One of the successful applicants for funding support under **€1.8 billion** second round of large-scale funding for clean-tech projects under the **EU Innovation Fund** was the **Northvolt** (Swedish headquartered technology corporation) **NorthSTOR PLUS** energy storage system (**ESS**) assembly plant located in **Gdańsk, Poland**. The **ESS** will use **high-nickel, nickel-manganese-cobalt (NMC)** cells, having a higher energy density than other technologies.
- **Iberdrola inaugurates 40 GWh pumped hydro-electric plant on July 18:** On **July 19, 2022**, [energy-storage.news](#) reported that **Iberdrola** had inaugurated its **Tâmega Giga-battery** in northern Portugal, as part of its renewable energy complex. As reported, **Iberdrola** has invested **€1.5 billion** in the renewable energy complex which combines **two run-of-river hydroelectric plants** and a **880 MW** pumped hydro energy storage (**PHES**) unit (Gouvães), with combined electrical energy output of 1.158 GW.

By way of reminder: Edition 35 of Low Carbon Pulse reported on the renewable energy complex as follows:

"Iberdrola pumps-up scale: On February 8, 2022, it was reported widely that Spanish renewable energy giant, Iberdrola is developing a MW hydro-electric power complex in northern Portugal, using water from three reservoirs: Alto Tâmega, Daivões and Gouvães.

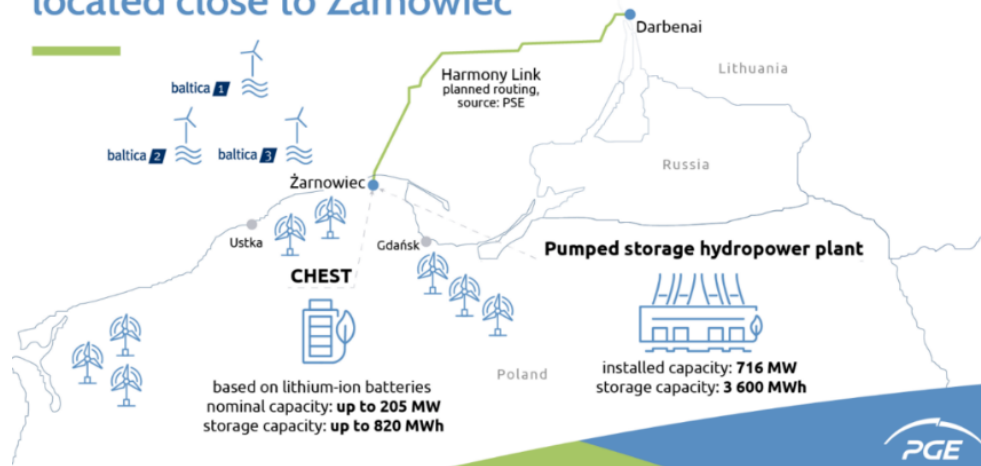
The hydro-electric power complex will deploy a 880 MW reversible storage facility (pumped-storage), which is able to store water from the Daivões reservoir delivered into the Gouvães reservoir. There is a 650 metre differential between the two reservoirs, use of the differential will generate renewable electrical energy, with the water in the Gouvães reservoir pumped into the Alto Tâmega reservoir. The pumped storage is being described as the "Alto Tâmega giga battery": on operation the energy storage of Portugal will increase by 30%".

- **PGE Group to develop Big BESS:** On **July 21, 2022**, [energy-storage.com](#) reported that **PGE Group** (state-owned energy corporation) had obtained approval to develop and to deploy a **200 MW / 820 MWh BESS** in Poland – named **CHEST (Commercial Hybrid Energy Storage)**.

As reported, **CHEST** will be integrated with the existing **716 MW / 3,300 MWh** pumped hydro-electric storage (**PHES**) plant at Żarnowiec, and with wind farm generation capacity (**PGE Group** is permitted to install up to **3.5 GW** of wind farm capacity).

The development is part of a broader plan to provide energy market and grid flexibility, and the planned synchronisation of Estonian, Latvian and Lithuanian power grids under the Harmony Link project (see **Edition 34** of Low Carbon Pulse).

Commercial Hybrid Energy Storage (CHEST) located close to Żarnowiec



- **Georgia Power granted approval:** On July 26, 2022, [energy.storage.news](#) reported that **Georgia Power** had been granted approval (by the Public Service Commission of Georgia) for its **2022 Integrated Resource Plan** outlining how **Georgia Power** is to develop and to deploy renewable energy and energy storage over the coming three years. As reported, **Georgia Power** is to develop and to deploy **2.3 GW** of renewable energy (with a long-term plan of **6 GW** by 2030) and for up to **765 MW** of **BESS**.

Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

This section considers news items that have arisen within the news cycle of July 2022 relating to carbon accounting and carbon dioxide removal (CDR), including bioenergy carbon capture (BECCs), bioenergy carbon capture use and storage (BECCUS), carbon capture and storage (CCS), carbon capture use and storage (CCUS) and direct air capture (DACs). Effective accounting for carbon arising and CDR go hand-in-hand.

By way of background CDR is recognised in the 2021 Report as including: afforestation, soil carbon sequestration, bioenergy with carbon capture and storage (BECCS), wet land restoration, ocean fertilisation, ocean alkalisation, enhanced terrestrial weathering and direct air capture and storage (DACs) are all means of CO₂ removal.

The IEA pathway to NZE estimates that in order to achieve NZE it will be necessary to capture and to remove up to 7.6 giga-tonnes of CO₂ each year through CCS, CCUS and CDR. CCS and CCUS (and BECCS and BECCUS) involve the capture at the source of CO₂, preventing release to the climate system. The following provides a helpful overview of carbon capture as things currently stand.

- **Coda Terminal funding support from European Innovation Fund:** On July 12, 2022, Carbfix [announced](#) that it and **Dan-Unity** had been awarded grant funding support from the **EU Innovation Fund** for the development of the **Coda Terminal**, a large-scale CO₂ transport and storage hub at **Straumsvik, Iceland**. As announced, operation of the **Coda Terminal** will commence in mid-2026, with full capacity of **3 million metric tonnes** a year of CO₂ storage to be achieved during 2031. (See [Edition 18](#) of Low Carbon Pulse for previous reporting.)
- **DAC for Microsoft:** On July 13, 2022, [Climeworks announced](#) that it had signed a 10 year carbon removal offtake agreement with **Microsoft Corporation**. (See [Editions 25, 26, 36](#) and [41](#) for coverage of **Climeworks**.)
By way of a reminder: [Edition 25](#) of Low Carbon Pulse (under **Microsoft founded but not forgetting**) noted that: "Microsoft Corporation was founded in 1975 by Mr Bill Gates and, the late, Mr Paul Allen. As noted in [Editions 11](#) and [13](#) of Low Carbon Pulse, Microsoft is committed to achieving NZE by 2030 and, as noted in [Edition 2](#) of Low Carbon Pulse, to removing from the climate system a mass of CO₂-e equal to the mass of GHG emissions that it has emitted since it was founded (zero historical GHG emissions or ZHE) by 2050".
- **ExxonMobil – seven things to know about CCS:** On July 13, 2022, **ExxonMobil** published **Seven Things to know about carbon capture and storage technology**. **1. CCS** is proven technology; **2. CCS** could capture more than 90% of CO₂ emissions; **3. CCS** is crucial to mitigating climate change; **4.** Natural gas with **CCS** ensures a more stable and cost-effective energy supply than renewables alone; **5.** There is more than one way to capture CO₂; **6.** CO₂ can be stored permanently and safely underground; and **7.** ExxonMobil is responsible for capturing 40% of all the CO₂ captured to date.
- **Peterhead Carbon Capture project awards FEED contract:** On July 13, 2022, **SSE plc** and **Equinor** [announced](#) that **Mitsubishi Heavy Industries, Tecnicas Reunidas** and **Worley** had been appointed to deliver carbon capture for the Peterhead Power Station. The **Peterhead Carbon Capture Project** is intended to capture **1.5 million metric tonnes** of CO₂ a year. As announced and reported, the **Peterhead Carbon Capture Project** involves the replacement of carbon-intensive generation capacity with renewable electrical energy, with the CO₂ capture units to be integrated into a power turbine with generating capacity of 910 MW.
- **Timor-Leste project awards FEED contract:** On July 13, 2022, it was reported widely that **Santos Ltd** had appointed **Worley** to undertake **FEED** on the **Timor-Leste CCS** project.
- **CDR required, lots of it:** It is well-known and understood that **carbon dioxide removal (CDR)** is critical to achieving **NZE** by 2050 (see [Edition 38](#) of Low Carbon Pulse) – **165 billion metric tonnes** (or **165 giga-tonnes**) of it. The rate of development of mechanical carbon capture and storage (**CCS**) solutions and direct air capture (**DAC**) solutions is increasing, and deployment of both **CCS** and **DAC** accelerating (with **CCS** having been used for around

50 years, with around **300 million metric tonnes** injected into storage, currently with around 30 projects globally injecting into storage around 40 million metric tonnes a year of **CO₂**).

In addition, there is increasing focus on nature based solutions (**NBS**), at the core of which is the absorption or sequestration of **CO₂** in biomass, i.e., negative **GHG** emission solutions. The need for negative GHG emission solutions is known, and the means of implementing the solution is known, in particular in areas of the world impacted by climate change, including Africa.

- On **July 14, 2022**, illuminem.com published [**COP27 Why Africa Needs to be at the Forefront of the Climate Change Conversation**](#), by **Adetayo Adetuyi** and **Nnanke Williams**, which provides an overview of the current dynamics for Africa, critically, that while Africa is not responsible for the level of **GHG** emissions in the climate system, it is one of the most, if not the most, susceptible regions to the resulting climate change, and the resulting impact, including the adaptation and mitigation. The article is well-worth a read.
- **DNV and Petronas Southeast Asian focus**: On **July 19, 2022**, upstreamonline.com reported that **Petronas** (Malaysia's natural energy corporation) and **DNV** are to work together on CCS and CCUS initiatives, in particular to address the business, regulatory and technical challenges of the development and deployment of CCS and CCUS within Southeast Asia. As reported, **Petronas** and **DNV** will work together on environmental and safety, risk generally, including technology, and identify and assess sites for storage, and the legislation and regulatory matters that are required.
- **"First of its kind" CCS project in North Dakota**: On **July 19, 2022**, politicopro.com reported that **Red Trail Energy LLC** (which operates an ethanol production facility in western North Dakota) had announced that the US's "first carbon capture and storage project allowed under state primacy" started operating during June 2022. As reported, in 2018 North Dakota became the first state to secure primacy over Class VI injection wells, being wells used to inject **CO₂** deep into rock formations for long-term (permanent) storage. **Red Trail Energy LLC** has announced that it is capturing **100%** of **CO₂** arising from its ethanol production facility.
- **WoodMac Energy Super Basins**: The **July Edition of Wood McKenzie's Horizon** publication [**Energy super basins: Where the renewable CCS and upstream stars align**](#). The publication is excellent, and compulsory reading for those in the upstream oil and gas industry working towards energy transition and **NZE**. As is an emerging theme, Scope 3 emissions are critical, and CCS is critical to sequestration of Scope 3 emissions, but CCS is not feasible in many oil and gas basins globally.
- **The Week in Carbon Dioxide Removal**: On **July 22**, and **July 31, 2022** Mr Wil Burns published his [**Week 1**](#) and [**Week 2 Editions**](#). The **Week 1** and **2 Editions** are great and are commended to anyone interested in CCS / CCUS.
- **BECCS launched by Mitsubishi Heavy Industries**: On **July 26, 2022**, **CO₂ Value Europe** posted that **Mitsubishi Heavy Industries**, one its members, had deployed the **First Compact CO₂ Capture System** at a biomass power plant in **Hiroshima, Japan**. The **CO₂** captured will be used in greenhouses on-site to enhance the growth of vegetables.

Carbon Credits and Hydrogen Markets and Trading:

This section considers news items that have arisen within the news cycle of July 2022 relating to the creation of carbon credits, the role of carbon credits, and the trading of them.

Also this section covers the development of hydrogen markets and trading (bilateral and likely wholesale).

- **Impact of VCM on Tropical Rainforests**: During the first week of **July, 2022**, an **Environmental Defense Fund** financed study was published [**Impact of the Voluntary Carbon Market on Tropical Forest Countries – Implications for Corresponding Adjustments**](#). The study estimates the capacity of the tropical rain forests to match the demand for carbon credits. The study uses three scenarios for carbon credit demand covering two periods – 2021 to 2030 and 2021 to 2050. The study is excellent and well-worth a read.
- **Climate Impact X**: As reported previously, **Climate Impact X** is working with Nasdaq. (See **Editions 18, 27** and **37** for coverage of **Climate Impact X**.) On **July 13, 2022**, digfingroup.com included a feature on **Climate Impact X**, in particular the distribution channels to market for high-quality carbon credits, being an auction venue for new projects, a corporate sustainability market, and a spot market. As stated in the feature, the voluntary carbon market for carbon credits represents around **360 million metric tonnes** of **CO₂-e** emissions that have been captured and stored by mechanical means or sequestered by natural means.

As part of multi-faceted progress towards **NZE**, carbon credits have a role to play, but to play a meaningful role **CO₂-e** emissions need to be removed at a rate of **10 to 20 billion metric tonnes** if **NZE** is to be achieved. In scaling-up **CDR** on this level of removal, carbon credits and the voluntary carbon markets need to scale-up. As carbon credits and the voluntary carbon markets scale up, to provide functioning distribution channels, investment in **CDR** projects can be expected to increase. As Head of Product, at Climate Impact X, Mr Tom Enger says: "*The carbon market needs integrated solutions, including money, project development, credit analysis, product design, contract definition, and platforms for trading, matching and settlement. It needs buyers and sellers*".

Voluntary carbon markets allow buyers to purchase carbon credits that match the **GHG** emissions arising from the activities undertaken by the buyer. A carbon credit arises from an activity or project that avoids, reduces or removes **CO₂-e** emissions. From a policy setting perspective, the idea is that over time the cost of the carbon credits increases forcing the buyers of carbon credits to decarbonise the activities that give rise to **CO₂-e** emissions. As such the carbon markets do not effect decarbonisation, but with appropriate policy settings can buy time and overtime drive decarbonisation.

- **Climate Impact X and Puro.earth align**: As reported previously, in **June 2022**, **Climate Impact X** announced that it and **Puro.earth** are to work together to address the growing imbalance in supply and demand in the voluntary carbon markets, by making it easier for businesses and financial institutions globally to access new and emerging carbon credit types. The CEO of **Climate Impact X**, Mr Mikkel Larsen, said that: "*Our partnership with Puro.earth helps to unlock new supply by sending a clear demand signal. It is a unique collaboration that will help drive the creation of a science-aligned solution that reduces frictions for businesses and institutions looking to incorporate a*

blend of curated credits in their carbon portfolios". (See **Edition 19** of Low Carbon Pulse for previous coverage of **Puro.earth**.)

- **Carbon markets can drive revenue:** On **July 13, 2022**, the **Environmental Defense Fund** published an article entitled [Carbon Markets Can Drive Revenue, Ambition for Tropical Forest Countries, New Studies Show](#). The article references publication [Financial Opportunities for Brazil form reducing Deforestation in the Amazon](#). Both the article and the publication are worth a read, providing an outline of how opportunities may be realised, in particular in the context of voluntary carbon markets.

The perspective of Climate Impact X is supported by these articles and studies.

- **Plastic Credits:** On **July 12, 2022**, the author of Low Carbon Pulse was introduced to the concept of a plastic credit in a paper from the good-folk at **South Pole**. At the outset, a plastic credit is not a carbon credit (because there is no carbon to off-set), rather a plastic credit is a credit to which value may be attached in the context of an appropriate policy setting framework.

The premise of a plastic credit is that there is environmental benefit / value in the collection of plastic that is at large in the climate system, and a means of encouraging collection may be the issue of plastic credits which will have value, and which will support projects to collect plastic that is at large.

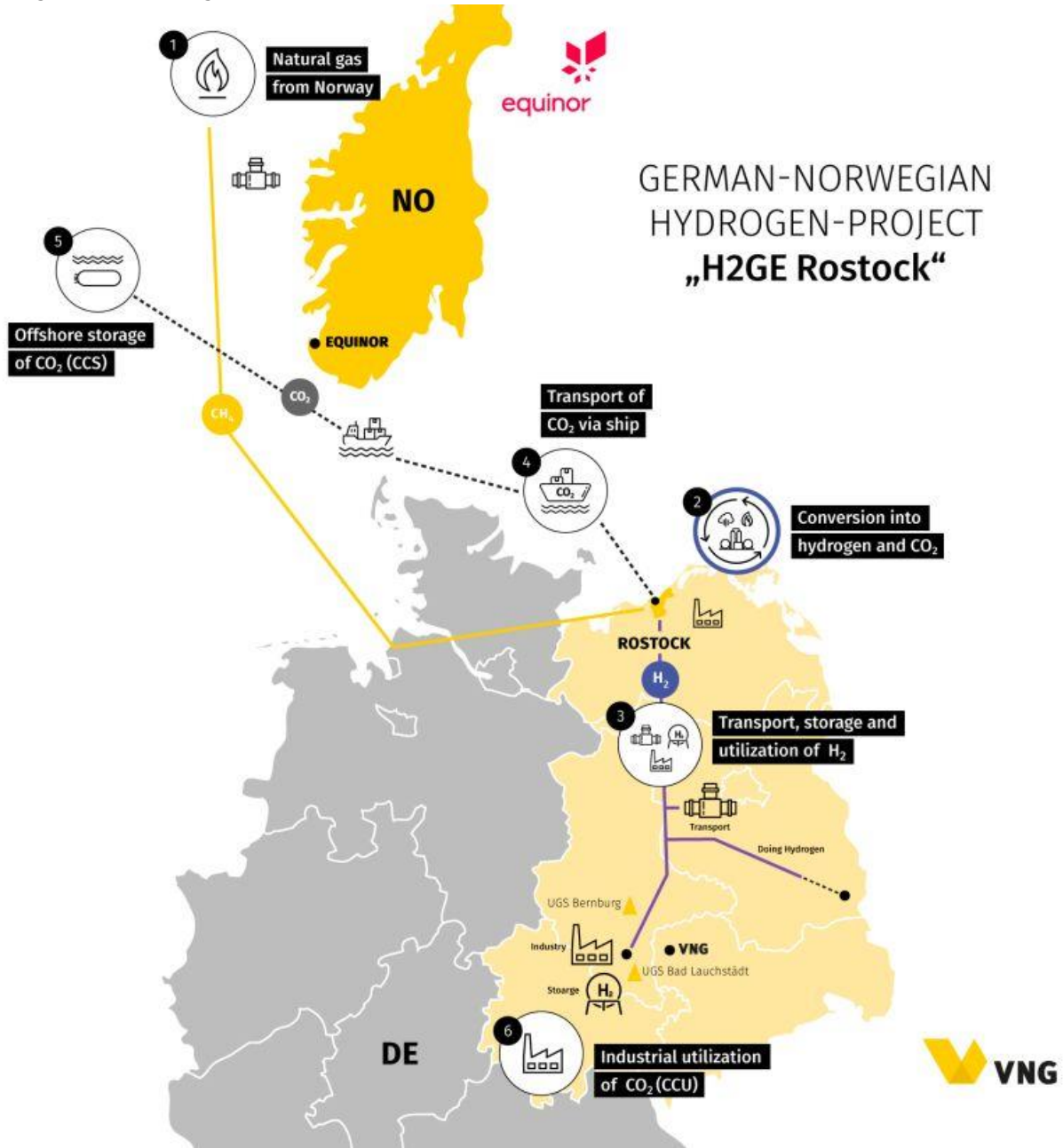
- **REDD+ Framework:** On **July 22, 2022**, the good folk at **Sylvera** published [Our Carbon Credit Ratings Framework for REDD+ Projects Reducing Emissions from Deforestation and Forest Degradation Project \(REDD+\)](#). The purpose of the publication is to provide a bottom-up approach to assess and to produce accurate ratings and analyses for carbon projects from which carbon credits are to be sourced for the voluntary carbon market.
- **Treasure Trove:** On **July 29, 2022**, **Carbon Growth Partners'** Chief Impact Officer, Mr Charles Bedford, outlined the roles of compliance / regulated carbon markets, and voluntary carbon markets, in an article entitled [Carbon Credits 101, Episode 3: Less Harm, Or More Good?](#) The article is well-worth a read. For ease of reference, links are attached to **Episodes 1** and **2** ([Episode 1: Building A Better Cookstove](#), [Episode 2: Mongolia's Power of the Wind](#)) in the **101-series**.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

*This section considers news items that have arisen within the news cycle of July 2022 relating to the development of production capacity to derive and to produce **E-fuels** (energy carriers derived or produced using renewable energy) and **Future Fuels** (energy carriers derived and produced that are characterised as clean carbon or low carbon fuels). **E-fuels** include Green Hydrogen and Green Ammonia, and **Future Fuels** include Blue Hydrogen and Blue Ammonia.*

- **Howden and Raven SR compact:** On **July 1, 2022**, [hydrogen-central.com](#) reported that **Howden** (leading compression technology corporation) had contracted with **Raven SR** to provide compression technology to **Raven SR** at its first **waste-to-hydrogen** facility, Richmond, California. (See **Editions 20, 23, 37** and **39** for previous news items on **Howden** and **Raven SR**.)
- **Hydrogen to produce lime:** On **July 1, 2022**, the [constructionindex.com](#) reported that a trial, led by **Tarmac** (UK building and construction materials supplier) at its sites at Tunstead, near Buxton, Derbyshire, UK, had used hydrogen successfully to displace the use of natural gas. As reported, the trial has demonstrated that it is possible to displace the use of natural gas completely by the use of hydrogen. Currently, lime is manufactured from the use of high-heat temperature kilns, heating calcium carbonate from limestone, using natural gas to create that high-heat temperature. The use of hydrogen to displace natural gas reduces the **GHGs** arising from the combustion of fuel. It is important to remember however that this is the minor part of the **GHG** equation – the production of lime gives rise to one metric tonne of **CO₂** for each metric tonne of cement derived.
- **A first waste to hydrogen facility in the UK:** On **July 1, 2022**, **EQTEC** [announced](#) that it had appointed Wood as its technology partner for the design, development and deployment of a waste-to-hydrogen facility at its Hybrid Energy Park, Southport, Merseyside. As announced **EQTEC** and **Wood** have agreed to co-develop waste-to-hydrogen facility, using refuse derived fuel as the organic feedstock for the production of hydrogen.
- **Sunfire to provide first multi-megawatt high-heat temperature electrolyser:** On **July 5, 2022**, it was reported widely that **Sunfire GmbH** had delivered the first two of 12 high-heat temperature electrolyser modules to be installed at **Neste's** facility at the **Port of Rotterdam**, as part of the **MultiPLHY project**. Once all electrolysers are installed they will provide **2.6 MW** high-heat temperature electrolyser capacity, using **Sunfire's solid-oxide electrolyser cell (SOEC)** which operates at temperatures of 850°C. The announcement on **July 5, 2022**, follows the announcement on **July 4, 2022** that **Sunfire GmbH** is to receive funding support under the Important Projects of Common European Interest (**IPCEI**) initiative to allow it to scale-up its **alkaline electrolyser** and **SOEC technologies**. The German Federal Government (under Ministry for Economic Affairs and Climate Action) has granted an **early start** to the work of **Sunfire**.
- **Shell takes FID on Maasvlakte Green Hydrogen Project:** On **July 6, 2022**, Shell [announced](#) that it had taken a final investment decision (**FID**) to develop its Green Hydrogen production facility located on the **Tweede Maasvlakte**. The Green Hydrogen production facility will deploy **200 MW** of electrolyser capacity to produce **60,000 kgs (60 metric tonnes)** of Green Hydrogen a day (**Holland Hydrogen I** project), with the renewable electrical energy to power the electrolysers to be sourced from the **Hollandse Kust** off-shore wind field. The Green Hydrogen production facility will be the largest in Europe. (See **Editions 27** and **31** of Low Carbon Pulse for previous coverage.) The **FID** in respect of **Holland Hydrogen I** project was "big news". This was reflected by the fact that Dutch Prime Minister, Mr Mark Rutte, and Shell CEO, Mr Ben van Beurden, together, announced the **Holland Hydrogen I** project (and the blanket coverage of the announcement across news-feeds and publications).

- **Equinor and VNG coherent whole:** On **July 6, 2022**, **Equinor** (leading international energy corporation) [announced](#) that it was working with **VNG** (German natural gas company) to assess options to produce low-carbon hydrogen from natural gas in Rostock on the Baltic Sea coast.



- **Air Products and VPI sign JDA:** On **July 6, 2022**, **VPI** (UK-based **power supply company**) announced that it had signed a joint development agreement with **Air Products** (one of the Big Three industrial gas producers) to allow the development of the Humber **Hydrogen Humber Hub** (or **H3**). The **Humber Hydrogen Hub** involves the development of a 800 MW low-carbon hydrogen production facility in Immingham, Lincolnshire, England.
- **UK's first and second plastic parks approved:**

- **Edition 41** of Low Carbon Pulse reported as follows:

"On **June 9, 2022**, utilityweek.co.uk reported that West Dunbartonshire Council had approved the development of the UK's second plastics-to-hydrogen (**P-to-H2**) project. The **P-to-H2** project comprises a **13,000 metric tonne** facility that will derive sustainable hydrogen from non-recyclable plastics.

The **P-to-H2** project will use **Powerhouse Energy** technology, and will be developed by **Peel NRE**. The **P-to-H2** Is to be located at Rothesay Dock, on the banks of the River Clyde. The **Powerhouse Energy** technology is reported to shred non-recyclable plastic, with the shredded plastic then treated thermally, at high-heat temperatures, with the plastic converting in a gaseous state, with the gases then reformed to derive a synthetic gas comprising **CH₄** and **H₂** (and **CO**). The **CH₄** is used to generate electrical energy and the **H₂** is used as feed-stock to produce fuel for the mobility sector. **Peel NRE** and **Powerhouse Energy** are reported to plan the development of **11 P-to-H2** projects in the UK. The development of the **P-to-H2** project on the banks of the River Clyde, follows the **Peel NRE Protos energy and resource hub** near Ellesmere Port, Cheshire, England".

- On **July 6, 2022**, the Councillors at Cheshire West and Chester gave unanimous approval to the **strategic energy and resource hub** located near Ellesmere Port, Cheshire, England. The **strategic energy and resource hub** will process and treat up to **367,500 metric tonnes** of plastics and mixed recyclables a year (**Plastic Park**). The approval for the **Plastic Park** includes approval for the development and deployment of a **materials recycling facility (MRF)**, **Plastics Recycling Facilities, One and Two**, a **Polymer Laminate Recycling Facility**, and a **hydrogen refuelling station**.
- **Tasmanian future fast-lane**: Over the weekend of **July 9 and 10, 2022**, it was reported that **HIF Global** (a Porsche "vehicle") intends to develop a **Future Fuels production facility** in the State of Tasmania, Australia.
- **Neste Porvoo refinery funding support from the EU Innovation Fund**: On **July 12, 2022**, **Neste** [announced](#) that it had been awarded grant funding from the **EU Innovation Fund** for the development of chemical recycling facilities at its Porvoo refinery – **Project Pulse** (see [Editions 31](#) and [39](#) of Low Carbon Pulse for previous coverage). The recycling facilities will pre-treat and upgrade plastic waste, with the resulting fluid being used to produce Future Fuels or as feedstock for chemicals.
- **Sunfire on target**: On **July 13, 2022**, [Sunfire GmbH](#) [announced](#) that it was the "first" Green Hydrogen corporation headquartered in the **EU** to receive funding from the **USD 2 billion Climate Pledge Fund** established by the good folk at **Amazon**.

The CEO of Sunfire, Mr Nils Aldag, said:

"We are proud to welcome on to the most successful companies in the world as our investor. It's great recognition to the first EU-based green hydrogen company to receive investment from Amazon".

- **Shell invests in plastic circular economy**: On **July 13, 2022**, **Shell** announced its ambition to recycle more than **1 million metric tonnes** a year of **plastic waste** at its chemical plants **by 2025**. For these purposes, **Shell** is to invest to develop a **new pyrolysis oil upgrader** at the **Shell Chemicals Park** at Moerdijk, the Netherlands.

The **new pyrolysis oil upgrader** will improve the quality of the **pyrolysis oil**, being the liquid derived from the chemical recycling of plastic waste. The **pyrolysis oil** is suitable for the production of new chemical products at the facilities of **Shell** in the Netherlands and Germany.

As announced, the **new pyrolysis oil upgrader** will have capacity to produce **50,000 metric tonnes** of **pyrolysis oil** a year. With other international energy corporations, **Shell** is progressing towards convergence in the recycling of plastics – long hypothesised, now with us, with chemical recycling of plastic waste (in contrast with mechanical recycling), increasingly seen as economic and sustainable.

- **HyCC launches Project H2era project**: On **July 13, 2022**, it was reported widely that the **Hydrogen Chemistry Company (HyCC)** launched **Project H2era**, a **500 MW Green Hydrogen** production facility, to be developed within the Port of Amsterdam. **HyCC** is a joint venture between **Green Investment Group** and **Nobian**.

In addition to **Project H2era**, **HyCC** is to develop **Project H2ermes** at the Port of Amsterdam in combination with the Port and Tata Steel. (See [Edition 32](#) of Low Carbon Pulse for earlier reporting on the **Project H2era project**.)

- **Waste-to-SAF**: On **July 14, 2022** it was reported widely that a **GBP 1 billion Lighthouse Green Fuels** plant is planned to be developed in the North East of England, as part of the **Net Zero Teesside** industrial cluster, itself part of the **East Coast Cluster**.

The **Lighthouse Green Fuels** project is being developed by **alfanar** (Saudi Arabian engineering group).

The Chief Investment Officer of **alfanar** said:

"With the third largest aviation network on the world, and with one of the world's largest potential off-shore CO2 stores, the UK has the industrial and geological advantages to become a global leader in developing green aviation fuel with the lowest possible emissions using CCS technology. This is why we want to build our first ever SAF plant in the UK by 2027 and two further plants by 2035".

The **Lighthouse Green Fuels** project entered front end engineering design (**FEED**) during June 2022.

- **Project Air**: On **July 13, 2022**, **Uniper** [announced](#) that **Project Air**, a project involving **Fortum**, **Perstorp** and **Uniper** had been successful in its application in the second round of large-scale funding for clean-tech projects under the **EU Innovation Fund**. **Project Air** seeks to move the chemical industry from the use of raw fossil fuels and feedstocks to the use of bio-based fuels and feedstocks, to allow the production of chemicals without the use of fossil fuels and feedstocks.

For these purposes, **Project Air** uses existing technology innovatively, with large-scale industrial application, to produce sustainable methanol, using **CO₂** (and other residual emissions) from **Perstorp's** operations and biogas derived from new facilities, and an electrolyser facility, with the water for electrolysis sourced from wastewater, and the electrical energy to power the electrolysers from renewable sources.

- **Enagas fully committed to hydrogen**: On **July 13, 2022**, the Hydrogen Economist ([pemedianetwork.com](#)) reported that **Enagas** (Spanish natural gas network operator) has earmarked **€800 million** for the development of hydrogen projects by 2030 as part of its plan to position itself as a "reference hydrogen network operator" by 2030.
- **RWE FUREC waste-to-H2 project gets EU funding support**: On **July 14, 2022**, **RWE** [announced](#) that it had been successful in its application in the second round of large-scale funding for clean-tech projects under the **EU Innovation Fund** in respect of its **Fuse Reuse Recycle (FUREC)** project.

The **FUREC** project involves the production for renewable hydrogen from waste arising to displace the use of natural gas. The **FUREC** project is being developed in **Limburg**, the **Netherlands**, and will process and treat residual waste into raw material pellets, with the pellets converted in renewable hydrogen **Limburg's** Chemelot industrial park, with the renewable hydrogen to be supplied to OCI for use in its fertiliser production plants.

The **FUREC** project is designed to produce up to **54,000 metric tonnes** of renewable hydrogen a year.

- **Green Hydrogen Taskforce**: On **July 14, 2022**, [ammoniaenergy.org](#) published an article entitled [New roadmap for ammonia imports into Germany](#). The article touches on the 10 point plan (see [Edition 41](#) of Low Carbon Pulse). The article reminds us of the 10 point plan as follows:

- **Hy2Gen plans €500 million Green Hydrogen project:** On **July 15, 2022**, fuelcellworks.com reported that **Hy2Gen** (headquartered in Wiesbaden, Germany and specialising in the development of future fuel facilities) plans to develop **Green Hydrogen** and **SAF production facilities**, named the **JANGADA project**, with the intention for the **JANGADA project** to be in operation by 2027. The **JANGADA project** is to be located in the municipality of Jänschwalde, Germany, with **Hy2Gen** working with **Euromovement Industriepark GmbH**.
- **Portugal to the Netherlands supply chain:** On **July 18, 2022**, the **Port of Rotterdam Authority** announced that **Engie**, **Shell New Energies NL BV**, **Anthony Veder** and **Vopak** had signed an agreement to study jointly the feasibility of producing and liquifying (in the precincts of the Sines Port) and transporting Green Hydrogen from the Sines Port in Portugal to the Port of Rotterdam in the Netherlands. Assuming that the feasibility of the Green Hydrogen supply chain is proved-up, the plan is for the first cargoes of liquified Green Hydrogen to be shipped from Sines Port to the Port of Rotterdam in 2027.
- **P2X Portugal's planned production:** On **July 25, 2022**, it was reported widely that a new joint venture had been established between **The Navigator Company** and **P2X-Europe**, **P2X-Portugal**, with plans to develop and to deploy a production facility to produce up to **80,000 metric tonnes** of renewable power-to-liquid fuels and feedstock. It is understood that the power-to-liquid fuel will be **SAF**: "*a world class production facility for industrial-scale production of ... carbon-neutral synthetic kerosene, based on green hydrogen and biogenic CO₂*". The planned capital cost of the development of **P2X-Portugal** is projected as **€600 million**.
A number of reports have pointed out that this means of the production of **SAF** requires around 770 MWh of renewable electrical energy generation to produce **SAF** to provide 100 MWh of energy for the power and propulsion of an aircraft.
- **Enel Brazil and Government of the State of Ceará aligned:** On **July 25, 2022**, it was reported widely **Enel Brazil** and the **Government of the State of Ceará** signed a memorandum of understanding to develop a Green Hydrogen production facility within the State. As regular readers of Low Carbon Pulse will recall, 16 MOUs have been signed by the State to allow the development of Green Hydrogen production facilities.
By way of reminder: Edition **35** of Low Carbon Pulse (under **Cactus Energie Verde plans GH₂ in Brazil**) reported that:
"Cactus Energia Verde (**CEV**) plans to invest €5 billion in the development of a Green Hydrogen Project in Ceará, Brazil, to produce 126,000 metric tonnes of hydrogen and 63,000 metric tonnes of oxygen annually.
For these purposes, it is reported that **CEV** had signed a memorandum of understanding (**MOU**) with the Government of Ceará (**GOC**) to develop a Green Hydrogen production facility at the Pecém Port Complex. The renewable electrical energy to power the electrolyzers will be sourced from a photovoltaic solar project (the 2.4 GW Uruque Photovoltaic Park) and wind project (a 1.2 GW offshore wind field currently under construction).
The **MOU** with **CEV** is the 15th MOU signed by the Government of Ceará with prospective proponents (see **Editions 10** and **21** of Low Carbon Pulse): AES, Differential, EDP, Enegix, Eneva, Engie, FFI, Green Energy Cactus, H2Helium, Hytron, Neoenergy, Qair, Total Eren, Transhydrogen Alliance, and White Martins / Linde have all signed **MOUs** with **GOC**".
- **Unigel plans green hydrogen plan in Brazil:** On **July 26, 2022**, h2-view.com reported that **Unigel** (leading chemical corporation) had announced plans to develop a green hydrogen production facility in Brazil, to be located in the **Camaçari Industrial Complex, Bahia State**. As reported, the green hydrogen production facility will be developed in phases, with **phase 1** to produce **10,000 metric tonnes** of green hydrogen a year, from which **60,000 metric tonnes of green ammonia** will be produced, and **phase 2** to produce **40,000 metric tonnes** of green hydrogen from which **240,000 metric tonnes of green ammonia** will be produced. The first phase is to be operational by the end of 2023, with three electrolyzers to be supplied by **thyssenkrupp nucera**.
- **Enel Green Power (EGP) shares Green Hydrogen Factbook:** On **July 28, 2022**, **EGP** published [Green Hydrogen Factbook](#). The publication provides a good summary of key dynamics and issues.
- **MEA Energy Transition Readiness Index released:** On **July 28, 2022**, **Roland Berger** and **Siemens Energy** published [The MEA Energy Transition Readiness Index](#). The report is well-worth a read, with the key takeaways being the scale of capital investment required to realise the potential for **MEA** to exploit its renewable resources, and the need for laws and regulations to facilitate this exploitation (including to provide certainty for investors).
- **CF Industries and Mitsui aligned on ammonia:** On **July 29, 2022**, fuelcellworks.com reported that **CF Industries** (as 52% participant) and **Mitsui & Co., Ltd.**, (as 48% participant) had agreed to work together to develop jointly a clean ammonia production project in the US, Gulf of Mexico. As reported, the project is to produce at least **1 million** metric tonnes of clean ammonia annually, with **CF Industries** acting as the operational partner using CCUS*1 processes to reduce **CO₂** emissions by more than 60% compared to conventional ammonia production processes. The plan is to undertake jointly a FEED study with a view to taking a final investment decision in 2023.
- **Nuclear Hydrogen Initiative:** During final week of July there was considerable coverage of the establishment of the **Nuclear Hydrogen Initiative** (a link to nuclear-hydrogen.org is attached detailing the corporations, governments, institutions and organizations that have signed up to date). The establishment of the **Nuclear Hydrogen Initiative** is a good thing: production of hydrogen from the steam arising from the production of nuclear energy provides an efficient and sustainable means of hydrogen production.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories and HVDC:

This section considers news items that have arisen within the news cycle of July 2022 relating to the development of:

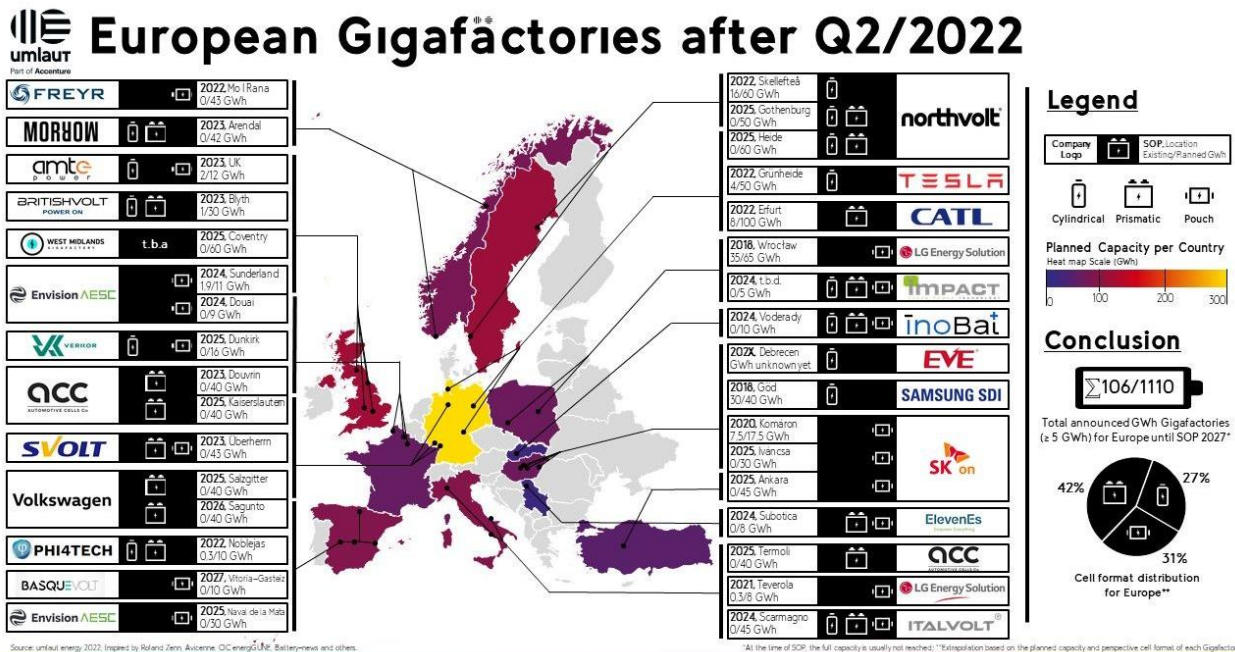
- areas in which: **1. infrastructure will be developed and deployed to support the development and deployment of hydrogen production capacity and use (Hydrogen Hubs), the capture of carbon dioxide, and the consolidation of captured carbon dioxide for storage or use or both (Carbon Clusters); and 2. technologies facilitating energy transition will be concentrated and supported (Hydrogen Corridors and Valleys); and**
- **giga-factories that fabricate and manufacture photovoltaic solar panels (and associated equipment), wind-turbine blades and towers (and associated equipment), electrolysers (and associated equipment), electric batteries and hydrogen fuel cells, and transmission cabling (including HVDC transmission cabling).**

Also the section considers developments in cities to decarbonise (including using waste heat), and to cool, cities. The development of infrastructure at ports and installation and support vessels for off-shore wind developments are considered in the **Ports Progress and Shipping Forecast** section of each edition.

- **EuroAsia Interconnector selects HVDC supplier:** Previous editions of Low Carbon Pulse have covered the **1,208 km, €2.5 billion 2 GW EuroAsia Interconnector** (see Editions **23, 32** and **34**) to connect **Greece (Crete), Cyprus and Israel**. The **EuroAsia Interconnector** is an Important Project of Common European Interest (**IPCEI**), and was provided with **€657** of funding support earlier in 2022 (see **Edition 34** of Low Carbon Pulse).

On **July 4, 2022, EuroAsia Interconnector Limited** announced its choice of **Nexans Norway AS** as its preferred bidder to supply the high voltage direct current cables for the project.

- **Umlaut giga-factory map:** On **July 5, 2022, umlaut company** published its giga-factory map for Europe capturing the Europe giga-factories at the end of Q2 2022.



The map is a great addition to the coverage of the ever-quicken development and deployment of giga-factories.

- **Panasonic Energy Co., Ltd** (the battery business division of the Japanese technology conglomerate) and the **Governor of Kansas, Ms Laura Kelly** had announced jointly that the US State of Kansas had approved the application from **Panasonic Energy** under the State's Attracting Powerful Economic Expansion incentive scheme.

With the approval of the application, it appears likely that **De Soto, Kansas** will be the location for a **USD 4 billion giga-factory** to manufacture **lithium-ion batteries** for use in the Battery Electric Vehicle (**BEV**) market.

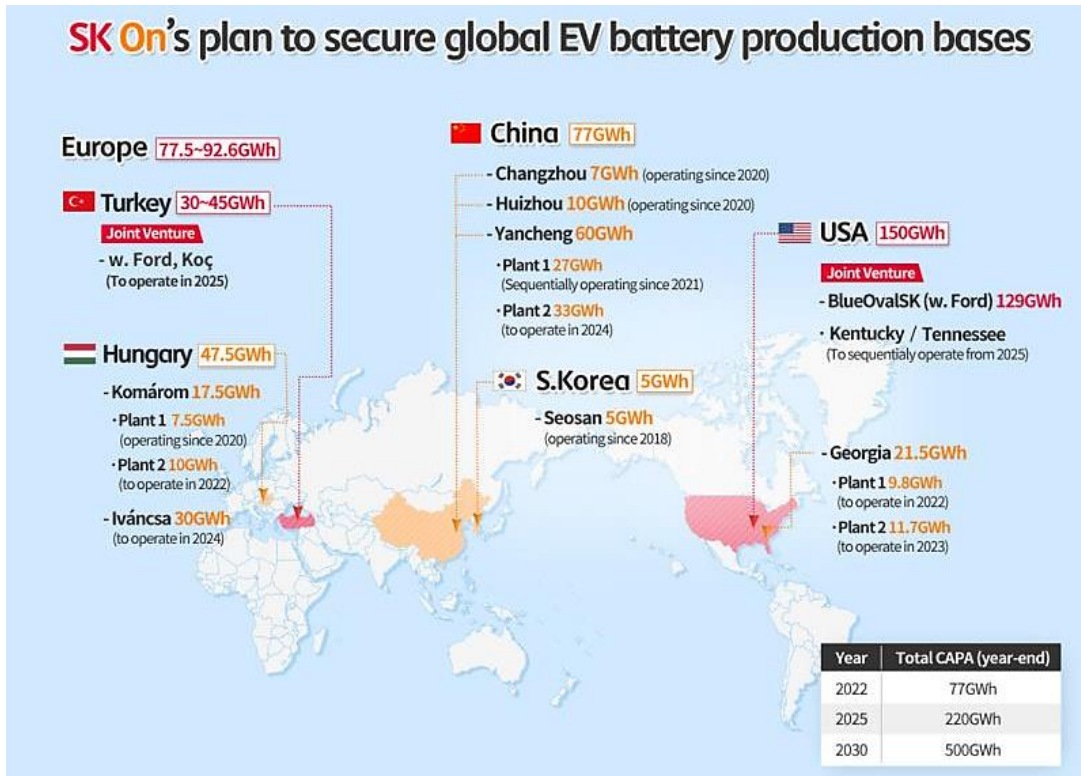
President and CEO of Panasonic Energy, Mr Kazup Tadanobu, said:

"With the increased electrification of the automotive market, expanding battery production to the US is critical to help meet demand".

- **SK On and Ford good to go:** On **July 13, 2022**, it was reported widely **Ford Motor Company** and **SK On** had progressed to establish **BlueOval SK**.

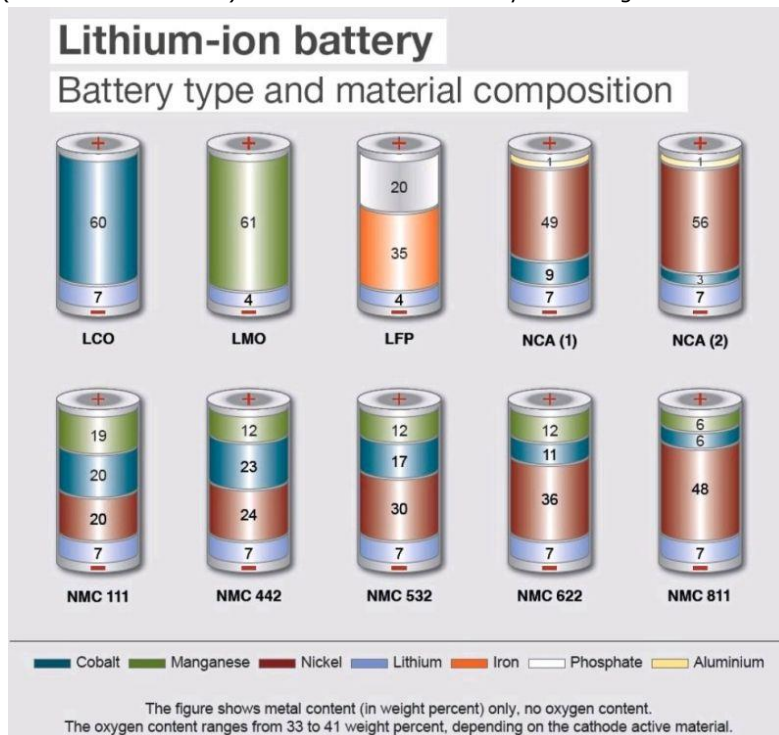
BlueOval SK, currently headquartered in the US State of Georgia, is to be headquartered in **BlueOval City** which Ford is developing in **Stanton, Tennessee**, at which **BlueOval SK's Tennessee EV battery giga-factory** will be developed, with **two further giga-factories** planned for the **US State of Kentucky**.

To regular readers of Low Carbon Pulse will know, **SK** is a leading corporation across all aspects of the energy transition. In respect of **EV** batteries, the map-info-graphic provides a snap-shot of the activities of **SK On** globally.



Source: [Batteriesnews.com](https://www.batteriesnews.com)

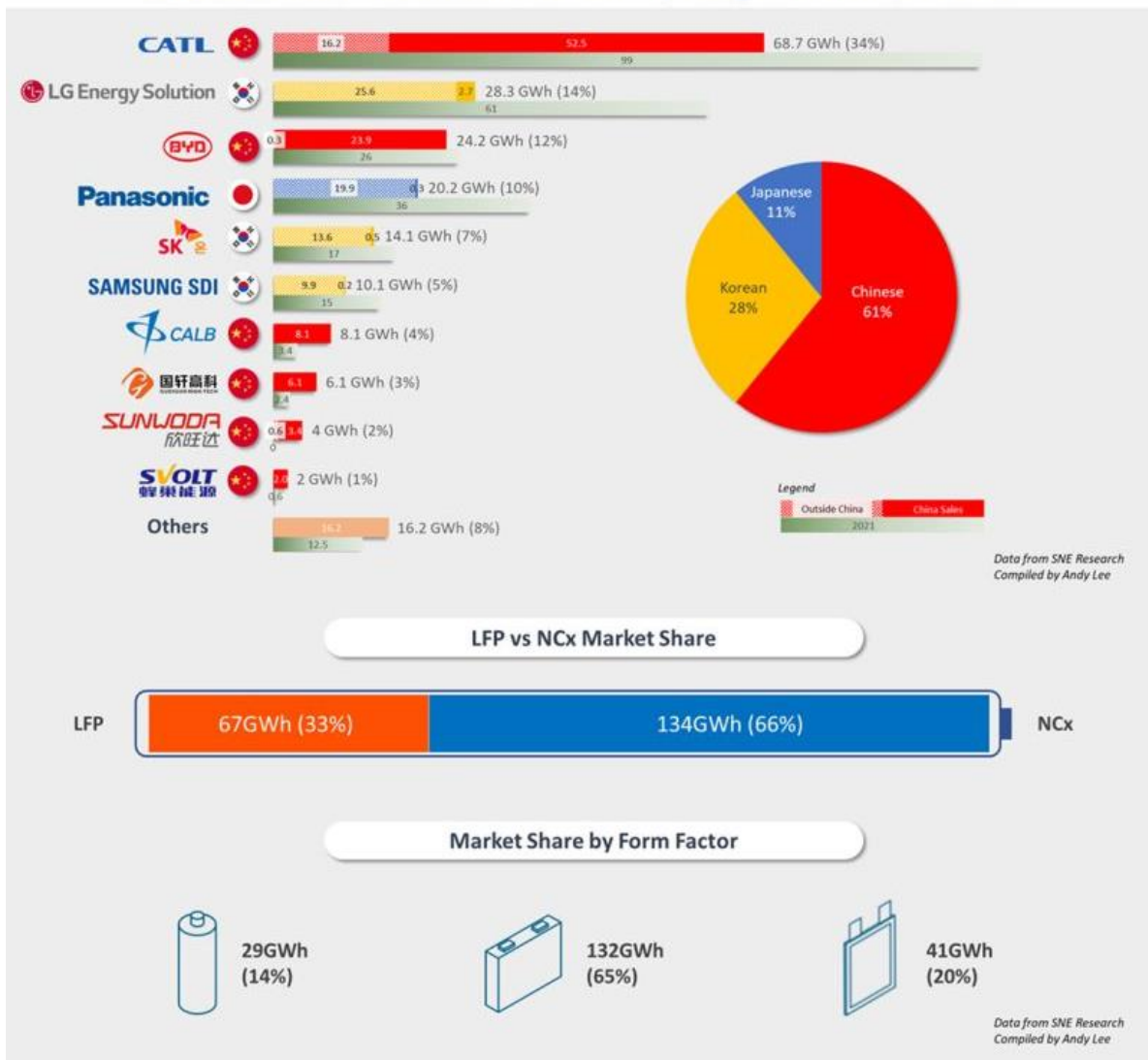
- **A infographic for this age:** On **July 15, 2022**, the good folk at the **visualcapitalist** (elements.visualcapitalist.com) published one of their sensational infographic providing a side by side comparison of lithium-ion battery and fuel-cell technologies.
- **And another ...** : On **July 15, 2022**, the author came across the following infographic from **Thermofisher** indicating the critical materials (metals and minerals) used in difference battery technologies.



Source: [Thermofisher](https://www.thermofisher.com)

- **CATL down Mexico way:** On **July 19, 2022**, it was reported widely that the world leading battery manufacturer, **Contemporary Amperex Technology Co (CATL)** is considering the development of two giga-factories to be located in Mexico – one in Ciudad Juarez, Chihuahua, and other in Saltillo, Coahuila. As reported, the two giga-factories will manufacture batteries for the **Ford Motor Company** and for **Tesla**.
- On **July 19, 2022** the market share of battery manufacturers were released for the first half of 2022. The bar-chart below provides an overview of the market leaders, and their market shares.

1H2022 Global EV Lithium-ion Battery Usage and Market Share



- **Envision and Spain have clear vision:** On **July 20, 2022**, it was reported widely that **Envision** and the **Government of Spain** had signed a Strategic Partnership Agreement (General Protocol for Collaboration) under which Envision and the Government are to work together to develop the first net-zero industrial cluster / park in Europe (**Net Zero Industrial Park**), with the first stage of the **Net Zero Industrial Park** including the development of a giga-factory for the manufacture of batteries for electric vehicles.
- **NeuConnect achieves financial close:** On **July 21, 2022**, the **European Investment Bank (EIB)** [announced](#) that **NeuConnect** (the **730 km, 1.4 GW** subsea interconnector between Germany and the UK) had achieved financial close, with construction of **NeuConnect** to commence during 2022, and operation planned to commence in 2028. **NeuConnect** will traverse Dutch, German and UK waters, running from the converter station at **Fedderwarden**, close to **Bremerhaven, Germany** (operated by Tennet) to the converter station at the **Isle of Grain** (operated by the National Grid) in the **UK**. The converter stations will step-up and step-down the high voltage current to be conveyed by **NeuConnect**, a 525 kV high voltage direct current (**HVDC**) interconnector. The **EIB** is providing **€400 million** in debt funding for the **€2.8 billion project**. The **EIB** led a consortium of 20 lenders. The equity investors are reported to be Allianz Capital Partners, Kansai Electric Power Company and Meridiam ACP. The Japan Bank for International Corporation (JBIC) and the UK Infrastructure Bank policy banks provided funding along with the **EIB**.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

*This section considers news items that have arisen within the July 2022 news cycle relating to the extraction of metals and minerals necessary for the decarbonisation of activities to progress towards achievement of **NZE**, the use of **E-fuels** and **Future Fuels** to power and to propel vehicles used to extract and to transport metals and minerals, and the use of **E-fuels** and **Future Fuels** to process and to treat those metals and minerals. Also this section considers the **Difficult to Decarbonise industries**, including the iron and steel sector.*

- **Gravithy gets off the ground:** On **July 1, 2022**, it was reported widely that **Gravithy consortium** had announced plans to develop a **€2.2 billion 2 million metric tonnes** a year **direct reduced iron (DRI)** plant. The **Gravithy consortium** comprising leading corporations, **EIT InnoEnergy, Engie New Ventures, Forvia, Groupe IDEC** and **Plug**, plans to develop the **DRI** plant at **Fos sur Mer, France**. It is contemplated that the **DRI** produced will be used on-site as feedstock to produce Green Steel or it will be traded as **hot-briquetted iron (HBI)**.

- EC Technical Report on iron and steel:** In the first week of July, the author of Low Carbon Pulse read the **European Commission Joint Research Centre (JRC) JRC Technical Report – [Technologies to Decarbonise the EU Steel Industry](#)**. The technical report is excellent, outlining the challenges with the decarbonisation of the iron and steel industry, the current size and scale of the iron and steel industry, the means of achieving decarbonisation (including hydrogen to produce direct reduced iron, CCS and CCUS, and iron ore electrolysis) and the cost of achieving decarbonisation, all placed in the context of current levels of **GHG** emissions and commitments to reduce them.

The **JRC Technical Report** follows the publication of **[The Sustainable STEEL Principles](#)** (in late June, 2022), which comprises "a set of bank-led commitments to adopt a common measurement and disclosure framework to support the steel industry in forging a pathway to net-zero carbon emissions". There are five **STEEL Principles** reflecting: 1. **S**tandardised assessment; 2. **T**ransparent reporting; 3. **E**nactment; 4. **E**ngagement; and 5. **L**eadership. The **STEEL Principles** were developed within **RMI** (Independent non-profit clean energy development consultant) and five working group banks, led by **Citi, ING, Societe Generale, Standard Chartered** and **UniCredit**.

It is estimated that greening the iron and steel industry in the **EU** will require **25.4 GWh** of renewable energy to produce sufficient Green Hydrogen. Stated another way, this is more than half of the increase in wind power capacity contemplated by the **EU REPowerEU** initiatives. As noted in a number of news items, the **EU** iron and steel sector is lobbying for **31 GW** of renewable electrical energy capacity to be developed and deployed by 2030.
- Lower cases align:** On **July 11, 2022**, **bp** [announced](#) that it is to work with **thyssenkrupp** to advance the decarbonisation of iron and steel production. As announced, **bp** and **thyssenkrupp** are to work together to promote jointly policy setting to support the development of low carbon hydrogen (both Blue and Green Hydrogen) production and green steel production across Europe.

The alignment of **bp** and **thyssenkrupp** is framed in a memorandum of understanding signed by each of them on July 11, 2022. The production of iron and steel by **thyssenkrupp** gives rise to around 2.5% of **GHG** emissions arising from economic activity across Germany. Overtime **thyssenkrupp** (and other producers of iron and steel) will replace blast furnace technology with direct reduced iron or sponge iron produced using direct reduced iron technology and electric arc technology.
- Salzgitter ironing out decarbonisation:** On **July 15, 2022**, the ever-excellent [rechargenews.com](#) published an excellent piece on the plans of leading Germany iron and steel producer, **Salzgitter**, to develop the **€723 million** first phase of its iron and steel decarbonisation project which will use Green Hydrogen as the high-heat temperature source for the production of iron and steel. As reported, the intention is to have developed the first phase by the end of 2023, with two further phases, 2 and 3, with direct reduction plants and electric arc furnaces to be developed to replace blast furnaces. (See **Editions 23, 34** and **36** for previous reporting about Salzgitter.)

In operation, the first phase will reduce total **GHG** emissions arising from economic activity across Germany by 1%. The iron and steel decarbonisation project is called **Salcos (Salzgitter Low CO₂ Steelmaking)**, which uses Green Hydrogen to displace the use of coking coal in blast furnaces (which produce pig iron).
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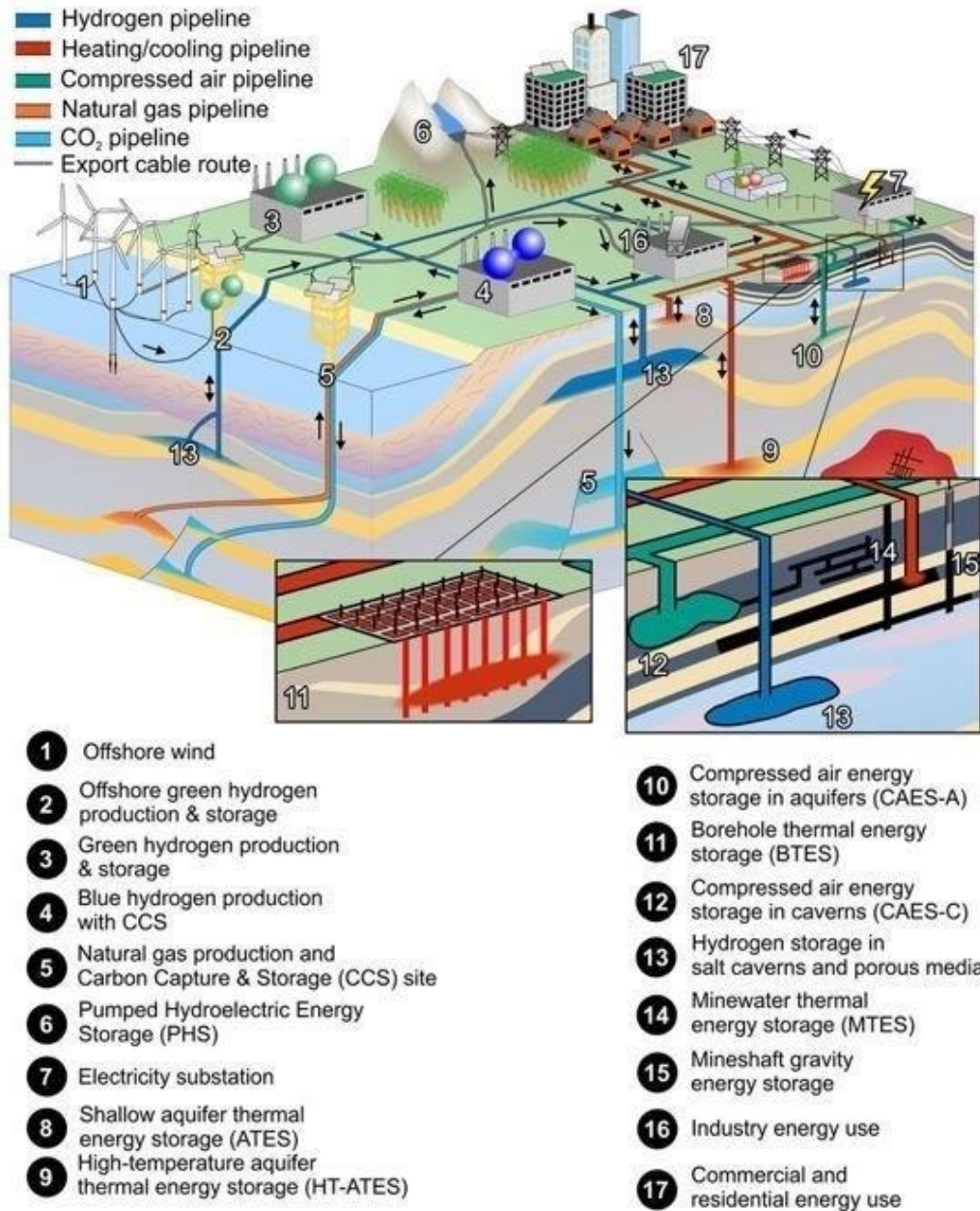
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- H2 Green Steel and Hitachi Energy partner:** On **July 20, 2022**, it was reported widely that **H2 Green Steel** and **Hitachi Energy** are to work together to develop an industrial steel start-up plant located in **Boden, Sweden**. For these purposes, **H2 Green Steel** and **Hitachi Energy** have entered into a memorandum of understanding, under which they will work together with **Hitachi** being a customer for green steel, developing and optimising a supply / value chain to provide distribution channels for green steel, and providing the development and operation of power infrastructure.
- Size and scale of greening iron and steel:** On **July 22, 2022**, the good folk at [rechargenews.com](#) published an excellent piece in the greening of iron and steel - "**[Average EU steel plant would need a whopping 1.2 GW of electrolyzers and 4.5 GW of solar to decarbonise](#)**". As the title of the piece suggests, the size and scale of the greening of the iron and steel industry should not be underestimated. The piece is informed by a report from **Hydrogen Europe [Steel from Solar Energy: A Techno-Economic Assessment of Green Steel Manufacturing](#)**.
- Ford Motor Company and Rio Tinto align:** On **July 26, 2022**, [batteryindustry.tech](#) reported that the **Ford Motor Company** and **Rio Tinto** had signed a non-binding memorandum of understanding (**MOU**) to develop jointly more sustainable and secure supply chains for battery and low-carbon materials to be used in Ford vehicles. As reported, the multi-materials partnership will support the transition of the **Ford Motor Company** to net-zero, with the **MOU** covering critical materials aluminium, copper and lithium. In this context, **Ford Motor Company** will become a foundation customer for the **Rio Tinto Rincon lithium project in Argentina** (see **Edition 37** of Low Carbon Pulse).

Wind round-up, on-shore and off-shore:

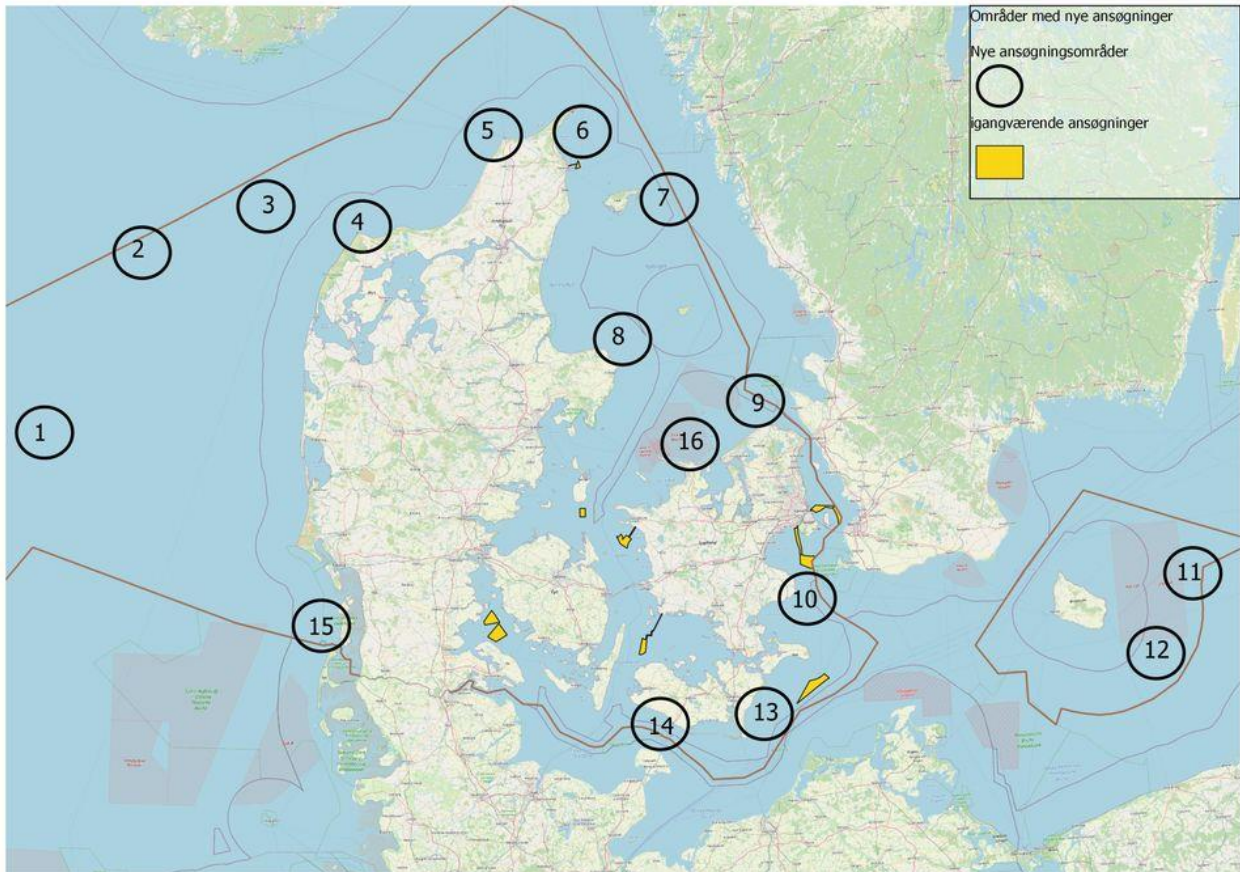
This section considers news items that have arisen within the news cycle of July 2022 relating to the development of wind power generation capacity, on-shore and off-shore (fixed bottom and floating).

- **Australis and wpd AG JV:** On **July 1, 2022**, ([wpd announcement](#)) it was reported widely that **Australis Energy Limited** (see [Edition 14](#) and [28](#) of Low Carbon Pulse) had entered into a **50:50 joint venture** with **wpd AG** (leading on and off-shore wind development corporation) for the purpose of the development and deployment of up to **1.4 GW** of offshore wind field capacity off the coasts of the States of South Australia, Victoria, and Western Australia.
- **Excellent info-graphic for OWF:** On **July 3, 2022**, the author of Low Carbon Pulse came across the following infographic posted by Charley Rattan on LinkedIn. The graphic is excellent, providing a clear sense of the ecosystem necessary to off-shore wind field development.



Source: Geoscience Solutions for Sustainable Offshore Wind Development

- **Corio and JERA align:** On **July 4, 2022**, it was reported widely that **Corio Generation** (part of the Macquarie Group Green Investment Group) and **JERA** (leading utility corporation headquartered in Japan) had agreed to work together for the purposes of off-shore wind field auction process scheduled for Taiwan to take place in Q3 of 2022.
- **Door open:** On **July 5, 2022**, ([offshorewind.biz](#)) reported that from **April 4, 2022** to **June 30, 2022**, the **Danish Energy Agency (DEA)** had received **43** applications to develop off-shore wind fields. Of the **43** applications **received, 16** were **rejected** due to overlap with state land reservations, and of the **27** applications accepted for consideration, most of the applications are from **Andel, Copenhagen Infrastructure Partners** and **European Energy**.



Source: Danish Energy Agency

- **Island deferred:** On **July 5, 2022**, it was reported widely that the **Danish Energy Agency (DEA)** had announced its decision to defer for 12 months the commencement of the tendering process in respect of the development of the energy / power island to be developed in the Danish sector of the North Sea – the **North Sea Energy Island**. (See **Editions 5, 8, 9, 27, 32,** and **39** of Low Carbon Pulse.)
- **EIB loan to Vestas:** On **July 5, 2022**, it was reported widely that the **European Investment Bank (EIB)** had agreed a **€475 million loan facility** with **Vestas** (Danish wind technology corporation). As reported the **€475 million loan** is to **fund research and development, and innovation initiatives**.
- **Rhode Island green:** On **July 7, 2022**, offshorewind.biz reported that the **Governor of Rhode Island, Mr Dan McKee** had signed a bill to produce between **600 MW and 1 GW** of off-shore wind field capacity off the coast of the **State of Rhode Island**. Under the bill **Rhode Island Energy** (electric utility corporation) is required to undertake a competitive procurement process by no later than October 15, 2022.
- **DP Energy and Iberdrola proceed with Inis Ealga Marine Energy Park:** On **July 14, 2022**, 4coffshore.com reported that **DP Energy** and **Iberdrola** had published an **EIAR Scoping Report** for their proposed **1 GW Inis Ealga Marine Energy Park** off the south coast of the Republic of Ireland. Consultation on the **EIAR Scoping Report** is open until **September 21, 2022**. The **EIAR Scoping Report** is said to be a significant milestone on the path to the preparation of a Development Permission for the off-shore wind field development application in due course.
- **Finnish Government approves permits:** On **July 15, 2022**, renews.biz reported that the Finnish Government had approved permits to lease state-owned sea area for **Suomen Hyötytuuli's 500 MW Tahkoluoto 2** off-shore wind field and the **1.3 GW Korsnas** project under development by **Metsähallitus** (a state-owned corporation). The State of Finland will receive rental income under the leases, and the municipalities of Korsnas and Pori will receive payment in the form of property taxes.
- **California takes aim at 20 GW of off-shore wind:** On **July 25, 2022**, it was reported widely that the **Governor of the State of California, Mr Gavin Newsome** had called for a target of **20 GW** of off-shore wind field capacity to be installed by 2045. This represents an increase of **5 GW** in the previous target. The Governor is reported to have said: "*The state's draft [carbon neutrality road map](#) does not go far enough or fast enough. That's why I am pushing state agencies to adopt more aggressive actions, from offshore wind to climate-friendly homes, and to make sure we never build another fossil fuel power plant in California again*".
- **Empire State third round of off-shore wind field solicitation:** On **July 27, 2022**, the **Governor of the State of New York, Ms Kathy Hochul**, launched the third offshore wind solicitation seeking to grant leases for the development of around **2 GW** of off-shore wind field capacity (**NY3**). The procurement process will be administered by the New York State Energy Research and Development Authority (**NYSERDA**): attached is the link to [NYSERDA – 2022 Offshore Wind Solicitation](#). The procurement process is part of the continued progress being made by the **Empire State** towards its goal of the development of **9 GW** of off-shore wind field capacity by 2030 under the **Climate Leadership and Community Protection Act (Climate Act)**. The timeline for the submission of proposals for **NY3** is **December 22, 2022**.

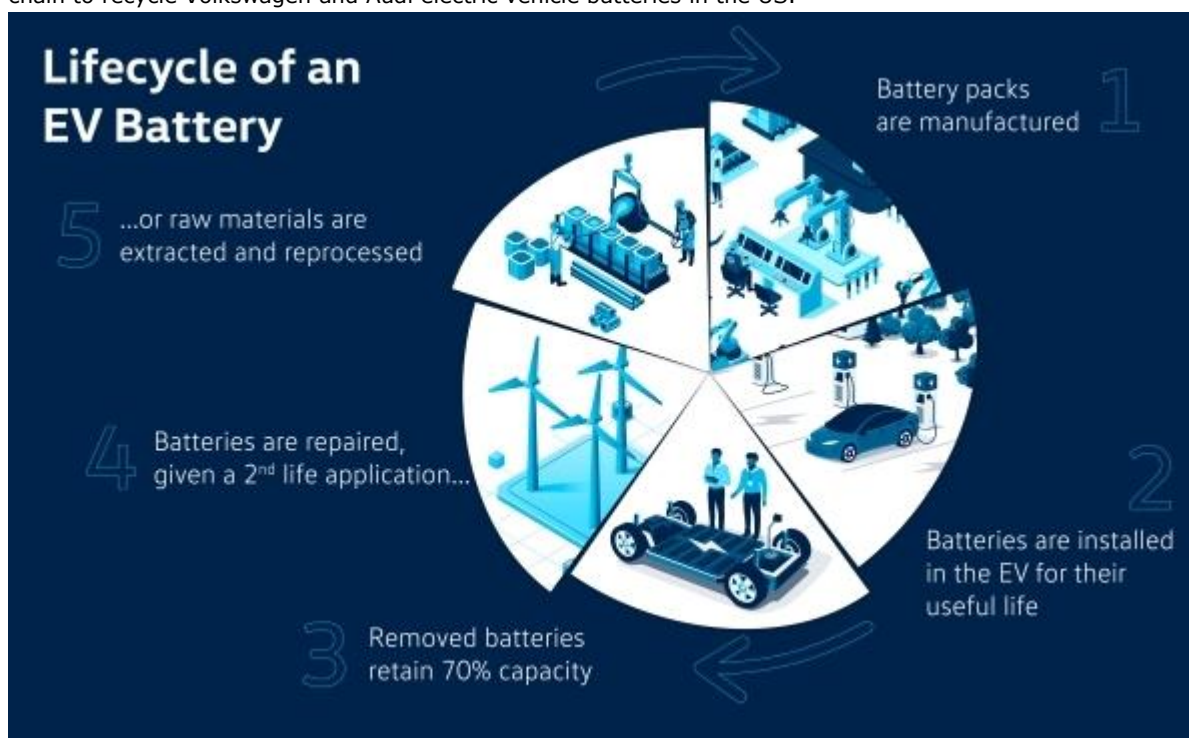
In addition, the procurement of an additional **2 GW** of off-shore wind field capacity, the **NY3** includes procurement of ports for use by off-shore wind projects, manufacturing and supply chain infrastructure, and "meshed ready" off-shore transmission infrastructure development.

- **Republic of Ireland increases offshore wind field target:** On **July 29, 2022**, it was reported widely that the Government of the Republic of Ireland had increased the Republic's offshore wind field development target from **5 GW to 7 GW** by 2030. This increase will allow the Republic to realise the **Sectoral Emissions Ceilings** that have been introduced for the agricultural, building, electricity, industrial, and transport sectors by 2030 – with a reduction of 51% of GHG emissions being targeted by 2030.

Solar and Sustainability (including NZE Waste):

This section considers news items that have arisen within the news cycle of July 2022 relating to the development of solar power generation capacity, on-shore (photovoltaic and concentrated) and floating. Also this section covers news items relating to the development of facilities and technologies to process and to recycle NZE Waste. Also this section considers the treatment of residual NZE Waste.

- **Floating photovoltaic solar and hydroelectric hybrid:** On **July 1, 2022**, the good folk at the **National Renewable Energy Laboratory (NREL)** published [Enabling Floating Solar Photovoltaic Deployment](#) considering the deployment of photovoltaic solar and hydroelectric sourced renewable electrical energy in combination. At a high level, **NREL** found that hybridisation of the two renewable electrical energy sources could reduce the curtailment of photovoltaic solar. The opportunities are regarded a highly prospective for South East Asia.
- **Tetra Pak progress to enhanced recycling:** On **July 3, 2022**, [gulfnews.com](#) reported that **Tetra Pak** had committed to a goal of developing the most sustainable for packaging, to be made solely from recycled and renewable sources, so as to achieve carbon-neutral packaging. This commitment is outlined in [Go Nature, Go Carton](#).
Clarke Creek construction commences: On **July 7, 2022**, [pv-magazine-australia.com](#) reported that construction had commenced of the **Squadron Energy 1.2 GW** hybrid renewable energy precinct in **Central Queensland** (around 150 kms north-west of Rockhampton, Queensland). The **Clarke Creek renewable energy precinct** comprises a **800 MW wind**, and a **400 MW photovoltaic solar**, farm.
 As reported in previous editions of Low Carbon Pulse, the electrical energy from renewable energy precinct is the subject of an agreement between **Squadron Energy** and **Stanwell Corporation** (Queensland Government state-owned generation corporation).
- **VWG and Redwood to develop recycling supply chain:** On **July 13, 2022**, [batteriesnews.com](#) reported that **Volkswagen Group North America, Inc.** and **Redwood Materials, Inc.** are to work together to create a supply chain to recycle Volkswagen and Audi electric vehicle batteries in the US.



Source: [Volkswagen](#)

- **Scatec and H1 Holdings gets to financial close of South African solar portfolio:** On **July 19, 2022**, [renews.biz](#) reported that **Scatec** (51% owner) and **H1 Holdings** (49% owner) had reached financial close in respect of their **540 MW photovoltaic solar** and **BESS** portfolio in **South Africa**: the portfolio to be developed comprises three photovoltaic wind farms and a **225 MW BESS**. The investment is the largest single project investment in the history of Scatec, with a total capex of USD 962 million, including USD 727 million of non-resource project finance debt. The debt providers include The Standard Bank Group as arranger.
 On development the portfolio will be able to dispatch 150 MW under a 20 year power purchase agreement. The portfolio is being developed under the auspices of the [Risk Mitigation Independent Power Producer Procurement Programme](#).

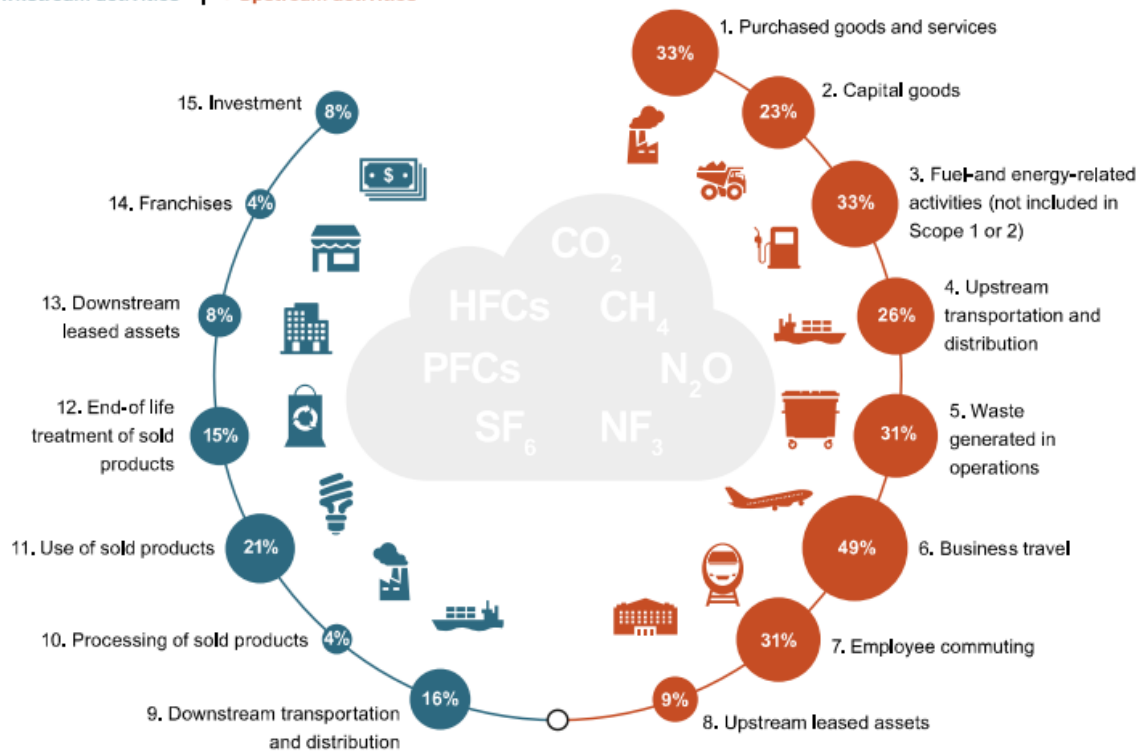
- **RWE looks for hybrid off-shore fields:** On **July 19, 2022**, offshorewind.biz reported that **RWE** is working with **SolarDuck** at its exclusive provider of off-shore floating photovoltaic solar as part of **RWE's** bid for the **Hollande Kust (west) VII** area (see **Edition 40** (Long Form Version) of Low Carbon Pulse for detail). See **Edition 16** of Low Carbon Pulse for reporting on **SolarDuck**.
- **Worthy of note:** While Low Carbon Pulse does not report on investment activity (including merger and acquisition activity) in the ordinary course, it does when a particular transaction is material and significant in a particular market. On **July 18, 2022**, the **Green Investment Group** [announced](#) that it has completed its investment in **Galehead Development**. **Galehead** is stated to have **5 GW** of photovoltaic solar and wind capacity, with co-located energy storage projects, and is developing a further **4 GW** of renewable energy generation (and storage) capacity.
- **HSBC Reports on Scope 3 emissions:** On **July 11, 2022**, **HSBC** published [Scope 3 emissions: The largest piece in the net zero jigsaw](#), authored by **Wai-Shin Chan** and **Polo Heung** on **Scope 3 emissions** (being those that "occur from sources owned or controlled by other entities in the value chain") – being emissions that provide most pieces in the 8 billion three dimensional jigsaw puzzle that we are seeking to finish by 2050. The following infographic gives a sense of the one dimensional jigsaw puzzle at it relates to Scope 3 emissions.

Scope 3 emissions in a nutshell

Scope 3 emissions come from a company's value chain ...

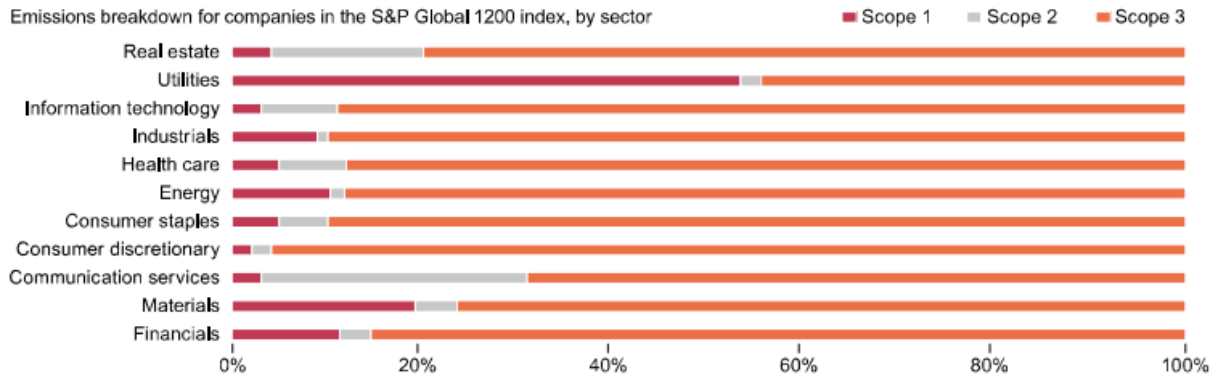
Disclosure rate by each of Scope 3's fifteen categories (FY2020, S&P Global 1200 index)

• Downstream activities | • Upstream activities



... and often represent the greatest share of corporate-related emissions

Emissions breakdown for companies in the S&P Global 1200 index, by sector



Source: [HSBC](#)

- **What a life-time of fossil-fuel consumption looks like:** On **July 22, 2022**, the good folk at the visualcapitalist.com published **Fossil Fuels**. The infographic provides a perspective as to the mass of fossil fuels consumed by folk, on average:



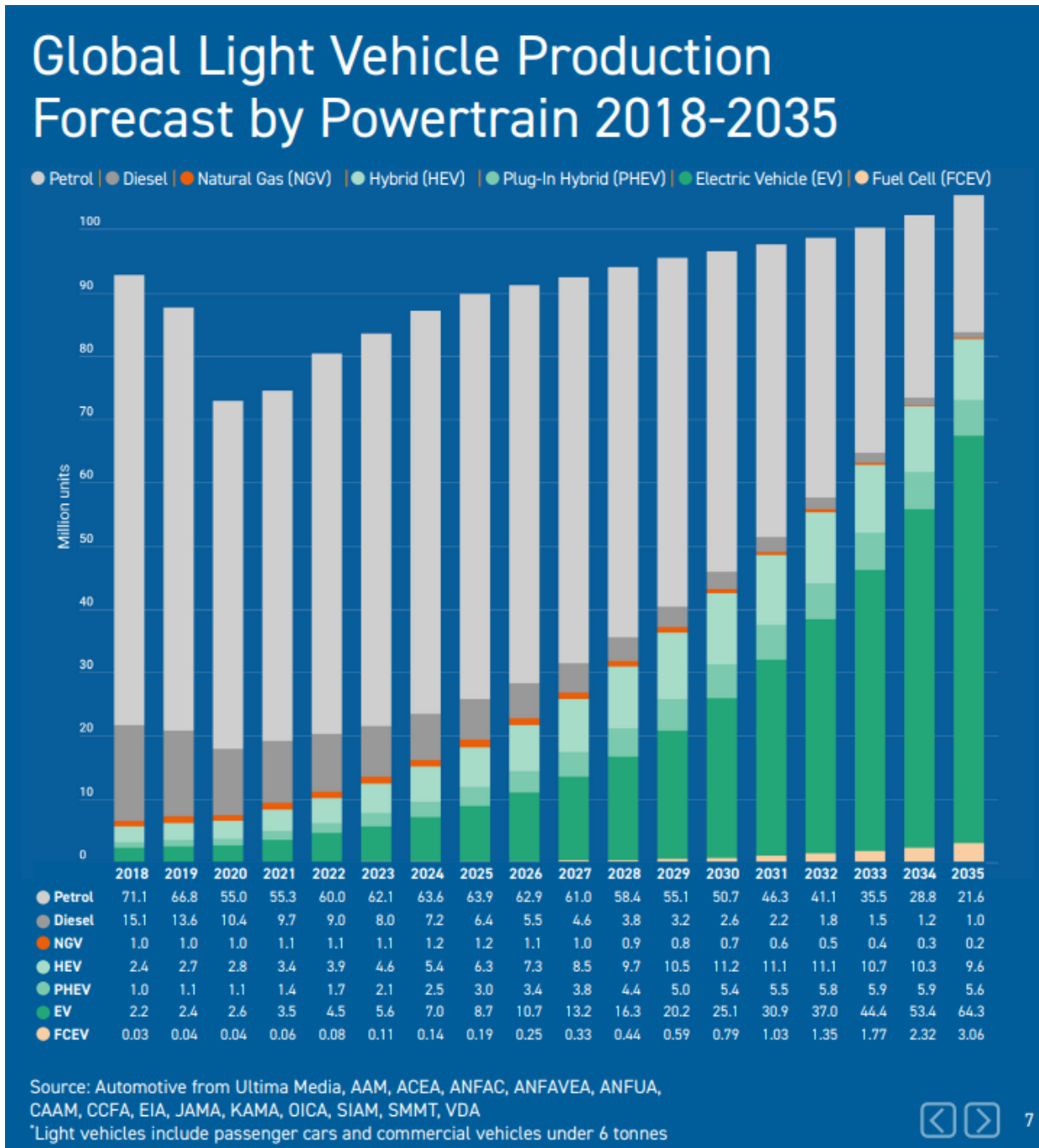
- **Air Products all in:** On **July 25, 2022**, it was reported widely that **Air Products** (one of the Big Three industrial gas producers globally) is to spend **USD 4 billion** over the next five years to reduce the **GHG** emissions arising from its activities. As part of broader plans to achieve **NZE** by 2050, **Air Projects** has set itself a **Third by 30** goal in respect of its Scope 3 emissions, providing a clear carbon intensity goal in respect of those emissions.
- **bp and Iberdrola teaming with projects:** On **July 28, 2022**, **bp** announced that it is partnering with **Iberdrola** (under a strategic collaboration agreement) to contribute to the decarbonisation of the industrial and transport sectors, specifically, together to invest up to **€1 billion** to develop and to deploy **11,000 fast-charging points** by 2030 for battery electric vehicles, and developing hydrogen production capacity on a large scale (with up to **600,000 metric tonnes** of production a year across Portugal, Spain and the UK) and for these purposes boosting renewable electrical energy development.

Land Mobility / Transport:

This section considers news items that have arisen within the news cycle of July 2022 relating to the development and deployment of land vehicles, buses and coaches, cars, industrial vehicles and trucks, and trains.

- **Buses and coaches:**
 - Electric buses:**
 - **Qatar procures fleet in time for World Cup:** On **July 4, 2022**, it was reported widely that **741 Yutong electric buses** had been delivered to Qatar, and will operated during the World Cup to be held later in 2022.
 - **Luxembourg procures midi-bus fleet:** On **July 7, 2022**, [sustainable-bus.com](https://www.sustainable-bus.com) reported that on **July 19, 2022**, **89 Karsan e-Atak eight-metre** electric buses will be mobilised in Luxembourg.
 - **Austria to procure 289 electric buses:** On **July 11, 2022**, it was reported that the Austrian government had committed **€122 million** to support the procurement of **289 electric buses**. Among the procurement are 16 double-articulated trolleybuses and 70 electric battery buses for Vienna. It is understood that Austria has a fleet of 184 electric batter buses, with the aim to have 682 e-buses in operation by 2026.
 - **16 Mercedes eCitaro electric buses head for Trento:** On **July 12, 2022**, it was reported that **Evobus Italia** and **Enel X Italia** had won a tender for **16 Mercedes eCitaro** to be operated in the **Province of Trento, Italy**.
 - **Ebusco to go:** On **July 12, 2022**, it was reported that **Ebusco** had contracted with **Nobina** for the supply of 19 **Ebusco 3.0 12 metre** buses for delivery during 2023.
 - **Agrale MT17.0LE sails for Buenos Aires:** On **July 13, 2022**, it was reported that the **Agrale MT17.0LE** was being shipped to Buenos Aires, Argentina, to commence in service trials for 12 months. The 70 PAX, 12 metre, single deck **Agrale MT17.0LE** is powered and propelled by an **Equipmake** powertrain.
 - Fuel cell buses:**
 - **Ile-de-France Mobilités to procure 47 hydrogen buses:** On **July 12, 2022**, is was reported widely that **Ile-de-France Mobilités** is to procure 47 hydrogen powered and propelled fuel-cell technology buses. This is a departure for **Ile-de-France Mobilités** which currently has a mixed fleet of electric battery buses and bio-natural gas vehicles.

- **Liverpool City Region to get yellow bus:** On **July 12, 2022**, hydrogen-central.com reported that the **Liverpool City Region** is to get 20 state-of-the-art hydrogen powered and propelled fuel-cell technology buses, the procurement of the buses being funded through the Liverpool City Region **Transforming Cities Fund**.
- **Cars** (including taxis and air-taxis):
 - **Macquarie approved for Green Climate Fund:** On **July 4, 2022**, **Macquarie Group** [announced](#) that it had been approved to lead the development of a finance platform to drive the adoption of the electric vehicles (**EVs**) across India. The finance platform will source financing from the private sector to provide leasing and financing options to help address the upfront capital costs of **EVs**, and the impediments around the development and deployment of **EV** charging infrastructure, and to manage uncertainty around performance of **EVs**.
 - During the week beginning **July 11, 2022**, **A.P. Moller – Maersk** published [Regional powerhouses – How logistics will charge EV battery localisation](#). The publication is excellent, providing an economically literate perspective on the shift in technologies used to power and to propel vehicle. The publication is well-worth a read, containing many useful facts and stats, but the high-light for the author of Low Carbon Pulse is the following bar-chart.



Source: [A.P. Moller – Maersk](#)

- **Battery, Fuel Cell and ICE Technology:**

- **China Yuchai hydrogen engine:** On **July 6, 2022**, hydrogen-central.com reported that **China Yuchai International Limited** (leading manufacturer and distributor of internal combustion engines), through its subsidiary, Guangxi Yuchai Machinery Company Limited, had announced its hydrogen fuelled, **heavy-duty ICE, YCK16H**, being a **16-litre, 560 horsepower ICE**.
- **ICE for heavy-duty commercial vehicles:** On **July 8, 2022**, it was reported widely that **Commercial Japan Partnership Technologies Corporation, DENSO Corporation, HINO Motors Limited, Isuzu Motors Limited** and **Toyota Motor Corporation** are to work together to assess the basis of the use of the internal combustion engine (**ICE**) fuelled by hydrogen for heavy-duty commercial vehicles.

E

Lithium Ion BATTERY vs Hydrogen FUEL CELL

Electric Vehicles

BEVs contain a large battery to store electricity.

Onboard charger
Converts AC electricity from power outlets into DC power.

Electric motor
Propels the car using energy from the battery.

Lithium-ion battery
Lithium ions create an electrical current by moving between the negative (anode) and positive (cathode) electrodes.

Cathode	Liquid Electrolyte	Anode
Lithium ions	→	
Charging		
	←	Lithium ions
Discharging		

Key Facts:

- The longest-range BEV is the 2022 Lucid Air Dream Edition, which has an EPA rating of **505 miles**.
- The longest-range FCEV is the 2022 Toyota Mirai XLE, which has an EPA rating of **402 miles**.

Source: U.S. Department of Energy

FCEVs use a hydrogen fuel cell to create electricity. This requires a tank to store hydrogen gas.

Fuel tank
Hydrogen gas is stored in a high-pressure tank. Liquid hydrogen can't be used because it requires cryogenic temperatures.

Exhaust
The only waste product of an FCEV is water.

Battery
Stores energy from regenerative braking.

Electric motor
Propels the car using energy produced by the fuel cell stack.

Fuel cell stack
The fuel cell combines hydrogen and oxygen to generate electricity.

Hydrogen gas (H₂) intake

Oxygen (O₂) intake

Anode | **Catalyst** | **Electrolyte** | **Cathode**

H₂ passes through the catalyst and splits into protons (H⁺) and electrons (e⁻)

Protons (H⁺) pass through the electrolyte

Chemical reaction creates water (H₂O)

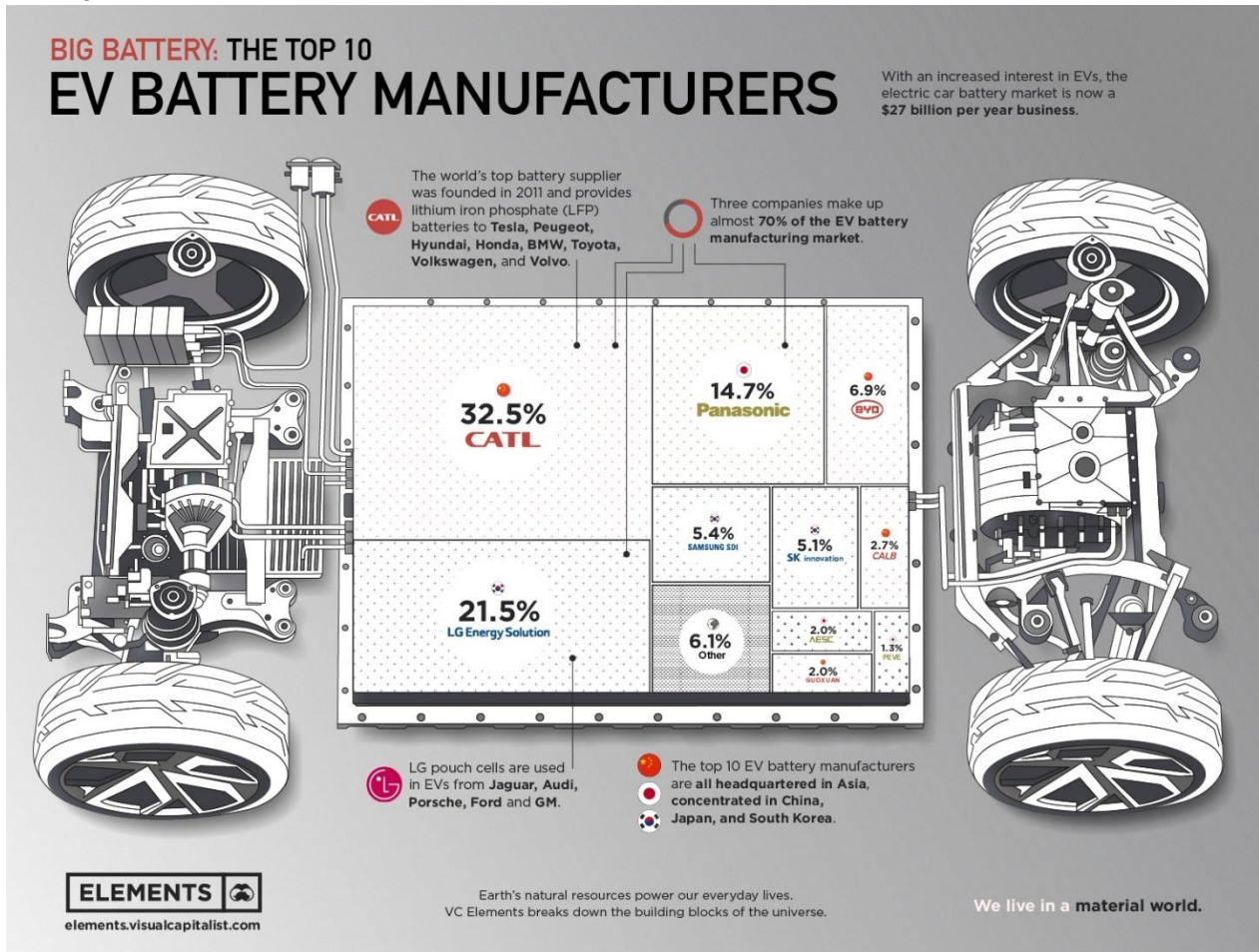
Water emitted through exhaust

Electrons can't pass through the electrolyte, so they take an external path. This creates an electrical current which powers the car.

ELEMENTS

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- **Batteries from biomass:** On **July 22, 2022**, [cnn.com](https://www.cnn.com) reported (under **Volkswagen-backed Northvolt to develop wood-based batteries for EVs**) that **Northvolt** is to work with **Stora Enso** (one of the largest forest owners in the world) to develop batteries (under a joint development agreement) with an anode made from lignin-based hard carbon: as described by **Northvolt** and **Stora Enso**, the lignin is "a plant-derived polymer found in the cell walls of dry-land plants". The feedstock for the plant-derived polymer will be lignin derived from managed forestry. The development of this technology is both exciting and timely.
- **Another graphic on market share:** On **July 24, 2022**, the author of Low Carbon Pulse came across another excellent infographic from the good folk at [element.visualcapitalist.com](https://www.element.visualcapitalist.com) entitled **Big Battery The Top 10 EV Battery Manufacturers**.



- **Industrial Vehicles and Trucks:**

- On **July 6, 2022**, [forbes.com](https://www.forbes.com) reported that **Tevva** (UK headquartered advanced clean vehicle manufacturer) is to launch production of its **7.5 metric tonne** hydrogen fuel-cell powered and propelled electric truck.
- On **July 8, 2022**, [Resilient Group](https://www.resilientgroup.com) announced the **first-ever hydrogen truck deployment in Spain**. As announced the deployment was achieved by **Hydrogenizing BCN** working together with **Butransa, Hyzon Motors, Redexis and Transportes Portuarios**.
- **H2Accelerate new Whitepaper:** On **July 18, 2022**, **H2Accelerate** (see **Edition 26** of Low Carbon Pulse for background) published **Whitepaper – The need for hydrogen trucking**. The **Whitepaper** is balanced and insightful, and as such well-worth a read.
While the author of Low Carbon Pulse finds it difficult to sift to the core of publications, there is one piece in the Whitepaper that is balanced and compelling:
"There are three potential solutions to achieve zero emissions long-haul trucks, which result in zero CO2 tailpipe emissions: 1. Hydrogen fuel cell trucks, 2. Battery trucks with stationary charging, and 3. Battery trucks with catenary charging.
While biofuels, power-to-x type fuels, ... may be able to reduce CO2 emissions from trucking in the short term, these solutions do not mitigate the NOx and particulate emissions associated with internal combustion engines. Hydrogen fuel cell or battery-based solutions will therefore be required in the long term".
- **Toyota plans to roll-out fuel-cell trucks by 2023:** On **July 21, 2022**, [cnn.com](https://www.cnn.com) reported that the Toyota Motor Company, with Hino Motors and Isuzu, and Commercial Japan Partnership Technologies Corporation, is working to roll-out light-duty fuel-cell technology trucks in Japan during 2023.
- **Daimler Truck eEonic production commences:** On **July 22, 2022**, **Daimler Truck** announced that production of the Mercedes Benz **eEonic** had commenced at its Wörth plant, the second battery electric truck from Daimler Truck, the first being the eActros. The **eEonic** is designed and built for inner-city municipal use.

- **Amazon delivering with Rivian:** On **July 21, 2022**, it was reported widely that **Amazon** had commenced the use of **Rivian battery electric vehicles** to make deliveries. The **Rivian delivery vans** are being used in Baltimore, Chicago, Phoenix and Seattle. By way of reminder: In 2019, Amazon committed to purchase 100,000 Rivian delivery vans.
- **Recharging and refuelling infrastructure:**
 - **LOHC HRS:** On **July 2, 2022** it was reported widely that on **July 1, 2022**, a hydrogen refuelling station (HRS) had been opened on Henri-Dunant-Strasse 2 on the Siemens AG campus, in **Erlangen**, [Germany]. The **Erlangen HRS** has been developed and deployed by **H2 Mobility Deutschland** together with its shareholder **Linde**, and **Hydrogenious LOHC Technologies** and **SiemensEnergy**, and supplying electrolytically produced hydrogen and hydrogen in **LOHC** form. (See the [announcement](#) from **H2 Mobility Deutschland** for more detail.)
Hydrogenious LOHC Technologies supplies the **Erlangen HRS** with Green Hydrogen compounded in liquid organic hydrogen carrier (**LOHC**) form – as benzyl-toluene **LOHC**. The use of **LOHC** means that hydrogen comprised in it can be handled as a liquid fuel, being a fuel with high energy density and more readily and safely stored in underground tanks. This is a significant development.
 - **Europe's most powerful EV recharging station launched:** On **July 5, 2022**, **Energy Superhub Oxford** [announced](#) that **Pivot Power** (part of **EDF Renewables**), **Fastned**, **Oxford City Council**, **Tesla Superchargers** and **Wenea** had opened the most powerful **electric vehicle (EV)** charging hub, marking the completion of the **Energy Superhub Oxford**. The **Energy Superhub Oxford** provides ultra-rapid charging for **42** vehicles at one time, with the electrical energy used to charge / recharge being 100% renewable electrical energy.
 - **BP and BOC refuelling plans:** On **July 6, 2022**, [forecourtrader.co.uk](#) reported that **BP** (leading international energy corporation) and **BOC** (leading industrial gas corporation, and part of the Linde Group) are working together to assess how they may work together to develop a network of hydrogen refuelling stations across the UK. **BP** and **BOC** are building on a feasibility study that concluded that in the near term distribution of hydrogen as compressed gas (using road / tube-trailers) was the best option in the UK market, focusing on the heavy-goods vehicle sector.
 - **Daimler Truck AG, TRATON Group and Volvo Group JV:** On **July 8, 2022**, it was reported widely that **Daimler Truck AG**, **TRATON Group** and **Volvo Group JV** had formalised their joint venture to develop and to deploy electric vehicle (**EV**) charging / recharging infrastructure across Europe (**EV JV**). As reported, the **EV JV** intends to install and to operate **1,700 high-performance EV** charging points to be located close to highways and motorways and within logistics hubs for use by the heavy-truck / vehicle sector. The investment contemplated currently is in the region of **€500 million**.
 - **BOC and BP on the road:** On **July 14, 2022**, [h2-view.com](#) reported that **BOC** (part of the Linde Group) and **bp** (leading international energy corporation) had announced that they have agreed to develop and to deploy a hydrogen refuelling station at a bp truck-stop at **Lytton, Queensland**.
BOC will supply and install the state-of-the-art Linde designed and developed hydrogen refuelling station, and **BOC** will supply Green Hydrogen produced at its **Bulwer Island** production facility.
As reported, this will be the first service station in Australia with hydrogen refuelling capacity, and will open later in 2022.
 - **Hynion to install two hydrogen refuelling stations:** On **July 15, 2022**, [h2-view.com](#) reported that **Hynion** (hydrogen refuelling station designed, developer and operator) is to develop and to deploy two high-capacity hydrogen fuelling / refuelling stations at **Västerås** and **Jönköping**, Sweden. The two stations are to be developed with funding support from the Swedish Energy Agency. Each station is reported to have capacity of 1,500 kgs a day.
 - **H2 Energy Europe and Phillips 66 announce JV:** On **July 20, 2022**, [esgnews.com](#) reported that **H2 Energy Europe** and **Phillips 66** had established a **50:50 joint venture (Jet H2 Austria GmbH)** to develop and to deploy a network of fuelling / refuelling stations across Austria, Denmark and Germany. **Jet H2 Austria GmbH** will combine the fuel retail expertise of **Phillips 66** and the hydrogen expertise for **H2 Energy**, with the plan to roll-out around 250 fuelling / refuelling stations by the end of 2026.
 - **Element 2 and Exelby Services on the road:** On **July 21, 2022**, [H2-view.com](#) reported that **Element 2** and **Exelby Services** are to work together to develop and to deploy the UK's first public hydrogen fuelling / refuelling stations for heavy-goods vehicle / truck fleets. As reported, stations are to be deployed at Exelby Services' existing Coneygarth and Golden Fleece service station locations along the A1 (M) (in Yorkshire) and the M6 (in Cumbria) motorways / freeways.
 - **bp opens charging / recharging island:** On **July 27, 2022**, **Daimler Truck** [announced](#) that **bp** (leading international energy corporation) had opened its first high-performance (and to many, ultra-fast) charging / recharging island for medium and heavy trucks in **Schwegenheim, Rheinland-Pfalz, Germany**, operating under the **bp** brand **Aral**. The **Daimler Truck** announcement notes that it had worked closely with **bp** to ensure that the site would meet the needs of European fleet operators.
 - **Shell to open its first hydrogen network in Asia:** On **July 29, 2022**, it was reported widely that **Shell New Energy Company Limited** and **Shanghai Shenergy Innovation and Development Co** had announced a joint venture to develop a network of hydrogen fuelling / refuelling stations in **Shanghai**, with between 6 and 10 stations to be developed and deployed in Shanghai and the Yangtze River Delta within the coming five years.
- **Trains:**
 - **Static testing of bi-mode train:** On **July 7, 2022**, [fuelcellworks.com](#) reported that **FCH2Rail** (a hydrogen powered and propelled train project) led by **Construcciones y Auxiliar de Ferrocarriles (CAF)** was to static test the electrical energy generation system of **FCH2Rail**, which sources electrical energy from hydrogen fuel-cells and from electric batteries (bi-mode). **FCH2Rail** will be a train without **GHG** emissions.
 - **Stadler Flirts:** On **July 21, 2022**, [hydrogen-central.com](#) reported that **Stadler Rail** (Swiss headquartered manufacturer of rolling-stock) had unveiled its hydrogen powered and propelled **FLIRT H2** multiple unit for use for rail passenger transport in the US. In addition to reporting on the **FLIRT H2**, the report recounts that **Stadler**

Rail has developed the battery electric powered and fuel cell train FLIRT train, the EURO9000 model, which is the most powerful hybrid locomotive in Europe.

- **First hydrogen powered and propelled passenger train enters service:** On **July 25, 2022**, it was reported widely that the first hydrogen powered and propelled passenger trains had entered into service on the German regional railway between **Bremervörde** and **Buxthude**, southwest of the city of Hamburg. The trains in service are 14 two-car Coradia iLINT trains manufactured by Alstom at Salzgitter, Germany (see [Editions 27](#) and [28](#) of Low Carbon Pulse). As reported the trains are owned by the German State of Lower Saxony and leased to the operator, **Eisenbahn und Verkehrsbetriebe Elbe-Weser** (itself owned by the German State of Lower Saxony).
- **Romanian Railway Authority (AFR) procuring 12 160-seater trains:** On **July 27, 2022**, [hydrogen-central.com](#) reported that the **Government of Romania** had approved the procurement of 12 160-seater passenger trains powered and propelled by fuel-cell technology as part of a pilot project implemented by **AFR**. The procurement includes "long-term vehicle maintenance and repair services and hydrogen supply".

Ports Progress and Shipping Forecast:

*This section considers news items that have arisen within the news cycle of July 2022 relating to the development and deployment of production and storage capacity, and infrastructure, at ports for **E-Fuels / Future Fuels** (including **Hydrogen Hubs**) and to capture and to store or to use carbon, or both (including **Carbon Clusters**), and the connection of port infrastructure to the hinterland.*

Also this section considers news items that relate to the development of infrastructure at ports, including to allow the development of off-shore wind fields.

• Ferries and other craft:

- **Green City Ferries AB Beluga24 vessel:** On **July 4, 2022**, [batteryindustry](#) reported that **Green City Ferries AB** was expanding its water-borne public transport offering in Stockholm, Sweden, with the development of the **Beluga24** ferry – stated to be the world's first fully emission-free, high-speed, carbon fibre catamaran. For these purposes, **Green City Ferries AB** has contracted with **Enchandia** (Swedish developer of heavy-duty energy solutions for maritime electrification) for the supply of fuel-cell technology.

By way of a reminder: [Edition 34](#) (under **Having a whale of a time**) reported that: "In late January 2022, **Green City Ferries** provided an overview of fast passenger ferries power and propelled by hydrogen, outlining the **Beluga24** – the world's first hydrogen powered and propelled high-speed catamaran ferry. The **Beluga24** has an electric energy option for shorter journeys. Both the hydrogen fuel cell and the electric energy options are designed to carry 150 passengers and 28 bicycles. As announced the first **Beluga24** is to be used in the Stockholm archipelago, with support from the **EU** funding".

- **TECO 2030 fast route:** On **July 4, 2022**, **TECO 2030** (leading technology corporation, including fuel-cell technology) [announced](#) that it is to lead a consortium of Norwegian corporations to develop the world's first hydrogen-powered-and-propelled-high-speed vessel. The consortium comprises **BLOM Maritime** (Marine engineering and maritime service company), **TECO 2030**, and **Umoe Mandal** (leading provider of surface effect ship technology), and the planned high-speed vessel is to carry between 200 and 300 passengers at speeds of up to 25 knots.
- **Green Ports (including infrastructure): Port of Tallinn leading public private partners:** On **July 6, 2022**, it was reported widely that the Port of Tallinn was a founding partner in the Management Team, Steering Group and a Support Group for Hydrogen Valley Estonia. Other founding partners include Tallinn Airport, Alexela, Eesti Energia, Terminal, Tartu University, the Island of Saaremaa, and the Municipalities of Pärnu and Tartu.
- **Saronic Ferries to procure 800 pax Ro-Pax ferry:** On **July 12, 2022**, it was reported that **Saronic Ferries** (Greek ferry operator) had appointed **C-Job Naval Architects** (the Netherlands based design and engineering corporation) to develop the design for a **Ro-Pax ferry** with capacity for 800 pax, and that is to have a fully electric propulsion system. The home port of the **Ro-Pax ferry** will be **Piraeus** (where the batteries for its propulsion system will be recharged), and will ferry vehicles and pax between **Piraeus** and the islands of **Aegina** and **Agistri**.
- **MS Medstraum voyage:** On **July 14, 2022**, [offshore-energy.biz](#) reported that **MS Medstraum** had embarked on its maiden voyage from the Norwegian Fjellstrand shipyard to its home port of Stavanger. From late summer 2022, the **MS Medstraum** is to ferry passengers between Stavanger and Hommersåk.

As reported, the 30 metre **MS Medstraum** is the "world's first fully electric and zero emission fast ferry classed as a high-speed craft".

- **Norled AS takes delivery of second Ro-Pax Ferry:** On **July 22, 2022**, **Sembcorp Marine Ltd** announced that its wholly owned subsidiary, **LMG Marine AS**, had delivered the **Dragsvik**, the second of three battery electric operated **roll-on-roll-off passenger (Ro-Pax) ferries** to **Norled AS**. The **Dragsvik** joins the **Hella** in the **Norled AS** fleet, both **Ro-Pax** ferries have an in service speed of 10 knots, powered and propelled by lithium-ion electric batteries, which are charged / recharged using electrical energy from renewable energy sources. The **Hella** started operating on the **Hella-Vangnes-Dragsvik** run in May 2022.

By way of reminder: [Editions 23](#) and [34](#) of Low Carbon Pulse reported that: "In late July 2021, the **MF Hydra** (styled as the first liquid hydrogen powered ferry) had been delivered. As reported, the **MF Hydra** is 82.4 metres in length, with capacity for 300 passengers and 80 motor cars. On February 2, 2022, it was reported widely that Ballard Power Systems is to supply two of its 200KW FCwave fuel cell modules to Norled A/S, the owner of the **MF Hydra**. As will be apparent from the previous news items, during 2022 the **MF Hydra** will start to serve the Hjelmeland-Skipavik-Nesvik route in Rogaland." And [Edition 37](#) of Low Carbon Pulse reported that: "On **March 16, 2022**, Sembcorp Marine announced that it had completed the fabrication of the first of three zero-emission battery powered Ropax Ferries for Norled AS.

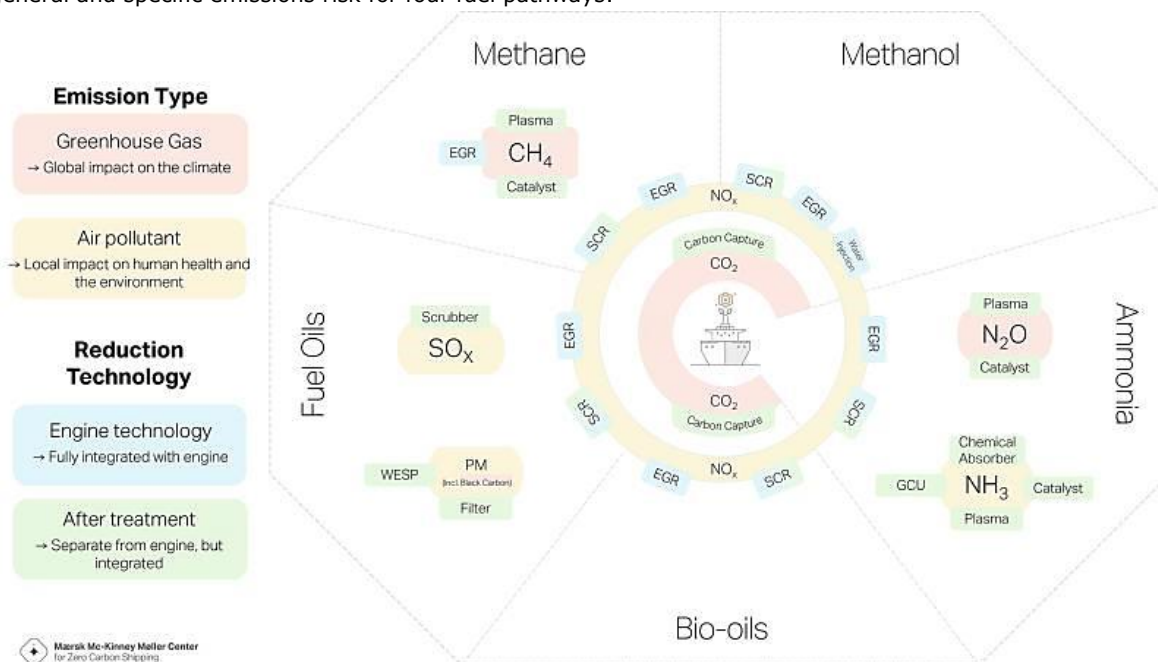
The design of each of the Ropax Ferries has been optimised for the requirements of Norled A/S, with each ferry to be powered and propelled by lithium-ion batteries, and having a back-up battery-diesel hybrid mode. Each battery is to be charged / recharged using renewable electrical energy from hydroelectric sources."

• **Green Shipping:**

- **MPC Container Ships orders methanol powered box-ships:** On **July 4, 2022**, [splash247.com](https://www.splash247.com) reported that **MPC Container Ships** (Oslo based box-shop owner) had contracted for two **dual-fuel-methanol-powered-and-propelled 1,300 TEU** newbuild vessels from Taizhou Sanfu Ship Engineering.
 - **MSC and Fincantieri order hydrogen powered cruise ships:** On **July 6, 2022**, it was reported widely that **MSC Group** and **Fincantieri S.p.A** (leading shipbuilding corporation) are to construct two next generation cruise ships powered and propelled by hydrogen and liquified natural gas (**Explora V** and **VI**), with the hydrogen to power the on-board hotel operations using a 6 MW fuel-cell, and allowing zero-emission operation in port. For these purpose **MSC Group's Explora Journeys**, and **Fincantieri** have signed a memorandum of agreement.
 - **Biofuels be used to ship DHL:** On **July 7, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **DHL Global Forwarding** (part of **Deutsche Post DHL Group**) had signed an agreement with container shipping line **Hapag-Lloyd** for **Hapag-Lloyd** to use advanced biofuels (being biofuels from waste fats, greases and oils (**FOGS**) to produce fatty acid methyl ester (**FAME**), and hydrotreated vegetable oil (**HVO**)) to ship **18,000 TEUs**.
- Elemanta H2 barge in:** On **July 8, 2022**, [h2-mobile.fr](https://www.h2-mobile.fr) reported that the **Elemanta H2** is to be installed in the river port of Rouen, France to provide electrical energy, and hydrogen bunker service, to vessels in dock. As reported, the **Elemanta H2** is able to provide power and refuelling services to container ships, cruise ships and to tankers. The **Elemanta H2** is being developed by a group of leading corporations led by **Hydrogène de France**.



- **Berge Bulk to install Anemoid rotor sails:** On **July 13, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that **Berge Bulk** had agreed with the assisted propulsion provider **Anemoid Marine Technologies** (UK headquartered technology corporation) to for the supply and installation of **rotor sails** on two of its bulkers, the **Berge Neblina** (a 388,000 dwt Valemax) and the **Berge Mulhacen** (a 210,00 dwt Newcastlemax).
- **Wonderfully clear perspective from Maersk Mc-Kinney Moller Center for Zero Carbon (MMMCOC):** On **July 21, 2022**, the good folk at **MMMCOC** shared an info-graphic providing an Emissions Web, describing the general and specific emissions risk for four fuel pathways.



- **AiPs for GTT:** On **July 28, 2022**, [fuelcellworks.com](https://www.fuelcellworks.com) reported that **DNV** had granted to **GTT (Gaztransport & Technigaz)**, the giant French containment system technology provider) approvals in principle (**AiP**) for the design

of a membrane containment system for liquid hydrogen and for the preliminary concept design of a liquid hydrogen carrier. (See [Edition 35](#) of Low Carbon Pulse for related reporting on [GTT](#).)

- **H2Ships project solid start:** On **July 29, 2022**, [offshore-energy.biz](#) reported that **Next Generation Shipyards** was to build a pilot vessel, the **Neo Orbis**, the first vessel in the world to be powered and propelled with hydrogen in solid form as an energy carrier – **sodium borohydride**. The advantage of hydrogen as an energy carrier in solid form is that it has a high-energy-density, and that it is bunkered safely.

Airports and Aviation:

This section considers news items that have arisen within the news cycle of July 2022 relating to the development and deployment of technology at airports and in the aviation sector to decarbonise the airports and the aviation industry.

- **SAF continues to find, and to expand, market:** On **July 7, 2022**, [channelnewsasia.com](#) reported that **ExxonMobil** (leading international energy corporation) had delivered its first sustainable aviation fuel cargo to **Changi Airport, Singapore** under a pilot program. Under the pilot program, **ExxonMobil** is supplying **SAF** to **Singapore Airlines** and to **Scoot**. (See [Edition 35](#) of Low Carbon Pulse.)
- **Neste delivers CORSIA certified SAF to AA:** On **July 12, 2022**, **Neste** [announced](#) that: "For the first time in aviation history a CORSIA batch of sustainable aviation fuel (SAF) was delivered to a commercial airline. Neste, the world's leading SAF producer, delivered a batch of its Neste MV Sustainable Aviation Fuel TM to American Airlines at San Francisco International Airport".

CORSIA stands for **Carbon Offsetting and Reduction Scheme for International Aviation**, being a carbon offset and carbon reduction scheme to lower **CO₂** emissions arising from international flights. **CORSIA** was developed by the International Civil Aviation Organization.

- **SAF continues to find, and to expand, market:** On **July 14, 2022**, it was reported **Alaska Air Group Inc.**, **Microsoft Corporation**, and **Twelve**, had signed a memorandum of understanding to work together to develop the market for sustainable aviation fuel (**SAF**), including derived from re-captured **CO₂**, to work towards the first commercial demonstration flight in the US powered and propelled using **Twelve E-Jet[®]** fuel.
- **Making Net-Zero Aviation Possible:** On **July 14, 2022**, the **Mission Possible Partnership** (sponsored by Energy Transition Commission, RMI, We mean Business Coalition, and World Economic Forum, supported by knowledge partner McKinsey & Corporation), published [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](#).

The publication notes that it builds on others as follows: [Waypoint 2050](#) by the **Air Transport Action Group** and its accompanying **ICF report [Fuelling Net Zero; Report on the Feasibility of a Long-Term Aspirational Goal for the International Civil Aviation CO₂ Emission Reductions](#)** by the **International Civil Aviation Organization**; [Decarbonising Air Transport](#) by the **International Transport Forum** and the **Organisation for Economic Co-operation and Development**; [Horizon 2050: A Flight Plan for the Future of Sustainable Aviation](#) by the **Aerospace Industries Association** and **Accenture**; [2021 Aviation Climate Action Plan](#) by the **US Federal Aviation Administration**; [PtL Roadmap](#) by the **German Federal Government**; [Decarbonisation Road-Map](#) by **Sustainable Aviation for the United Kingdom**; and [Roadmap to Climate Neutral Aviation in Europe](#) by **Transport and Environment**. All are excellent publications, and links to all are included for ease of reference.

The [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](#) provides **11 critical insights** as follows: **1.** Bringing aviation on a path to net-zero emissions by 2050 requires a doubling of historical fuel efficiency gains for aircraft, a rapid roll-out of **SAF**, and market development of novel propulsion aircraft by 2030; **2.** Aviation can comply with a sectoral 1.5°C carbon budget if all levers are pulled. Achieving net-zero by mid-century avoids cumulative **GHG** emissions of **25 to 26 Gt CO₂-e**; **3.** The average annual investments between 2022 and 2050 to get global aviation to net zero is estimated at about USD 175 billion, about 95% of which would be required for fuel production and upstream assets; **4.** Current project pipelines for **SAF** production are insufficient and need to be scaled-up by a factor of 5 to 6 until 2030; **5.** The faster the cost decline in renewable electrical energy generation, the higher the expected market share of Power-to-Liquids (PtL). In contrast, if electrical energy costs do not drop as rapidly, biofuels are likely to dominate the market; **6.** Hydrogen and battery-electric aircraft can make global aviation more efficient starting in the late 2030s and supply up to a third of the final energy demand by 2050; **7.** By 2050, net-zero emission aviation could require an additional **5,850 TWh** of renewable electrical energy, **95 million metric tonnes** of hydrogen, and **12 EJ** of **sustainable biomass**; **8.** Aircraft fuel efficiency gains and operational measures could avoid over 15 Gt CO₂-e of cumulative **GHG** emissions at zero or even negative abatement costs; **9.** Although average fuel costs are increasing in the net-zero scenarios, the cost of flying could remain stable, being counterbalanced by efficiency gains; **10.** Carbon dioxide removal (**CDR**) solutions are needed to remove residual emissions from renewable fuels, but are not a replacement for deep and rapid sector decarbonisation; and **11.** Policy makers must create a level playing field between fossil fuel jet fuel and **SAF**, industry collaboration across the value chain can ramp up **SAF** demand and supply, as well as trigger technological innovation.

The [Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy](#) is outstanding, and is worth-repeated reading and reflection.

- **DAC and carbon credits:** On **July 18, 2022**, **Airbus** [announced](#) that it and a number of major airlines (Air Canada, Air France-KLM, easyJet, International Airlines Group, LATAM Airlines Group, Lufthansa Group and Virgin Atlantic) had signed letter of intention to assess opportunities for the future supply of carbon removal credits that may arise from the use of direct air capture (**DAC**) technology.

DAC and **Direct Air Capture and Storage (DACCS)** are regarded as high-potential technologies. Airbus explains that: "As the aviation industry cannot capture **CO₂** emission releases into the atmosphere at source, a direct air capture and storage solution would allow the sector to extract the equivalent amount of emissions from its operations directly from the atmospheric air". The continued embrace of **SAF** and the prospective embrace of **DAC** and **DACCS** by the aviation sector, combined with continued development of hydrogen technology to power and to propel aircraft, illustrates that the aviation sector provides a large and ready market for **NZE** initiatives.

- **Airbus joins hydrogen infrastructure fund:** On **July 21, 2022**, **Airbus** [announced](#) that it had joined the "world's largest" hydrogen infrastructure investment fund (the **Hy24 Fund**). The move by **Airbus** underlines its commitment to the greening of aviation, and the attendant need for the development of infrastructure and supply from Green Hydrogen production facilities globally.
AA purchases SAF from Gevo, Inc: On **July 22, 2022**, [stattimes.com](#) reported that **American Airlines** and **Gevo, Inc.** (a biofuels production corporation) had signed an agreement under which **Gevo, Inc.** is to sell **500 million gallons** for **SAF** to **American Airlines** over five years.

Low Carbon Pulse - Edition 46

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 46** of **Low Carbon Pulse** – sharing significant news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from **Monday August 1, 2022** to **Sunday August 14, 2022**.

Click [here](#) for the **First Compendium of Low Carbon Pulse** (containing **Editions 1** to **28**, covering the period from October 6, 2020 to October 5, 2021), [here](#) for the **Second Compendium of Low Carbon Pulse** (containing **Editions 29** to **38**, covering the period from October 7, 2021 to March 31, 2022), and [here](#) for the **Third Compendium of Low Carbon Pulse** (containing **Editions 39** to **45** covering **April, May, June, and July 2022**).

A change in approach:

Given changed circumstance, **Low Carbon Pulse** is going to take a different form. As currently planned, each Friday a summary of the key news items of the week will be published, more in the nature of a headline publication, with monthly articles going into further detail on decarbonisation and **NZE** initiatives, with the first such article to be on **NZE Waste**.

Two weeks of progress:

• Week-beginning August 1, 2022:

- **Inflation Reduction Act of 2022: Edition 45** of **Low Carbon Pulse** reported on the **Inflation Reduction Act of 2022**, commonly referred to as the **Manchin-Schumer Act**, noting that the **Act** had breathed life back into the decarbonisation agenda of the **Biden Administration**, and, that, if the **Act** became law, it would provide a clear pathway for the US to reduce its **GHG** emissions by 40% by 2030 (or 2.4 giga-tonnes reduction in **CO₂-e**).

On **August 5, 2022**, Senator Kyrsten Sinema (D-Arizona) was ready "to move forward" to support the **Manchin-Schumer Act** in the Senate. Following the "move forward signal" from Senator Sinema, over the weekend of August 6 and 7, 2022 the Senate debated the **Manchin-Schumer Act**.

On **August 7, 2022** (after an all-night sitting), the **US Senate** approved the **Act**. On **August 12, 2022**, the **Act** was approved by the House of Representatives, and now goes to President Joe Biden for signature. A link to the Statement by President Biden is to be found at <https://whitehouse.gov> under [Statement by President Biden on Senate Passage of the Inflation Reduction Act](#).

The passing of the **Inflation Reduction Act** is good news for the US and globally.

- **World Cities Summit:** Between **July 31, 2022**, and **August 3, 2022**, the **World Cities Summit** took place at the Marina Bay Sands, Singapore, under the theme of **Liveable and Sustainable Cities: Emerging Stronger**. For those in attendance, the conference was regarded as worthwhile in this increasingly important area.
- **Week-beginning August 8, 2022:** In addition to the news articles covering the **Manchin-Schumer Act**, at the start of the week (and for a good portion of the week), India continued its progress its policy setting, with the Lower House of the Indian Parliament passing the **Energy Conservation (Amendment) Bill** on **August 8, 2022**. This occurred five days after the Union Cabinet adopted a revised nationally determined contribution (**NDC**) (on **August 3, 2022**) committing to reduce the emissions intensity of GDP by 45% by 2030 compared to 2005 (a 10%

increase on the previous commitment), a reduction of 1 giga-tonne of **CO₂-e**, and that 50% of its cumulative installed electrical energy capacity will be from non-fossil fuel-based sources by 2030, or **500 GW** by 2030.

While India has yet to reach peak **GHG** emissions, ahead of **September 23, 2022** (the date for revised **NDCs** to be reported to the United Nations Framework Convention on Climate Change) and **COP-27**, the revised Indian **NDC** may be regarded as good news.

74 days to COP-27:

As of **August 17, 2022**, there will be **74** days to go to the commencement of **COP-27** to be held in **Sharm El-Sheikh, Egypt** between **November 6/7 and 18, 2022**. As was the case in 2021 (see **Editions 23, 25, 26, 27 and 28**) ahead of **COP-26** held in Glasgow, Scotland, ahead of **COP-27** Low Carbon Pulse will commence coverage of key themes and issues in respect of which progress needs to be made at **COP-27**.

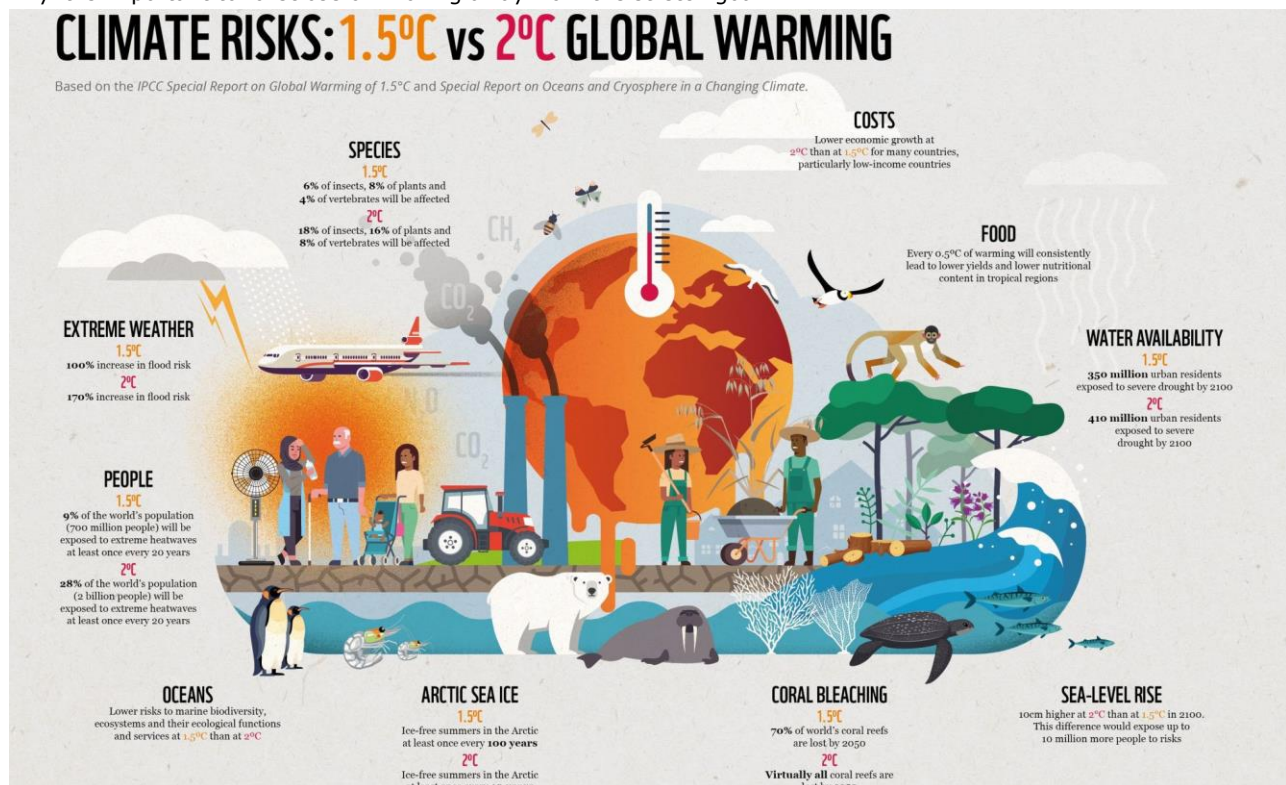
The overarching theme for **COP-27** is that Egypt will work to make **COP-27: "a turning point in international efforts to coordinate with all parties, for the benefit of Africa and the entire world"**.

In this context, it is noted that by **September 23, 2022**, countries that are parties to the Paris Agreement are scheduled to submit their updated nationally determined contributions (**NDCs**). The **UN General Assembly (UNGA)** is meeting from **September 13, 2022**, to **September 27, 2022**, and **New York Climate Week (NYCW)** is taking place from **September 19, 2022**, to **September 25, 2022**. It might be expected that **NDCs**, and progress on them, will be a focus at both the **UNGA** and **NYCW**.

Progress at **COP-27** will be more likely, and more viable, if informed by updated **NDCs**. Continuing a theme identified some time ago, **GHG** emission reduction commitments are required at an increased, and at a faster, rate.

One of the themes that emerged ahead of **COP-26**, and did not gather momentum (thankfully) during **COP-26**, was whether it was necessary to continue commitment to the Paris Agreement stretch goal of limiting the increase in global average temperatures to a **1.5°C** or to move to a point somewhere between **1.5°C** and **2°C**.

It is hoped that this theme does not re-emerge ahead of **COP-27**. The following infographic provides some sense of why it is important to foreclose on moving away from the stretch goal.



For a summary of the infographic in narrative form, the reader can click through to **The Urgency of 1.5°C** at <https://wwf.panda.org>.

Vale those lost:

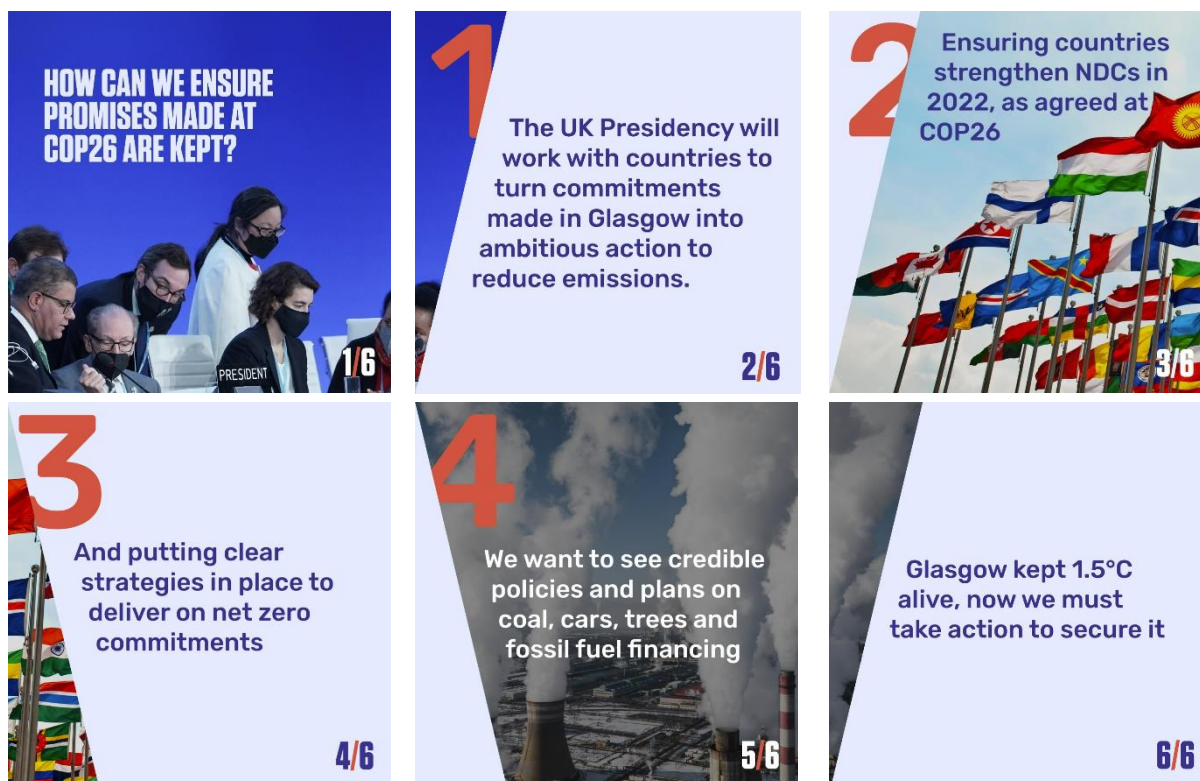
Our continued condolences for those lost in the conflict in Ukraine, and safe-haven for those displaced.

Legal, Policy Setting and Regulatory highlights, and Helpful Publications:

- **Through the portal, Green Hydrogen country by country:** On **August 5, 2022**, the good folk at **GH₂ Green Hydrogen Organisation** published **The GH₂ Green Hydrogen Portal** (<https://gh2.org/countries>) which provides an overview of announced policies, roadmaps and strategies (and accompanying targets) by country – two clicks and you are there!
- **Historic day for human rights and healthy planet:** On **July 28, 2022**, the **UN General Assembly** adopted a resolution to recognise that everyone, everywhere, has a human right to live in an environment that is clean, healthy and sustainable. A link to the UN [press release](#) is attached. As at August 18, 2022, the text of the official resolution had not been uploaded.

- World Economic Forum ask GH2 question:** On **August 10, 2022**, the **World Economic Forum** asked **What's stopping the world from using more green hydrogen?** (at <https://www.weforum.org>). In answering the question, the good folk at the **World Economic Forum** note that while 45 countries are devising or have published hydrogen plans, roadmaps and strategies (and policies), the high production costs of Green Hydrogen (**GH2**) do not yet justify the demand side making investment decisions to shift to the use of **GH2** (sufficient supply of **GH2** at an appropriate price is needed). In this context, multi-faceted policy settings are needed to allow the development of sufficient supply at an appropriate price to encourage, to promote, and, in some cases, to force, a shift to the use of **GH2** is required. While cost of production, and resulting price, is at the core of the answer, it is important to add that a fleet of **GH2** carriers is required to allow the development of a global trade in **GH2**, and an increased fleet of ammonia carriers. None of these concepts are new, they are well-known and understood.

On **August 12, 2022**, the following six slides were published, and provide a helpful reminder of the resolution that emerged from **COP-26**, and that continues to be required, critically, the need to realise the benefit of having kept **1.5°C** alive at Glasgow.



Climate change reported and explained:

- Extreme weather events:** Extreme weather events have continued to be reported during the first two weeks of August, 2022.

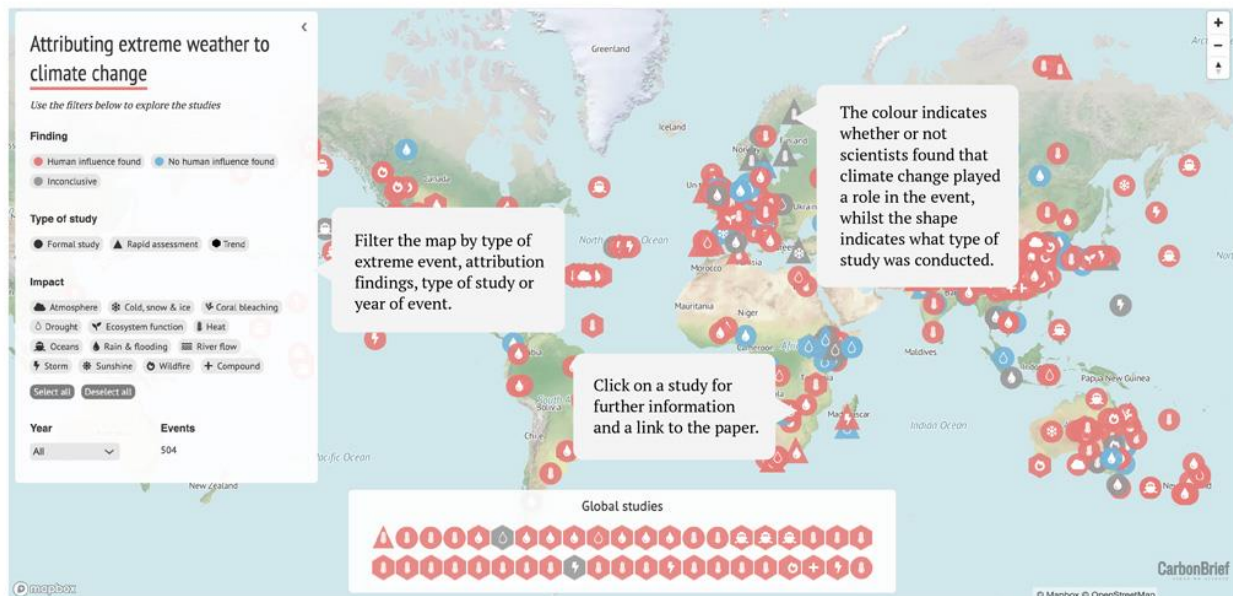
The **International Panel on Climate Change (IPCC)** defines an extreme weather event as follows:

"An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme".

It is fair to say that North America, North Africa, India and Europe, and the **PRC**, have been experiencing **extreme weather events**, and in many instances those extreme weather events, having persisted, may be characterised as **extreme climate events**. The climate system has changed, and continues to change.

- NOAA July Report:** On **August 10, 2022**, the **US National Oceanic and Atmospheric Administration (NOAA)** published its **July Report**. The headline from the **July Report** is that average temperatures across the Lower 48 states of the US in July 2022 were 76.4°F, 2.8°F above the 20th century average, and ranking the third warmest July in 128 years.
- NZ has a plan:** On **August 3, 2022**, **The Guardian** (at <https://www.theguardian.com>, under [New Zealand releases its first national plan to protect against climate-driven disasters](#)) reported on the first national plan for New Zealand to prepare for fires, floods and rising sea-levels that are expected as a result of climate change. The plan was published on **August 3, 2022**, and a link to it is [attached](#) (the **Climate Adaptation** plan). The **Climate Adaptation** plan is described by The Guardian as a sprawling document, providing a roadmap to seek to protect cities, cultural treasures, and infrastructure. It might be expected that climate adaptation plans will become the norm.
- Too many Hot Spots:** On **August 4, 2022**, **Carbon Brief** (at <https://www.carbonbrief.org> under **Mapped: How climate change affects extreme weather around the world**) reported on **extreme event attribution** and that

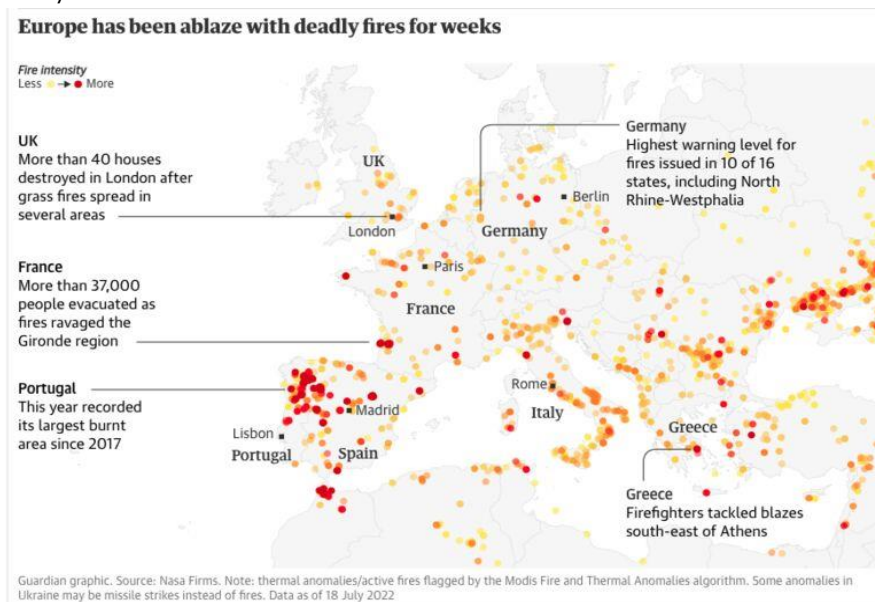
it has mapped every **extreme weather attribution** study published to date. As interesting as the mapping are the following findings: **1. 71% of 504** extreme weather events and trends mapped were found to be made more likely or more severe by human induced climate change; **2. 9%** of events and trends mapped were found to be made less likely or less severe by human induced climate change; **3. Of the 153** extreme heat events assessed by scientists, 93% were found to be more likely or more severe by human induced climate change; and **4. Of the 126** flooding or rainfall events studied, **56%** were found to be more likely or more severe by human induced climate change. The map is included below.



- **Too Hot to Handle:** On **August 5, 2022**, the **UNFCCC** (at <https://unfccc.int/blog/too-hot-to-handle>) reported on the incidents of forest / wildfires across the northern hemisphere during this summer.

In Europe, France, Greece, Italy, Portugal and Spain have all experienced record high temperatures, and the inevitable resulting forest / wildfires, to the end of July affecting around **515,000 hectares** of land. As outlined in previous editions of Low Carbon Pulse, fires reduce **CO₂** absorption capacity and increase the mass of **CO₂** released to the climate system, each exacerbating climate change.

The conditions experienced during extreme weather events involving high temperatures are invariably accompanied by rainfall deficit, and, if those events, persist they will give rise to soil moisture deficit and flora distress, from which recovery is necessary.



In **Russia** more than 6,000 forest / wildfires had started by the end of June, covering **2 million acres** (or 810,000 hectares) of land, predominantly in the far east and in Siberia.

In the **US** multiple states have been fighting forest / wildfires, with upwards of **5.5 million acres** (or 2.225 million hectares) having been the subject of fire during 2022 to August 5, 2022 (with around **3 million acres** in the State of Alaska), which is 70% more than the 10 year average.

The article from the **UNFCCC** notes that while the forest / wildfires impact developed countries, forest / wildfires are more common and have a greater impact in developing countries. Forest / wildfires start due to a number of factors,

including high-heat temperatures, and a lack of moisture in grasses and trees, and other flora. "Add longer, warmer and drier summers and it is no surprise that we are seeing more frequent, and longer-lasting wildfires across the World". The article ties back to a press release from the **UNFCCC** on February 23, 2022, [Number of Wildfires to Rise by 50% by 2100 and Governments Are Not Prepared, Experts Warn](#), outlining the findings from a report from the **UN Environmental Programme (UNEP)** and **GRID-Arendal** titled [Spreading like Wildfire: The Rising Threat of Extraordinary Landscape Fires](#).

The focus during the summer months of 2022 has tended to be on forest / wildfires. Readers will recall that during the summer of 2021 the focus was on flooding, in particular flooding in Northern Europe arising from rainfall. One cause of flooding that does not receive the same level of focus is flooding that arises from rising sea-level, no doubt because it is not caused by an extreme weather event. By way of reminder, in February 2022 the **NOAA** published (at <http://oceanservice.noaa.gov>) an excellent publication entitled [2022 Sea Level Rise Technical Report](#), providing an excellent insight in to the nature of flooding that is likely to occur as sea-levels rise.

- **Sea ice cover for July 2022:** During the first week of August, **Copernicus – Europe's eyes on Earth, Climate Change Service** (at <https://www.copernicus.eu>) outlined the key findings from its observations during July 2022. The headlines being that:
 - Antarctic sea ice extent reached is lowest value for July in the 44-year satellite data record, at 7% below average;
 - The Southern Ocean had widespread areas of below-average sea ice; and
 - Arctic sea ice extent was 4% below average, and ranking as the 12th lowest for July in the satellite data record.

Middle East including GCC Countries:

- **Oracle Power Green Hydrogen green light:** On **August 4, 2022**, it was reported widely that **Oracle Power Ltd** (listed on the AIM) had announced that the Directorate of Alternative Energy of the Government of Sindh, Pakistan, had confirmed that it was to issue a Letter of Intent to **Oracle Power** in respect of the development of a **1.2 GW photovoltaic solar** (700 MW) and **wind** (500 MW) project to provide renewable electrical energy to a **400 MW electrolyser** to up to **55,000 metric tonnes** of Green Hydrogen a year.

As reported, the **Oracle Power** is to develop the Green Hydrogen production facility in joint venture with Sheikh Ahmed Dalmook Al Maktoum, with the Sheikh participating as to 70% and Oracle Power as to 30% in the joint venture. (See **Editions 29** and **35** of Low Carbon Pulse for earlier coverage of the Oracle Power project.)

- **UAE battery recycling centre to open:** On **August 4, 2022**, the **Khaleej Times** (at <https://khaleejtimes.com>, under [UAE's first used battery recycling centre to open in Ras Al Khaimah](#)) reported that **Royal Gulf Industries** is to add a state-of-the-art lead acid recycling unit to its industrial ecosystem, with the unit to be developed in **Ras Al Khaimah Economic Zone (RAKEZ)**. The unit will have capacity to recycle up to **35,000 metric tonnes** of used lead batteries annually, from which **21,500 metric tonnes** of **lead ingots** and **2,400 metric tonnes** of **plastic granules** will be derived. With this capacity, the unit will recycle around **58%**, by mass, of **lead acid battery waste** arising in the **UAE**.
- **UAE plastic recycling facility progressing to FEED:** On **August 4, 2022**, **Quantafuel** announced (at <https://www.quantafuel.com>, under [Quantafuel, DUBAI Holding and BASF sign FEED agreement for plastic recycling in Dubai](#)) that after a six month feasibility study, during which the main design parameters were settled, and the feedstock and site were secured, the chemical plastic recycling facility in Dubai, UAE, is now entering FEED. A final investment decision to proceed with the development of the chemical plastic recycling facility is expected during Q1 of 2023. The chemical plastic recycling facility will be a plastics-to-liquid (**PtL**) facility. It is hoped that the concept of **PtL** will be heard and written increasingly over the coming years.
- **Aramco and SABIC blue light:** On **August 5, 2022**, it was reported widely that **Aramco** and **SABIC Agri-Nutrients Company** had obtained the first certification, globally, for Blue Hydrogen and Blue Ammonia, with each corporation having made announcements on **August 4, 2022**. As reported and announced, **TÜV Rheinland** (see **Edition 39** of Low Carbon Pulse, outlining the basis upon which **TÜV** provides certification) had provided certification for **37,800 metric tonnes** of **Blue Ammonia**, and **8,075 metric tonnes** of **Blue Hydrogen**, used to produce the Blue Ammonia.

Vice-President for Chemicals for Aramco, Mr Olivier Thorel, is reported to have said: "These certifications are the first of their kind in the world and signify a major milestone in our efforts to develop clean energy solutions, and advance our hydrogen and ammonia export capabilities".

Africa:

- **Trans-Saharan Gas Pipeline:** On **August 1 and 2, 2022**, there was increased reporting in respect of the signing of a memorandum of understanding by **Algeria, Niger** and **Nigeria**, under which it is planned to develop a **trans-Saharan Gas Pipeline** and **hub**, at Hassi R'Mel, to enable the export of natural gas from Africa to Europe via natural gas pipelines to Spain (Cordoba via a GME pipeline, and Almeria via a Medgaz pipeline) and Italy (via a TransMed pipeline).

In addition, some of the natural gas will be liquified to produce liquified natural gas (**LNG**), with the LNG to be transported to northern Europe. While the trans-Saharan pipeline project has been talked about for many years, it appears more likely that previously to progress.

- **East Africa transmission connectivity:** On **August 3, 2022**, **Green Building Africa** (at <https://greenbuildingafrica.com>, under [Construction of Tanzania Zambia Transmission Line to Begin Q1 2023](#)) reported that the construction of the 400 kW, 616 km, Tanzania Zambia transmission system would commence in January 2023, and will be completed in January 2025.
- **Masdar and Tanesco create JV:** As reported widely, on August 3, 2022 (including detailed reporting on **August 9, 2022**, from **Energy Utilities** (at <https://energy-utilities.com>, under [Tanzania welcomes Masdar to help develop renewable resources](#))) **Masdar** (the Abu Dhabi Future Energy Company) and the **Tanzania Electric Supply Company Ltd (TANESCO)** signed a joint development agreement (**JDA**) to develop up to **2 GW** of renewable electrical energy projects within Tanzania. The **JDA** contemplates the establishment of a joint venture corporation to

develop projects, with the first phase involving the development of 600 MW of photovoltaic solar and onshore wind capacity.

India and Indonesia:

- **Hydrogen Mission document drafted:** On **August 2 2022**, it was reported widely that the Minister for State of New and Renewable Energy (**MNRE**), Mr Bhagwanth Khuba had indicated that the National Hydrogen Mission document for India had been developed (foreshadowed by Indian Prime Minister, Mr Narendra Modi, during his Independence Day speech – see **Edition 25** of Low Carbon Pulse). According to Minister Khuba the draft National Hydrogen Mission document provides a framework for both supply and demand side creation, focusing on the production and use of Green Hydrogen within India. Critical elements of the framework include research and development programs, proposals for pilot projects, and policy settings, and implementing laws and regulations, intended to promote and to enable capacity development.
- **Energy Conservation (Amendment) Bill 2022 introduced, and NDC revised:** On **August 3, 2022**, it was reported widely that **Government of India (GoI)** had introduced [The Energy Conservation \(Amendment\) Bill 2022](#). As reported, the **Bill** is intended to provide the framework to allow India to progress to the use of non-fossil fuel sources, including to facilitate the development of Green Hydrogen and Green Ammonia, and ethanol, production capacity, and the development of the use biomass and bioenergy. The framework includes mandating designated users of energy to source energy from non-fossil fuel sources, thereby providing the basis for a known demand to provide a market for which the supply side can produce Future Fuels.
As outlined on a number of occasions by the **GoI** (and as reported in Low Carbon Pulse), the framework will reduce the dependence of India on fossil-fuel sources of energy, and provide for energy security for India. While the main thrust of the **Bill** is the development of Future Fuel production capacity, the **Bill** promotes energy conservation in the building sector and provides for the establishment of a carbon market, with the establishment of a carbon market considered as being key to increased investment in clean energy and energy efficiency.
Also on **August 3, 2022**, it was reported that the Union Cabinet, chaired by Prime Minister, Narendra Modi, and that on **August 4, 2022**, had approved India's revised **NDC** to be communicated to the United Nations Framework Convention on Climate Change for the purposes of the **Paris Agreement**. As reported, India will commit to reduce emissions intensity of its GDP by 45% by 2030, compared to 2005, and to source 50% of its electrical energy from non-fossil fuel sources by 2030.
On **August 8, 2022**, it was reported by **Money Control News** (at <https://moneycontrol-com>, under **Lok Sabha passes Energy Conservation (Amendment) Bill**) that the lower house of the India Parliament passed the **Bill** (also visit <https://moneycontrol-com>, under **MC Explains Proposed changes in Energy Conservation regulations: Why they are important for India**).
- **India to stop carbon credit exports:** On **August 8, 2022**, **The Business Times** (at <https://www.businesstimes-com>, under **India to stop carbon credit exports until climate goals are met**) reported that India is to ban the export of carbon credits from India until India meets its climate goals. The Power and Renewable Energy Minister, Mr Raj Kumar Singh, made this clear as the Lok Sabha passed the **Energy Conservation (Amendment) Bill**. While the detail of the ban is yet to take shape, the logic and the accompanying narrative is clear: "Carbon credits are not going to be exported. No question. These credits will have to be generated by domestic companies, bought by domestic companies". As noted above, the **Energy Conservation (Amendment) Bill** provides the framework for the development of a national carbon credit trading market in India.
- **India Hydrogen Alliance - July 2022:** Attached is the link to the June edition of the [India H2 Monitor – July 2022](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link to, rather than to repeat the content of, the **India H2 Monitor**.

Japan and Republic of Korea (ROK):

KOGAS and Matrix align: On **August 8, 2022**, **H2 View** (at <https://h2-view.com>, under **MOU looks to develop large-scale liquid hydrogen storage in South Korea**) reported that **Matrix Service Company** (leading cryogenic containment and storage tank corporation) and **Korea Gas Corporation (KOGAS)** had signed a memorandum of understanding to provide a framework for **Matrix** and **KOGAS** to work together to develop liquid hydrogen storage technology, with scope to work together on containment and storage systems on board liquid hydrogen carriers.

PRC and Russia:

- **Ganfeng developing 10 GWh giga-factory:** On **August 3, 2022**, **Battery News** (at <https://batterynews.com>, under **Ganfeng Lithium Plans to Build China's Largest Solid-State Battery Production Base**) reported that Ganfeng Lithium is to develop the largest solid-state manufacturing plant in Liangjiang New Area, Chongqing, in the south west of the **PRC**. As reported, construction commenced on July 30, 2022. The manufacturing plant will have 10 GWh of battery production capacity and 10 GWh of pack production capacity.
- **NIO and Shell open:** On **August 2, 2022**, **NIO** (at <https://www.nio.com>, under **NIO and Shell introduce the First Integrated Power and Swap Station**) announced that on **August 1, 2022**, the first **NIO** and **Shell** integrated **Power Charger and Swap Station** had been opened officially. The **Power Swap Station** is located in **Tongan, Xiamen**. As announced by **NIO**, this is the first of **100 Power Swap Stations** that **NIO** and **Shell** plan to install across the **PRC** by 2025. In addition, **NIO** and **Shell** plan to commence the development and deployment of **Power Swap Stations** across **Europe** later in 2022. The first Power Swap Station with Shell, is NIO's 1,048th swap station, and its 1,777th charger station, across the **PRC**.
- **Johnson Matthey and Sinopec MOU:** On **August 3, 2022**, it was reported widely the **Johnson Matthey** and **Sinopec** had signed a memorandum of understanding to allow them to assess opportunities for them to work together to produce Blue and Green Hydrogen, and to develop decarbonisation and fuel-cell technologies.

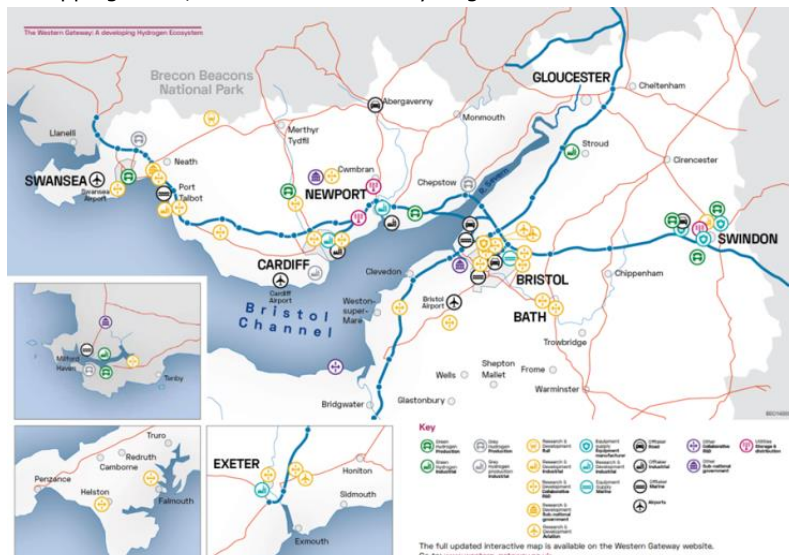
Europe and UK:

- **North Sea Transition Authority provides more thinking on CCS sites:** On **August 1, 2022**, the **North Sea Transition Authority** published [Measurement, Monitoring and Verification \(MMV\) of Carbon Capture and](#)

Storage (CCS) Projects and Co-location considerations. The publication is a technical report, and the key themes from it are: **1.** There is not a one-size-fits-all solution to the monitoring of activities at off-shore CCS facilities; **2.** Seismic surveying of carbon storage sites that are located in and around off-shore wind field sites has challenges, and that the use of areas with large overlap between carbon storage sites and off-shore wind fields are not considered feasible, and to the extent of any overlap cooperation is required; and **3.** There is an expectation that first-of-a-kind monitoring approaches may be over-engineered as different approaches to **MMV** are tested and certified.

On **August 10, 2022, Hydrogen East** (at <https://www.hydrogeneast.uk>, under **NSTA explores monitoring offshore carbon storage sites**), picks up on the key themes of the publication. The article is worth a read.

- **Full-house for Round 4 contract for difference scheme:** On **August 3, 2022 4coffshore** (at <https://4coffshore.com>, under **All contracts signed for UK governments Round 4 CfD scheme**) reported that all 99 contracts for difference offered in the fourth allocation round had been signed and returned to the Low Carbon Contracts Company (**LCCC**). What this means on the ground is that 93 projects across the UK will now proceed, working with the **LCCC**, to meet the milestones in their contract for difference, with the 93 projects to result in the installation of **11 GW** of renewable electrical energy capacity.
- **UK Government on the benefits of LDES:** On **August 3, 2022**, the UK Government (Department of Business, Energy and Industrial Strategy) published **Benefits of long duration electricity storage** (with an accompanying **methodological annex**), providing an outline of the role and requirements for LDES and associated system impacts.
- **UK Government awards funding for BECCS:** On **August 4, 2022**, the UK Government (Department of Business, Energy and Industrial Strategy) announced the results of its **Bioenergy with Carbon Capture and Storage (BECCS)** programme (more formally Hydrogen BECCS Innovation Programme Phase 1 – see <https://www.gov.uk>, under **Hydrogen BECCS Innovation Programme Phase 1: successful projects**), awarding funding for 22 applicants to promote the use of technologies using **BECCS** to derive or to produce hydrogen from biomass and waste, all of which are listed in the announcement. As structured the innovation programme awarded in respect of three categories: Category 1: Feedstock pre-processing; Category 2: Gasification components, and Category 3: Novel biohydrogen technologies.
- **Greece establishes 2 GW off-shore wind field target:** On **August 4, 2022**, it was reported widely that the **Greek Parliament** had passed a law that establishes a target for Greece to develop at least **2 GW** of offshore wind field capacity by 2030. To implement this policy setting, the Green Ministry for the Environment and Energy will arrange for environmental impact assessments to be undertaken in areas that may be regarded as appropriate areas for development. As reported, the first round of applications will be sought within the coming 12 to 18 months.
- **Decommissioning cost estimate revised downward:** On **August 4, 2022**, the **North Sea Transition Authority** (at <https://www.nstaauthority.co.uk>, under **UK decommissioning cost estimate drops 25% to £44.5 bn**) announced a reduction in the cost estimate of GBP 15 billion, with the revised cost estimate expected to maintain industry focus on cost-efficiency. A link to the **Decommissioning Cost Estimate Report 2022** of the North Sea Transition Authority is attached.
- **European Battery Atlas:** During the week beginning **August 8, 2022**, through the combined efforts of **VDMA, PEM** and **RWTH Aachen University**, the first edition of the www.battery-atlas.eu was published, edited by Heiner Heimes. The **Battery Atlas** provides a summary of the current state of the battery industry across Europe.
- **Hydrogen Ecosystem Map launched in the UK:** On **August 9, 2022, Hydrogen Central** (at <https://hydrogen-central.com>, under **Launch of UK First Hydrogen Ecosystem Map for South West and South Wales**) reported on the **Hydrogen Ecosystem Map**, the work of the **GW4 Alliance** and the **Western Gateway** in producing an interactive on-line tool mapping lower, low and no carbon hydrogen activities.



- **INTOG offshore wind leasing opens:** On **August 10, 2022, The Crown Estate Scotland** (at <https://www.crownestatescotland.com>, under **INTOG of offshore leasing opens, aiming to encourage innovation and decarbonise North Sea**) opened registration for the Innovation and Targeted Oil and Gas (**INTOG**) offshore wind leasing process, under which off-shore wind field developers are being invited to make proposals for the leasing of seabed to reduce the **GHG** emissions arising from activities in the North Sea, and to boost innovation. Registration closes on **August 24, 2022**, and on **November 18, 2022**, the application submission process will close.

- **Another 20 projects on progress:** On **August 12, 2022**, the **UK Government** (Department of for Business, Energy and Industrial Strategy (at <https://www.gov.uk>, under **20 projects shortlisted for next stage of carbon capture, usage and storage (CCUS) cluster process**) announced that **20** innovative projects had been shortlisted for the next stage of the **Phase-2 CCUS cluster** process.

In **November 2021**, the **HyNet** cluster, and the **East Coast** cluster were selected as **Track 1 Clusters** (with the Scottish Cluster in reserve). On **March 22, 2022** the UK Government issued a notice (entitled **Cluster sequencing Phase-2: eligible projects (power CCUS, hydrogen and ICC)** detailing projects that had satisfied the eligibility criteria for **Phase-2 CCS cluster** process – see **Edition 37** of Low Carbon Pulse, with each eligible project located within the **HyNet** cluster and the **East Coast** cluster (and the Scottish cluster).

It is understood that each of the **20** shortlisted projects will be considered for funding support to allow development by the mid-2020s.

CLUSTER	POWER CCUS	HYDROGEN	INDUSTRIAL CARBON CAPTURE
East Coast	Net Zero Teesside Power; Whitetail Clean Energy; and Keadby 3 Carbon Capture Power Station	bpH2 Teesside; H2NorthEast; Hydrogen to Humber (H2H) Saltend	CF Fertilisers; Tees Valley Energy Recovery; Norseia Carbon Capture; Redcar Energy Centre; Teesside Hydrogen CO2 capture; Humber Zero – Phillips 66 Refinery; Prax Lindsey Oil Refinery and ZerCal 250
HyNet	No project to progress	HyNet Hydrogen Production Project	Hanson Padeswood Cement Works; Viridor Runcorn Energy Recovery Facility; Protos Energy Recovery Facility; Buxton Lime Net Zero; and EssarOil UK CO2 capture

Americas:

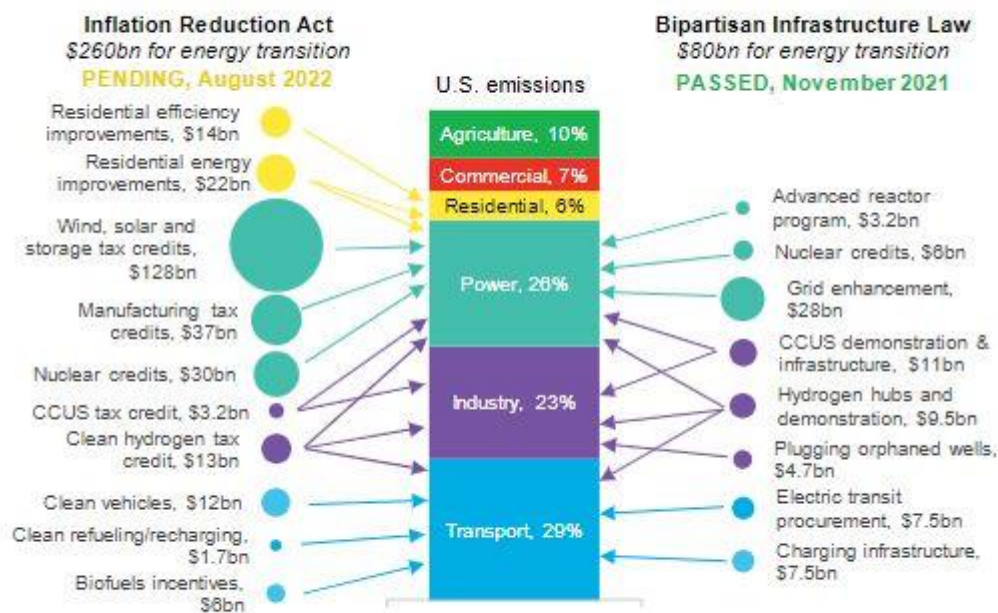
- **Inflation Reduction Act heads to Congress:** On **August 7, 2022**, the US Senate passed the **Manchin-Schumer Act** the **[Inflation Reduction Act of 2022](#)** was published in revised form. **Edition 45** of Low Carbon Pulse included the following short form summary, which remains correct.

SHORT FORM SUMMARY OF THE MANCHIN-SCHUMER ACT	
USD 369 billion for Energy Security and Climate Change over 10 years	"investing in domestic energy production and manufacturing and reduce carbon emissions by roughly 40 percent by 2030"
USD 9 billion consumer home energy rebate programs and 10 years of tax credits	This initiative is focused on lower-income customers to electrify home appliances and energy efficient retrofits
USD 4,000 tax credit (used) and USD 7,500 tax credit (new) clean vehicles	This initiative is focused on lower and middle income folk to buy used and new clean vehicles
USD 1 billion grant program	This initiative is to make affordable housing more energy efficient
Production tax credit scheme	This initiative is to accelerate US manufacturing of batteries, solar panels, and wind turbines, and extraction of critical materials, modelled to result in USD 30 billion investment
USD 10 billion investment tax credit scheme	This initiative is to accelerate the development of clean technology manufacturing facilities for batteries, solar panels, and wind turbines
USD 2 billion in grants to retool	This initiative is to accelerate the retooling of existing manufacturing facilities to manufacture clean vehicles
USD 20 billion in loans	This initiative is to accelerate the development of new clean vehicle manufacturing
USD 2 billion in funding	This initiative is to accelerate the development of breakthrough technologies

A fuller summary of the Energy Security and Climate Change provisions is [attached](#).

- **Infographic representation as to the implications of the Manchin-Schumer Act:** During the week beginning August 8, 2022, the good folk at BNEF published the following infographic.

Figure 1: Estimated 2022-31 energy transition spending in Inflation Reduction Act and Bipartisan Infrastructure Law



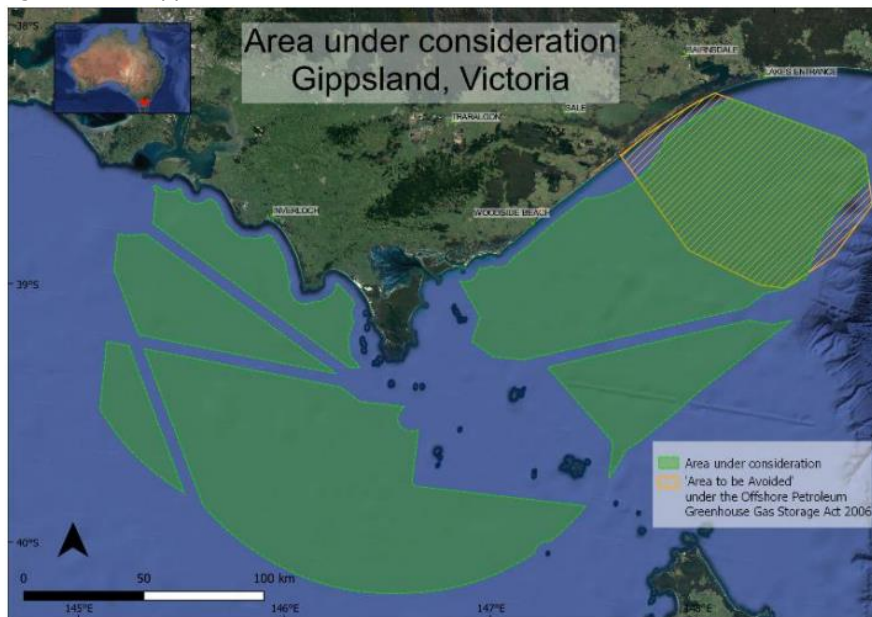
Source: EIA, EPA, Joint Committee on Taxation, BloombergNEF. Note: Chart only captures tax credits and incentives, not grant programs or loans. Bn is billion. CCUS is carbon capture, utilization and storage.

France and Germany:

- Germany supports Hyundai imports:** On **August 2 and 3, 2022**, it was reported widely that the German Federal Government, Ministry for Digital and Transport (**BMDV**), had provided funding support to enable seven German corporations to acquire **27 Hyundai XCIENT** trucks (using fuel-cell technology), now a well-proven FCT truck.
- European Commission approves German Federal Government's heating program:** On **August 2, 2022**, it was reported widely that the European Commission had approved the **€3 billion** district heating program (using renewable energy and waste heat). Under the program, the German Federal Government will promote and enable the development of district heating capacity by providing funding support, in the form of grants, through 2028, in respect of capacity that uses not less than 75% renewable and waste heat derived energy. As reported, it is expected that the program will result in the installation of around 680 MW of renewable energy capacity year on year.
- France shortlists bidders:** On **August 2, 2022**, it was reported widely that 13 proponents had been pre-selected in respect of the **1.5 GW AO6 Mediterranean Floating Off-shore** wind tender being run by France. The 13 shortlisted proponents (comprising consortiums and single corporations) are to bid for two off-shore floating wind field projects, each of 250 MW, but with the ability to expand to up to 750 MW. The pre-selected shortlisted proponents is part of the tender process, and marks the commencement of the competitive dialogue phase which is scheduled to continue until the end of 2022, with the preferred proponents to be selected by the end of 2023.
 The 13 shortlisted proponents is a veritable who's who of the off-shore wind field industry, including BlueFloat Energy, Sumitomo and Akuo; EDF Renewables and Maple Power; Iberdrola; Marine Energy Archipelago involving TotalEnergies, Qair and Corio Generation; Ocean Winds; Ocole partnership of Equinor, Q Energy and Green Giraffe; RWE and Bourbon; Shell and EnBW's Les Moulin du Leonis partnership; and Vattenfall.
- France new FiTs:** On **August 3, 2022**, it was reported widely that France's energy regulator (Commission de régulation de l'énergie) had released feed-in tariffs (**FiTs**) for roof-top photovoltaic solar installations of up to 500 kW to apply during the **Q3 of 2022**. The **FiTs** have been increased, and range between **€0.1951 kWh** in respect of installations of less than **3 kW** to **€0.1068 kWh** in respect of installations in the **100 kW to 500 kW range**. The increase in the **FiTs** is consistent with the policy setting from the French Government to encourage increased installation of roof-top solar.
- France mandates use of rooftops:** Also during the first week of August 2022, the President of France, Mr Emmanuel Macron approved a new law requiring all new buildings in commercial zones to be covered with photovoltaic solar panels or plants. A number of news-items covered the new law, and in doing so noted the benefits expected to be realised, including, in respect of plants, that they can absorb between 50 and 80% of annual rainfall, create habitats for flora biodiversity, reduce temperatures and the heat effect of urban islands, and to allow the use of rooftops as amenities, for example, parks and vegetable gardens.
- German power sector climate-neutral by 2035:** During the week beginning **August 8, 2022**, **Agora Engiewende** (at <https://www.agora-energiewende.com>, under **Climate-neutral power system 2035 – How the German power sector can become climate neutral by 2035**) published a **paper** providing a roadmap for how Germany can achieve its policy objective of a renewable energy electricity system by 2030. The paper is well-worth a read.

Australia:

- **Australia pegs out off-shore wind field areas off Victoria:** On **August 5, 2022**, it was reported widely that the Australian Federal Government had commenced the process to develop off-shore wind field areas off the coast of Gippsland, Victoria. The Federal Government has indicated that the public consultation process will start immediately, with a map detailing areas off Gippsland released for consultation. Submissions have been invited by October 7, 2022.



As reported in previous edition of Low Carbon Pulse, there is considerable interest in the development of off-shore wind fields off the coast of Gippsland, in the Bass Strait, including the **BlueFloat Energy** and **Energy Estate 1.3 GW Greater Gippsland Project** (see **Edition 33** of Low Carbon Pulse), the **Copenhagen Infrastructure Partners 2.2 GW Star of the South Project** (see **Editions 13, 14, 16, 31** and **39** of Low Carbon Pulse), the **Corio Generation** (part of the **Green Investment Group**) **2.5 GW Great Southern Wind Project** (see **Edition 41** of Low Carbon Pulse), the **Flotation Energy 1.5 GW Seadragon Project** (see **Edition 31** of Low Carbon Pulse), and **Alinta Energy's** long-anticipated **Spinifex Offshore Wind Project** (see **Editions 29** and **32** of Low Carbon Pulse). The **Star of the South Project** was the first, and is the most progressed, of the off-shore wind field projects, being in development phase.

After the consultation in respect of the Gippsland areas, consultation will commence in respect of the Pacific Ocean region of Portland in Victoria, the Bass Strait region off northern Tasmania and the Indian Ocean region off the Perth and Bunbury regions of Western Australia.

The good folk at **RenewEconomy** have long established an [Offshore Wind Farm Map of Australia](#).

- **Frontier Energy reports positive PFS:** On **August 5, 2022** [pv-magazine.com](#) (under **Australian solar park could generate hydrogen for less than \$2/kg**) reported that a pre-feasibility study (PFS) for the **Frontier Energy Bristol Springs Solar** project in Western Australia indicated that the project would be able to produce Green Hydrogen at AUD 2.83 / kg or at sub-USD 2 / kg. Low Carbon Pulse will report on the **Bristol Springs Solar** project as it progresses.
- **PHES project progresses in QLD:** On **August 5, 2022**, it was reported widely that **Bechtel Corporation** had been appointed by **BE Power** and **GE Renewable Energy** for the **Big-T** (large scale pumped-hydro-energy storage (PHES) project at **Lake Cressbrook**, south east Queensland). The **PHES** is a **10 hour, 400 MW / 4,000 MWh** facility, that will work with a **200 MW / 200 MWh BESS**. If a final investment decision is taken to develop **Big-T** **Bechtel Corporation** will be the EPC contractor.
- **Australia formalises its NDC at 43%:** On **July 27, 2022**, Australia's Energy and Climate Minister, Mr Chris Bowen introduced [legislation](#) to the Australian Federal Parliament to formalise Australia's new nationally determined contribution (NDC) of a 43% reduction by 2030 compared to 2005, and **NZE** by 2050.

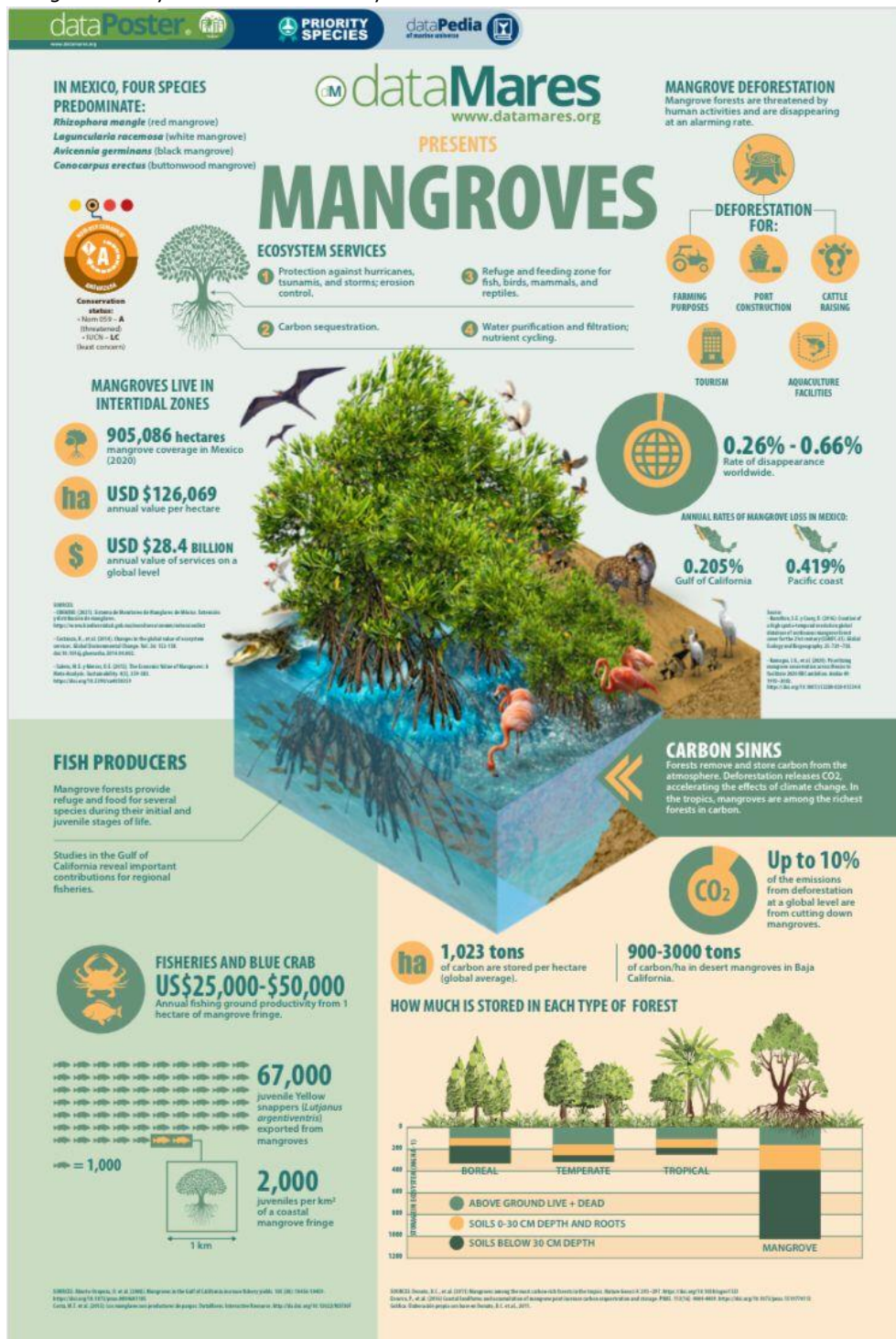
In addition to increasing the **NDC** and committing to **NZE**, the legislation provides for the establishment of a new independent agency, the **Climate Change Authority**, requires the Minister of Climate Change and Energy to issue an annual report to the Australian Federal Parliament, and incorporates the **NDC** and **NZE** targets into the objectives of key agencies, including the Australian Renewable Energy Agency (**ARENA**), the Clean Energy Finance Corporation (**CEFC**), Export Finance Australia, Infrastructure Australia, and the Northern Australia Infrastructure Facility (**NAIF**).

On **August 6, 2022**, the House of Representatives (the Lower House of the Australian Federal Parliament) passed the Climate Change Bill 2022. The **Bill** now goes to the Senate of the Australian Federal Parliament in September 2022 at the next sitting of the Senate.

Blue and Green Carbon Initiatives and Biodiversity

- **More about mangroves ecosystems:** **Edition 45** of Low Carbon Pulse reported on the **International Day for the Conservation of the Mangrove Ecosystem** (on July 26, 2022) and in so doing recapped on the fact that the author of Low Carbon Pulse has long included background on the role that mangrove forests and swamps play, and the increased role that they can play, as a nature based solution to mitigate the impact of climate change (see **Editions 29, 31, 32, 33** and **44** of Low Carbon Pulse).

During the first week of **August 2022**, the author came across the **dataMares** website (at www.datamares.org), which provides an excellent source of data and information, including the following infographic providing key information and insights into the mangrove ecosystem. As will be apparent from the bottom right hand side of the infographic, mangrove ecosystems have the ability to store more **CO₂** than other nature based solutions.



- **Missing links:** During July the author came across the following news items on Blue Carbon, which missed the final cut in editing of **Edition 45** of Low Carbon Pulse, but squeezed into to this **Edition 46**.
- **UK to map Blue Carbon Stores:** In mid-July a report on **BBC news** (under [The UK will become the first nation to create a full map of its blue carbon stores](#)) reported that two thirds of the UK is underwater! The **BBC** report provides an overview (explaining Blue Carbon, i.e., that it comprises mangroves, saltmarshes and wetlands, and seagrass). The mapping of Blue Carbon is important for conservation, preservation and restoration purposes.
- **Carbon Capture at sea:** A week or so after the BBC news report, **DNV** (<https://dnv.com> under **Commencing carbon capture with seaweed**), announced that it is to establish, together with **Equinor, Lundin and Sintef**, the "world's first pilot project for active, nature-based carbon capture at sea". As announced the objective, is to develop methodologies and technologies "to enable the capture of millions of tonnes of CO₂ through the cultivation

of seaweed [in the form of sugar kelp]". The announcement from **DNV** explains the methodology to be used, and the harvesting and use of the seaweed.

- **Clear lines of sight to green:** During the first week of **August 2022**, the good folk at **South Pole** and the **WWF** published [Commons success factors for bankable nature-based solutions](https://www.southpole.com) projects (see <https://www.southpole.com>, under **Common success factors for bankable nature-based solutions**). For the purposes of scoping the publication, nature based solution (**NBS**) is defined as "actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefit".

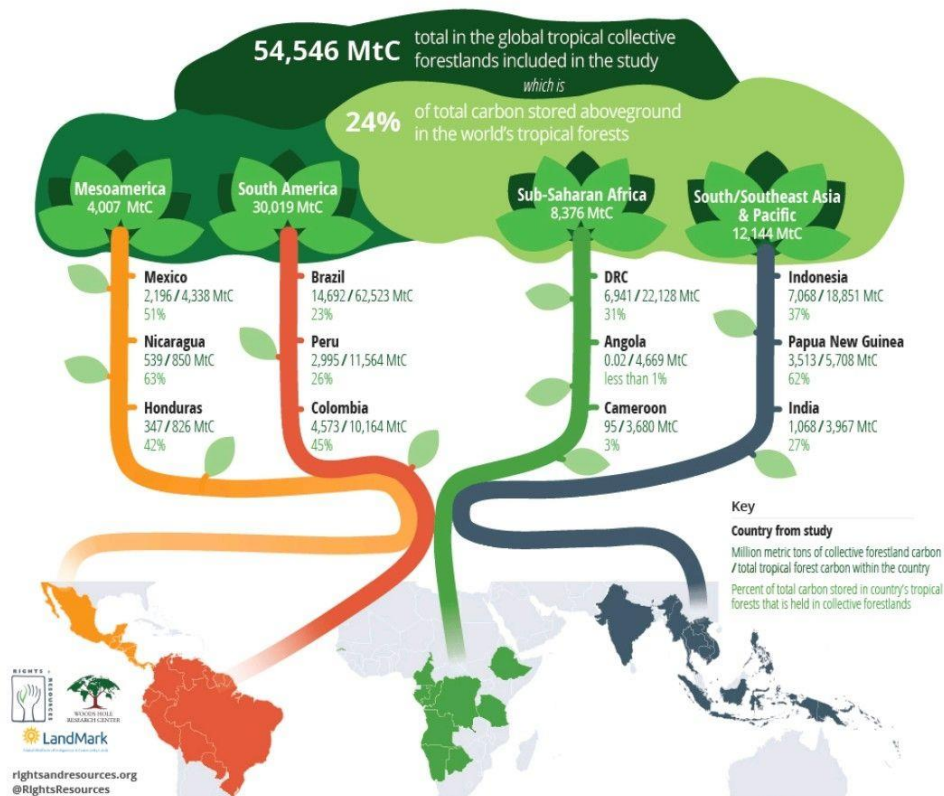
Four key themes emerge from the publication: **1.** There isn't one-size-fits-all "blueprint to bankability of a **NBS**; **2.** While some success factors have a high potential for improving the bankability of a **NBS**, implementing them remains a challenge for most projects; **3.** Projects must be designed in close collaboration with potential investors; and **4.** A success factor for one project can be a hindrance for another, and understanding the local context is key. While none of these themes is revelatory, they are confirmatory.

- **A strait view:** On **August 2, 2022**, **The Straits Times** (at <https://www.straitstimes.com>, under **Cities can tap nature for solutions as they seek to develop without harming the environment**) published an excellent article (in the context of the World Cities Summit) on the use of nature based solutions in an urban context. The article starts with: "In China, Hainan province built interlocking fingers of land that channel sea tides into the island's 10 ha mangrove park", and the article only gets better! The article is well-worth a read, and well-worth sharing.
- **Pictures and Stories:** Low Carbon Pulse has provided considerable background on the importance of biodiversity, and in this context of the importance of ceasing deforestation and promoting afforestation and reforestation. To help illustrate the point the author returned to a World Resources Institute source to provide a perspective, and in doing so came across a post from my Omar AL-Ajaji, who had posted the following infographic (noting that the 13% in now 16%).

Toward a Global Baseline of Carbon Storage in Collective Lands

The countries with the highest concentration of forest carbon per region are highlighted, and the proportion of carbon managed by Indigenous Peoples and local communities is presented as a percentage of the total carbon stored aboveground in each of these countries.

Read the full report at: <http://www.rightsandresources.org/carbonmapping2016>.



- **World Resources Institute (WRI) Five Reasons for Cities to include trees in climate action:** In the context of the World Cities Summit, on **July 29, 2022**, the **WRI** (under [5 Reasons Cities Should Include Trees in Climate Action](#)) noted that while cities and communities around the world are focusing on **GHG** emissions from the building, energy, industrial, transportation and waste sectors a number of overlooking the benefits of forestry and trees. The **WRI** introduces its publication, [Global Protocol for Community Scale Greenhouse Gas Inventories: Supplemental Guidance for Forests and Trees](#), and guides us to the [GHG Protocol for Cities – An Accounting and Reporting Standard for Cities](#), which has been piloted in Jakarta, Mexico City, Mumbai and Salvador, and in respect of multiple US communities (through the [process of estimating annual emissions and removals by forests and trees](#)).

The **WRI** outlines the five reasons as follows: **1.** Forests and trees both emit (on degradation or removal) and remove carbon (on growth); **2.** Protecting urban forests is low-hanging fruit, even if the mitigation potential is small (in a global context, and in the context of other means and solutions); **3.** Urban forests and trees are important for climate adaptation; **4.** Expanding forest and tree coverage can address inequities; and **5.** The benefits of forests and trees go well beyond climate. The **WRI** publication is well-worth a read, providing links to many helpful sources of data and information, and providing a number of case studies. More worthwhile still is to spend an afternoon or evening with all of the materials to which links are provided, and the article itself.

Bioenergy and heat-recovery:

- **Coëvrons biomethane plant opens in France:** On **August 4, 2022**, **Biogas Channel** reported the opening of the Coëvrons biomethane plant, designed by **ENGIE BIOZ**, which will take agricultural and food waste to derive biogas, and then upgrade that biogas to produce biomethane to be sent out across the natural gas pipeline system.
It is clear that biogas and biomethane derivation and production is becoming increasingly viewed as a part of the solution to **GHG** emissions reduction. By way of background, the **European Biogas Association** (at <https://www.europeanbiogas.eu>, under **Record-breaking year for biomethane production – shows EBA / GIE Biomethane Map 2021**), has recently provided an article providing an overview of the levels of biogas and biomethane derivation and production across Europe. The article provides a map that can be downloaded and with an on-demand function that provides for printing and shipping. The map is detailed, and as such reproduction in Low Carbon Pulse would not do it justice.
- **World Biofuel Day:** Each **August 10** is **World Biofuel Day**, among other things, commemorating the work of **Sir Rudolf Diesel**, which in **1893** ran an engine on **peanut oil**, as legend relates, the first non-fossil fuel liquid biofuel.
- **UK Government seeks to improve diversity of energy supply:** On **August 11, 2022**, the **UK Government** (Department of Business, Energy and Industrial Strategy) announced (at <https://www.gov.uk>, under **Government seek to further improve diversity of energy supply by boosting biomass**) the launch of a consultation process on how it might support the development of biomass energy generation (with associated BECCS and BECCUS) in the UK with the basis of consultation outlined in **Business model for power bioenergy with carbon capture and storage (power BECCS)** to be found at <https://www.gov.uk>. The consultation process is scheduled to close at 11.45 pm on October 7, 2022.
- **Biogas reading for those taking a vacation:** In **July 2022**, the ever-excellent biogasworld.com published **Top 10 Biogas Reports To Add To Your Summer Reading List**. The Top Ten Biogas reads listed are: **1. Best Practices for Reducing Costs of Anaerobic Digestion of Organic Waste**; **2. Biomethane Production Potentials in the EU** – see below; **3. Renewable Natural Gas as a Complementary Solution to Decarbonizing Transport**; **4. Fuelling Clean Mobility with Bio-LNG**; **5. Hitting Canada's Climate Targets with Biogas and RNG**; **6. Bioenergy Europe Statistical Report 2022**; **7. Green Gas: The Green Economy under our Feet**; **8. Turning Circle: How Bioenergy can Supercharge Australia's Circular Economy**; **9. The Landscape of Methane Abatement Finance**; and **10. Anaerobic Digestion Deployment in the UK**.

BIOENERGY

Biomethane: is **Biogas** that has been processed and scrubbed (referred to as "upgrading") so that it can be used as pipeline gas (i.e., complying with the specification for hauling through the applicable natural gas pipeline, including the removal of **CO₂**, and other compounds and elements, such that the gas hauled through the pipeline is **CH₄**). **Biomethane** is a **Biofuel**.

Biogas and **Biomethane** can be used as a fuel (typically, as a gas that is combusted / oxidised to produce electrical energy or heat energy or both) or as a feedstock. Also, either may be referred to as **Renewable Natural Gas** (or **RNG**), or in compressed form, as compressed natural gas (or **CNG**) and in liquified form as **Bio-LNG** or, less frequently, **Renewable LNG**.

Biofuel is a fuel derived or produced from **Biomass**, whether in gaseous, liquid or solid form. In addition to **Biogas** and **Biomethane**, for example, wood products (gaseous and solid biofuels), the following may be regarded as the most prevalent **liquid biofuels**:

- **Bio-ammonia:** being ammonia that is derived or produced using H₂ derived from a renewable source that is then combined with N to produce the compound NH₃;
- **Bio-butanol:** being butanol (i.e., a synthetic alcohol) that is derived or produced from the microbial fermentation of carbohydrates (typically from corn and from agricultural waste), and is similar to motor spirit, and as such may be used as a fuel for internal combustion engines. (It is a drop-in fuel.)
- **Bio-diesel:** being diesel (i.e., synthetic paraffinic compound) that is produced typically using transesterification of animal fats and vegetable oils;
- **Bio-ethanol:** being ethanol (i.e., synthetic alcohol) that is derived or produced the microbial fermentation of carbohydrates (including from corn and sugarcane, and lignocellulosic biomass);
- **Bio-kerosene:** being kerosene (i.e., synthetic paraffinic compound and another kind of methyl ester) that is derived or produced from animal and vegetable oils (containing fatty acids);
- **Sustainable or Synthetic Aviation Fuel (SAF)**, is a synthetic paraffinic kerosene. Currently, most SAF is derived or produced from used animal fats and cooking oil and from the gasification of other organic waste streams (typically using some natural gas). As noted below, typically fatty acids and hydrogenated acids are used to produce synthetic paraffinic kerosene. If the feedstock is sourced from Biomass it is a Bio-kerosene;
- **Bio-LNG:** being Bio-methane that is liquified at a temperature of -161°C, with the liquified Bio-methane 1/600th the volume of gaseous Bio-methane; and

- **Bio-methanol:** being methanol (i.e., produced from CO₂ (captured or derived) and H₂ derived from Biomass) that is derived or produced from biochemical (fermentation) or thermochemical (including gasification and pyrolysis) technologies.

A **Biofuel** is an **E-Fuel** (an **electro-fuel**) if the electrical energy used to produce it is sourced from a renewable source. Hence the use of **E-Diesel**, **E-Ethanol**, **E-Kerosene**, **E-LNG** and **E-Methanol**.

BESS and HESS (and energy storage):

- **Ameresco working around the clock:** On **August 3, 2022**, Energy Storage News (at <https://energy-storage.news>, under **Ameresco South California Edison "working around the clock" on 2.1 GWh BESS portfolio**) reported that Ameresco and Southern California Edison teams are working around the clock to deploy **2.1 GWh** of **BESS** capacity over three sites by the end of 2022 - see **Edition 35** of Low Carbon Pulse.
- **Greenspot green-lighted:** On **August 5, 2022**, Greenspot announced (<https://greenspot.com.au> under **Wallerawang 9 Battery Approved for development**) that the development of its **AUD 400 million 500 MW / 1 GWh** grid-scale **BESS** had been approved by the New South Wales Department of Planning and Environment for development at the site of the decommissioned coal-fired Wallerawang Power Station near the town of Lithgow, New South Wales. (See **Editions 17** and **32** Low Carbon Pulse for previous news about the **Wallerawang 9 BESS**.)
- **BESS map for Australia:** During the week beginning August 1, 2022, the good folk at **Maoneng** published their **Big Battery Storage Map – Australia**.



Carbon Accounting, Carbon Capture and Carbon Capture and Use and CDR:

- **Drilling of injection wells commences:** On **August 5, 2022**, Northern Lights [announced](#) that the joint venturers had started a drilling campaign in the southern North Sea (within the area of its storage licence Exploitation Licence 001), being an important milestone in the preparation by the joint venture for the injection, and storage, in the Johansen Formation (with the overlaying Drake Formation of shale providing an effective seal), of **1.5 million metric tonnes** a year of **CO₂** from **2024**. Further information can be found at http://linkd.in/dMKPe2_X.
- **Eramet Norway and Northern Lights combine efforts:** On **August 9, 2022**, Northern Lights (at <https://norlights.com>, under **Eramet Norway and Northern Lights announce collaboration**) announced that it and **Eramet Norway** had signed a memorandum of understanding which provides a framework for **Northern Lights** and **Eramet Norway** to work together to capture and to store 70% of the **CO₂** emissions arising from the operation of the **Eramet Norway** manganese smelter located in **Sauda, Norway**.
- **Another useful CCS and CCUS resource:** On **August 12, 2022**, the author of Low Carbon Pulse came across a great resource for keeping track of CCS / CCUS projects globally – **The CCUS Hub** (at <https://www.ccushubogci.com>), covering Aramis, Antwerp@C, HyNet North West, Net Zero Teesside, Northern Lights / Longship, Porthos, China Northwest, Ravenna and Louisiana.
- **The Week in Carbon Dioxide Removal:** On **August 8, 2022** Mr Wil Burns published his [Week 3 Edition](#). Links to the Week 1 Edition and [Week 2 Edition](#), are attached.

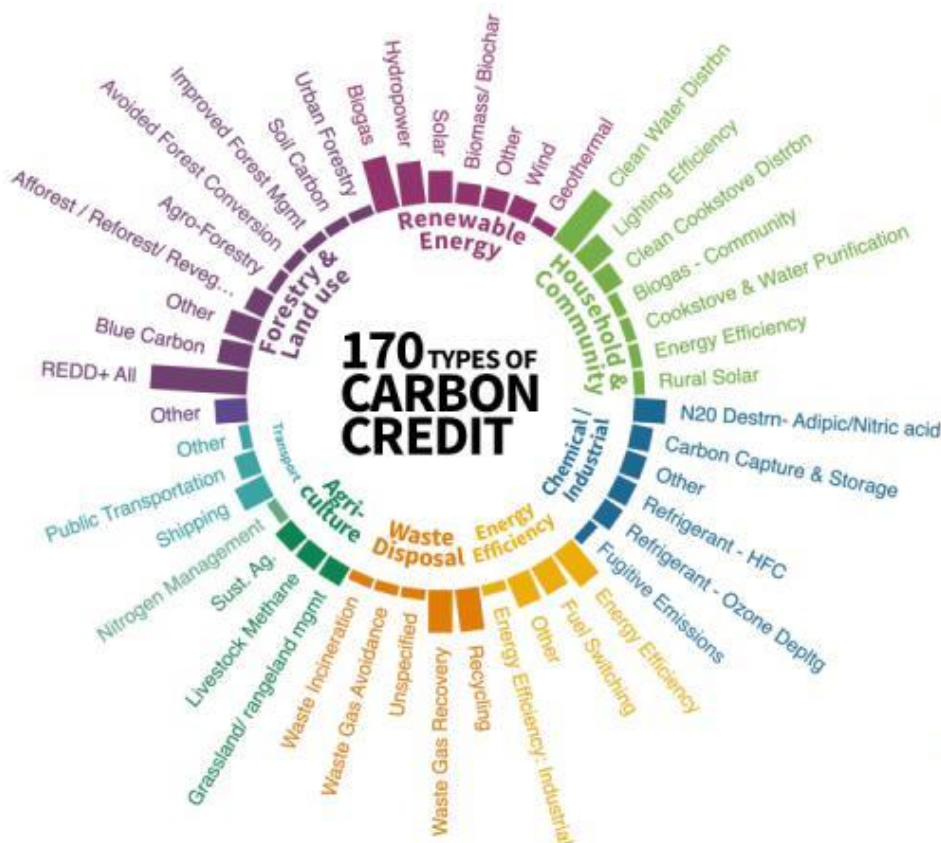
Carbon Credits and Hydrogen Markets and Trading:

- **BNEF analyses carbon credit buy and sell sides:** During the week beginning **August 1, 2022**, the good folk at **BNEF** published a report analysing the buying and selling trends. The coverage of the **BNEF report** is well-informed: nearly 98% of carbon credits used to off-set carbon emissions in 2021 came from projects in Africa, Asia and Latin America, predominantly (83.7%) bought by corporations in Europe and North America.

The informed conclusion is that while carbon credits are arising from projects in Africa, Asian and Latin America, the buy / sell side dynamics are such that the value realised for the carbon credits does not provide a benefit that is sustainable for the countries hosting the activities giving rise to the carbon credits, and the sale of carbon credits is not allowing host countries realise their own decarbonisation and reduction targets.

It may or may not be the case that the **BNEF Report** informed the decision of India (see above **India to stop carbon credit exports**), but it is clear that there is a strong emerging logic, and narrative.

- **Carbon Direct and Eco-Engineers:** On **August 2, 2022**, **Carbon Direct** (at <https://carbon-direct.com> under **A New Proto-Protocol of Bio-oil Sequestration**) announced that it and **Eco-Engineers** had developed a prototype protocol on bio-oil sequestration, working with **Charm Industrial**. As announced, the protocol provides for carbon accounting, life-cycle analysis, and monitoring, reporting and verification (**MRV**). A [link](#) to the protocol is attached.
- **Variety the spice of life:** On **August 3, 2022**, the good folk at **Ecosystem Marketplace** (<https://ecosystemmarketplace.com>) published **The State of the Voluntary Carbon Markets 2022 Q3 briefing, "The Art of Integrity"**. The publication is well-worth a read. In addition to the headline picked up by many news-feeds to the effect that the voluntary carbon market is now worth areas **USD 2 billion**, the publication provides a fantastic infographic entitled **170 Types of Carbon Credit**, which is set out below.



In addition, the good folk at **Ecosystem Marketplace** echo a number of themes that have been canvassed in **Low Carbon Pulse**, critically, the importance of high quality carbon credits underpinned by their integrity, which is achieved by transparency and verification. High quality carbon credits are essential to the establishment and the functioning of high-quality voluntary carbon markets.

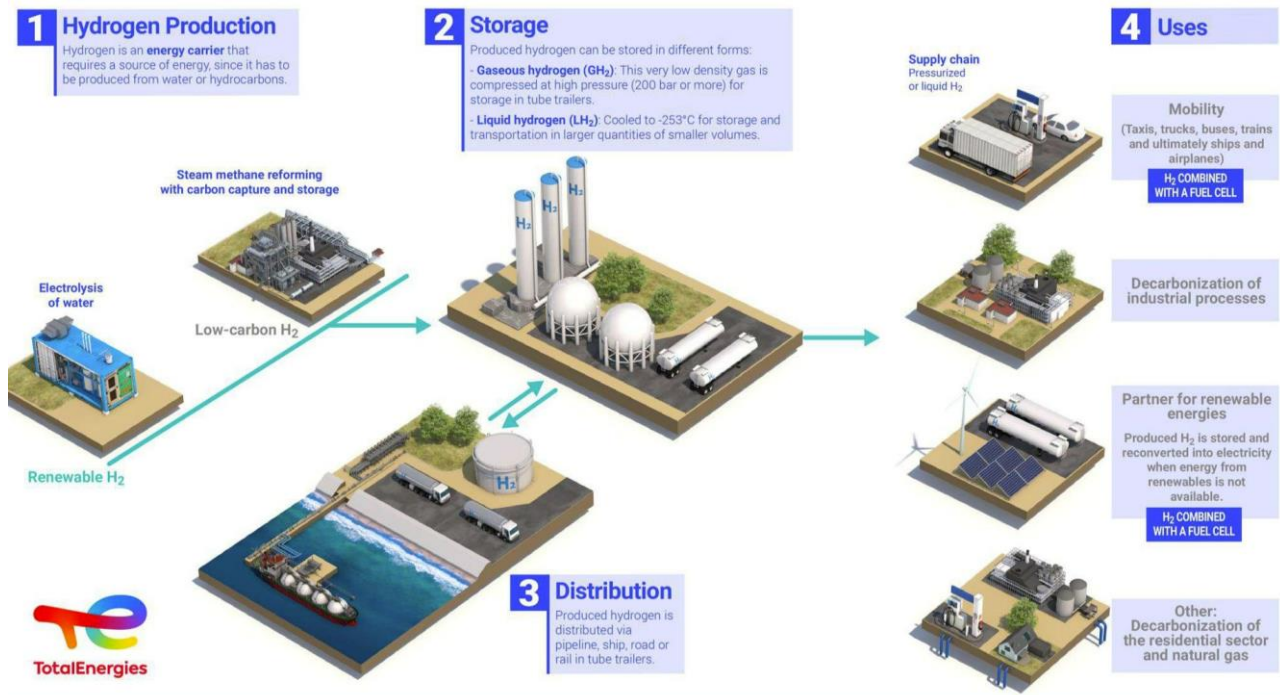
- **Gold Standard and Partners scope digital carbon market:** On **August 11, 2022**, **Gold Standard** (at <https://goldstandard.org>, under **Gold Standard and Partners start work to define future of digital carbon market**) announced that Gold Standard working groups are developing digital solutions and governance frameworks for: **1.** Digital Monitoring, Reporting and Verification (**MRV**); **2.** Digital Assets for Climate Impact, and **3.** Digital Infrastructure and Open APIs, with the intention to develop carbon markets that accelerate climate mitigation and sustainable development.
- **Treasure Trove: Carbon Growth Partners** continues to share articles on a range of topics. **Edition 45** of **Low Carbon Pulse** covered **Carbon Credits 101, Episode 3: Less Harm, Or More Good?** Since then Carbon Growth Partners have published **Carbon Credits 101, Episode 4: Understanding COP26** and **Carbon Credits 101, Episode 5: How To Build a Forest**.

For ease of reference, links are attached to **Episodes 1** and **2** (**Episode 1: Building A Better Cookstove, Episode 2: Mongolia's Power of the Wind**) in the **101-series**. In addition, **Carbon Credits 101, Prologue: The Carbon Market Explained** is attached.

E-fuels & feedstocks / Future Fuels & Feedstocks / Now Fuels & Feedstocks:

- **TOTALenergies infographic:** Various editions of **Low Carbon Pulse** have included infographics from the good folk at **TOTALenergies**. On **August 3, 2022**, the team at **TotalEnergies Green Gas and LNG** published the following infographic outlining some of the means of production and storage of hydrogen, and its distribution. As always, with infographics from **TOTALenergies**, the infographic is excellent.

HYDROGEN PRODUCTION ECOSYSTEM



- **B&W and Newpoint Gas combine to advance hydrogen:** On **August 1, 2022**, it was reported widely the **Babcock and Wilcox** and **Newpoint Gas** had teamed up to explore the use of the former **US DOE** Portsmouth Gaseous Diffusion Plant site to produce hydrogen (using the Babcock and Wilcox BrightLoop™ technology) and to capture **CO₂** arising from hydrogen production for its storage (and to supply the Babcock and Wilcox BrightGen™ hydrogen combustion technology).
- **PT Pertamina (Persero) plans pilot project:** On **August 2, 2022**, it was reported widely that **PT Pertamina** plans a pilot project to produce Green Hydrogen using renewable electrical energy generated at its **Ulubelu Geothermal** project.
- **Wintershall Dea and Noord-West Oelleitung go blue:** It has been reported widely that on **August 2, 2022**, **Wintershall Dea** (the largest independent oil and natural gas producer in Europe) and **Noord-West Oelleitung** entered into a memorandum of understanding (**MOU**) in respect of the development of the **BlueHyNow** hydrogen production facility to be located on the **Noord-West Oelleitung** site at Wilhelmshaven. **Wintershall Dea** and **Noord-West Oelleitung** will work together in relation to the development of the **BlueHyNow** hydrogen production facility which will use natural gas sourced from Norwegian natural gas fields as feedstock for the production of Blue Hydrogen, with the Blue Hydrogen to be transported to customers of **Wintershall Dea** using pipeline infrastructure owned and operated by **Noord-West Oelleitung**.
- **Project Bad Lauchstädt progresses:** On **August 4, 2022**, **Uniper** announced (<https://www.uniper.energy/news> (under **Hydrogen Lighthouse Project Bad Lauchstadt: Uniper orders Sunfire Electrolyser**) that the **Bad Lauchstadt energy park** is to enter execution phase, with **Uniper** having ordered a 30 MW pressurized alkaline electrolyser from **Sunfire GmbH**, with delivery scheduled for 2024.
- **At Liberty Hydrogen:** On **August 4, 2022**, **Liberty Hydrogen** [announced](#) plans to develop a **100,000 metric tonnes** a year clean and renewable ammonia production facility in Western Australia using wood waste as feedstock to produce clean and renewable hydrogen, which will then be compounded with nitrogen.
- **New Fortress Energy Inc. Plugged in:** On **August 4, 2022**, it was reported widely that **New Fortress Energy Inc** and **Plug Power Inc** had contracted for the supply of **120 MW** (50 metric tonnes a day, and 18,250 metric tonnes a year) of proton exchange membrane (**PEM**) electrolysers for the industrial-scale Green Hydrogen production facilities to be developed by **New Fortress Energy** near Beaumont, Texas. As reported, the Green Hydrogen production facility will be scalable to **500 MW**.
- **AGL Energy and FFI expand thinking:** Edition **32** of Low Carbon Pulse reported on feasibility study to be undertaken by **AGL Energy** and **FFI** as to assess the development of the Hunter Energy Hub.
On **August 9, 2022**, it was reported widely that **AGL Energy** and **FFI** had agreed to expand the size and scope of the feasibility study to **2 GW** and to include new partners **Inpex**, and **APA** and **Jemena**.
By way of reminder: Edition **41** of Low Carbon Pulse (under **AGL leading two feasibility studies on BESS**) reported that **AGL Energy Limited** (one the Big Three integrated energy corporations in Australia) was undertaking feasibility studies in respect of two sites, one at its **Liddell** site, in the Hunter Valley, New South Wales, and the other at **Torrens Island**, its site in South Australia.
In respect of the **Liddell** site, **AGL Energy** was working with **Fortescue Future Industries** (see Edition **32** of Low Carbon Pulse) and **Osaka Gas Australia**, now joined by new partners **Inpex**, and **APA** and **Jemena**.
In respect of the **Torrens Island** study, **AGL Energy** is working with (in alphabetical order), **Adbri** (leading cement manufacturer), **Brickworks** (leading building products manufacturer), **Flinders Ports** (the leading port operator in South Australia), **Inpex** (leading international energy corporation), **Osaka Gas Australia** (leading international gas

and power corporation), **SK ecoplant** (a wholly-owned subsidiary of SK Group), and **Spark Renewables** (leading renewable energy development corporation).

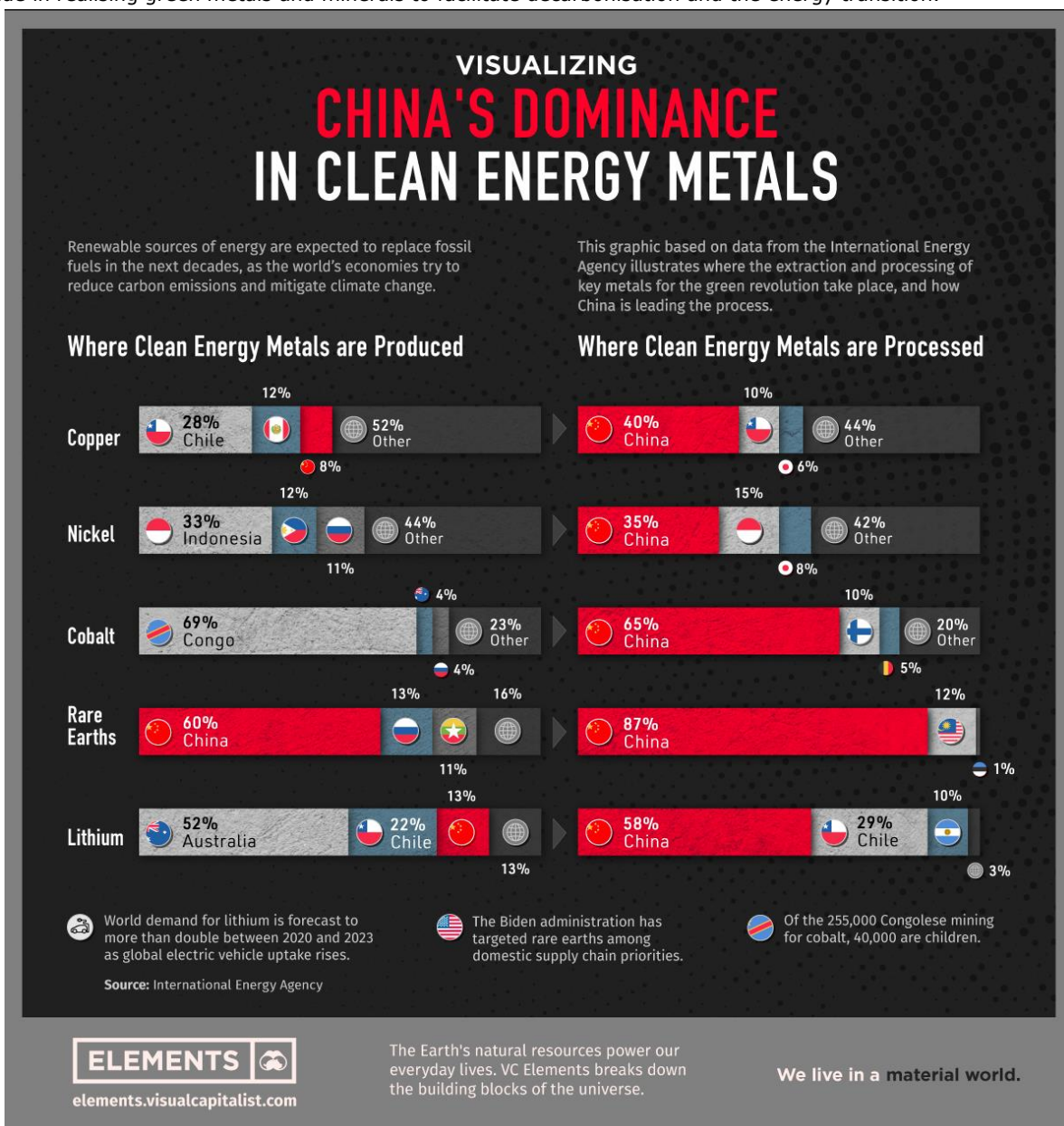
- **Cumbrian hydrogen hub:** On **August 10, 2022**, it was reported widely that **Barrow Borough Council, Carlton Power, Cumbria Local Enterprise Partnership** and **Electricity North West** had signed a memorandum of understanding to develop a **35 MW** hydrogen hub in coastal town of Barrow-in-Furness, Cumbria, England.

Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories:

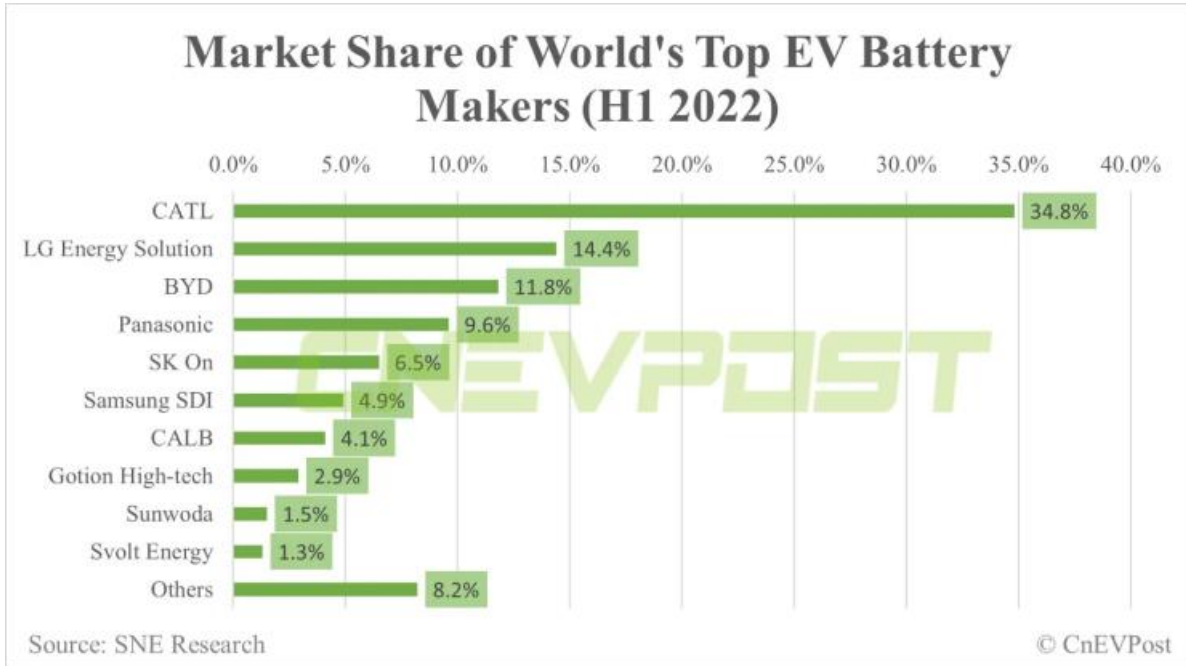
- **Sustainable Cities:** On **August 2, 2022**, the good folk at the **Global Environment Facility (GEF)** published [*Advancing Urban Sustainability for Green Recovery – Learning from the GEF's Sustainable Cities Program*](#). The publication is well-worth a read, providing helpful and informative guidance on practical matters.
- **Navantia to build 500 MW electrolyser manufacturing plant:** On **August 3, 2022**, <https://rechargenews.com>, under **EXCLUSIVE/Shipbuilder Navantia to build 500 MW hydrogen electrolyser plant with "world-renowned technologist"**, reported that Spanish shipbuilder **Navantia** intends to develop an assembly line in northwest Spain for the assembly of 500 MW of electrolysers initially, with the ability to increase rapidly the assembly capacity.
- **Nel doubles up:** On **August 11, 2022**, it was reported widely that **Nel** is to develop a second production line at its giga-factory located in Herøya, Norway – see **Editions 34** and **39** of Low Carbon Pulse.

Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

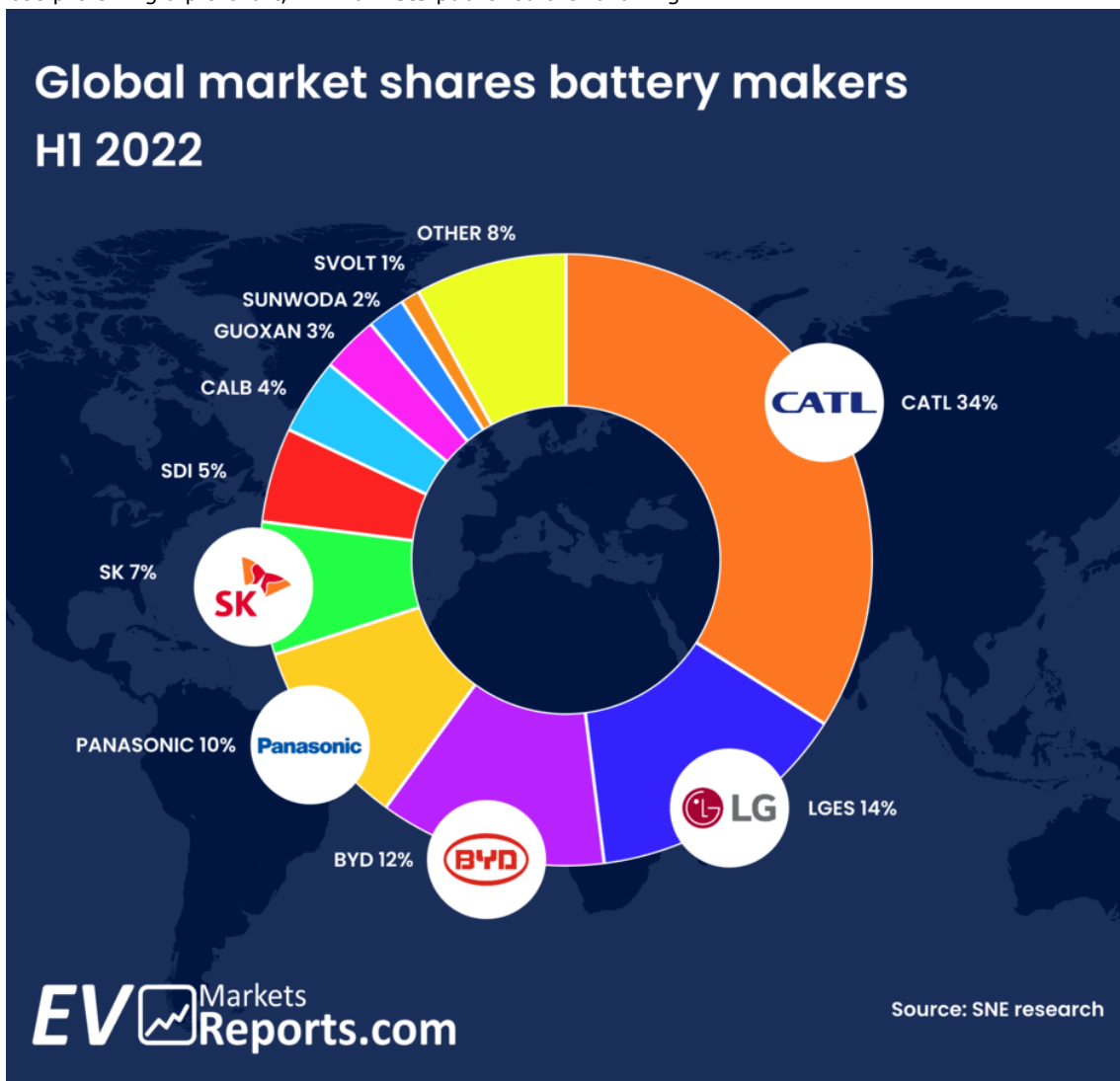
- **Size and scope of green metals and minerals:** During the week beginning **August 8, 2022**, the good folk at the **Visual Capitalist** provided us with the following infographic providing a clear sense of the progress that the **PRC** has made in realising green metals and minerals to facilitate decarbonisation and the energy transition.



- **Size and scope of EV battery market:** On **August 8, 2022**, **Batteries News** (at <https://batteriesnews.com>, under **CATL Holds 34.8% of Global Power Battery Market in H1**) reported on the global power battery market for H1 of 2022. The bar chart below provides a summary of the market share of each battery manufacturer.



For those preferring a pie-chart, **EV Markets** published the following:



- **140 MW roof-top array:** On **August 9, 2022**, **PV Magazine** (at <https://www.pv-magazine.com> (under **140 MW rooftop PV project to help carbon-free 'green' steel industry**) reported that **SolarApex** had built the world's largest roof-top photovoltaic solar array to help **Tosyali** (Turkish iron and steel producer) to move to carbon-free 'green steel' production.

Wind round-up, on-shore and off-shore:

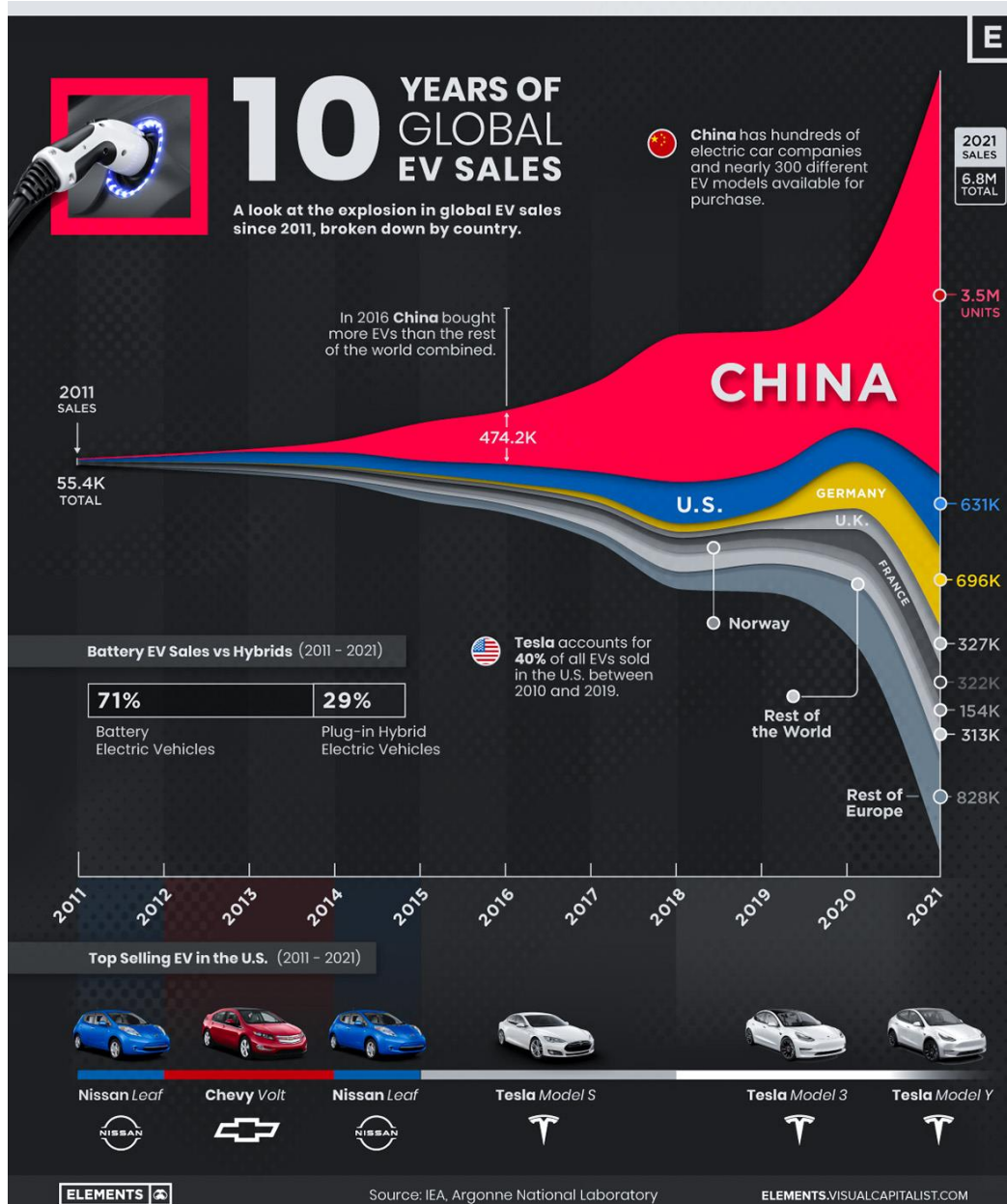
- **First electrical energy from Hollandse Kust Zuid:** On **August 7, 2022**, **Renew Economy** (at <https://www.reneweconomy.com.au>, under **World's first subsidy free offshore wind farm starts to produce power**) reported that electrical energy from the 140, 11 MW, wind turbine, **1.5 GW, Vattenfall Hollandse Kust Zuid** offshore wind field project, had been dispatched to the grid in the Netherlands. The award to **Vattenfall** was on the basis that it would be a truly merchant offshore wind field project, dispatching electrical risk and assuming the risk of the price of that electrical energy.
- **US backs offshore wind in the Philippines:** On **August 8, 2022**, **Offshore Wind** (at <https://www.offshorewind.biz>, under **US Backs Philippines Offshore Wind Development**) reported that the US Trade and Development Agency (**USTDA**) had awarded a grant to Aboitiz Renewables, a subsidiary of **Aboitiz Power Corporation**, to fund a feasibility study to develop up to **3 GW** of off-shore wind field capacity off-shore of the Philippines. As reported, the feasibility study will be undertaken with the Rocky Mountain Institute and Clime Capital Management (based in Singapore).
- **Financing off-shore wind field projects:** On **August 9, 2022**, the good folk at **BlueFloat Energy, BVG Associates, Reuters Events** and **Vestas** released **Financing Offshore and Floating Wind Projects** (to be found at <https://1.reuters-events.com>, under **Analysis: Financing Offshore Wind**). The publication provides an overview of the current key dynamics, and is well-worth a read.
- **California firms to 25 GW of offshore floating: Edition 45** of **Low Carbon Pulse** reported on the desire of the Governor of California, Mr Gavin Newsom, for the US State of California to commit to the development of 25 GW of offshore floating wind field capacity. On **August 10, 2022**, California committed to **25 GW** of offshore floating wind field capacity **by 2045**, and **5 GW by 2030**, with the **California Energy Commission** changing policy settings for these purposes.
- **Copenhagen Energy goes offshore Western Australia:** On **August 12, 2022**, it was reported widely that **Copenhagen Energy** has submitted a proposal to develop a **3 GW** offshore wind project offshore of the coast of Western Australia, north of Geraldton. As reported, the proposed development straddles Federal waters and Western Australian State waters.

Solar and Sustainability (including NZE Waste):

- **ENEOS and TotalEnergies good to go:** On **August 5, 2022**, it was reported widely that **ENEOS** and **TotalEnergies** had obtained clearance for their joint venture. The **ENEOS / TotalEnergies** incorporated joint venture, named **TotalEnergies ENEOS Renewables Distributed Generation Asia Pte Ltd**, plans to develop **2 GW** of photovoltaic solar projects across Asia over the next five years on a business-to-business basis, the joint venture company contracting under power purchase agreements to provide renewable electrical energy sourced from the **2 GW** of photovoltaic solar projects.
- **Holcim produces 100% recycled clinker:** On **August 4, 2022**, **Holcim** announced (at <https://www.holcim.com>, under **A World First: Holcim Produces 100% Recycled Clinker**) that it had produced clinker made entirely from recycled materials at its plant in Altkirch, France.
- **Nigeria secures US Export-Import Bank loan:** On **August 8, 2022**, **Energy & Utilities** (at <https://www.energy-utilities.com>, under **Nigeria solar power development to get boost from US loan**) reported that leading Nigerian newspaper, **The Day**, had reported that Nigeria had secured a 20 year **USD 1.5 billion** term loan facility from **US Export-Import Bank** to fund the development of photovoltaic infrastructure.

Land Mobility / Transport:

- **Buses and coaches:**
 - **Dresden Line 68 electric:** On **August 8, 2022**, **Daimler Truck AG** (at <https://media.daimlertruck.com>, under **Electrifying Dresden: Transport companies in the state capital are switching to electric on the 68 bus route with Mercedes-Benz eCitaro**) announced that from August 8, 2022, **Dresdner Verkehrsbetriebe** was using electric battery buses along the backbone of the public transport system in Dresden, Saxony.
 - **Brisbane City Council order 60 electrics:** On **August 8, 2022**, **Sustainable Bus** (at <http://www.sustainable-bus.com>, under **Brisbane has officially ordered 60 extralong e-buses**) reported that **Brisbane City Council**, specifically, its **Metro Project**, had ordered 60 high-capacity, extralong (at 24.5 metres) bi-articulated battery electric buses from **HESS** (leading Swiss manufacturer), with deliveries to commence in 2023. The **Metro Project** will be powered by the first flash charging system in Australia, to be supplied and installed by **Hitachi Energy**, working with **HESS**.
- **Cars and taxis (and light-vehicles generally):**
 - **The EV's journey:** On **August 9, 2022**, the following infographic was published by the good folk at the [Visual Capitalist](https://www.visualcapitalist.com).



As will be apparent, the **PRC** and the EU are leading the way in the EV journey.

- **BMW and Toyota to deliver FCEV SUV by 2025:** On **August 12, 2022**, **autoevolution** (at <https://www.autoevolution.com>, under **Hydrogen-Powered BMWs Co-developed With Toyota Are Coming in 2025**) reported that **BMW** plans to develop a the **iX5 Hydrogen**, working with Toyota (including using fuel-cell technology developed by Toyota).

- **Battery, Fuel Cell and ICE Technology:**

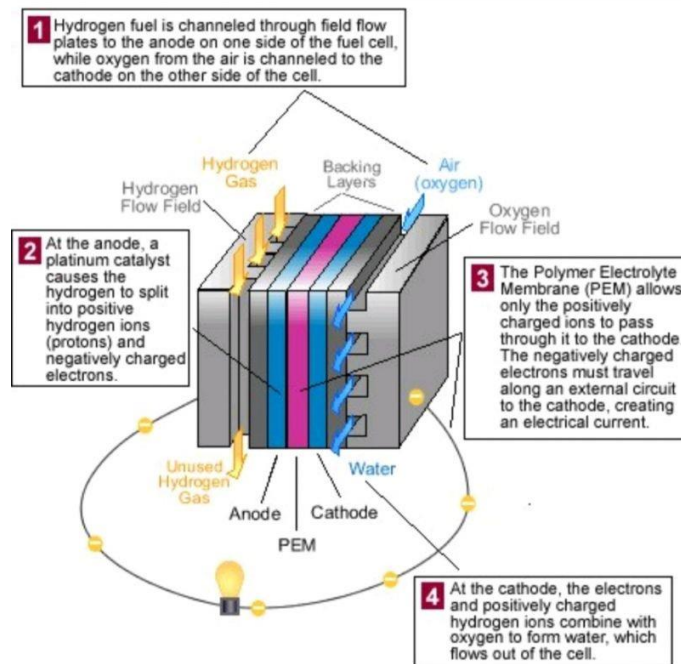
- **Technology insight:** [Sustainable-bus.com](https://www.sustainable-bus.com) has run a series of articles about the application of hydrogen. In an article on the main benefit of the use a high voltage battery in fuel-cell technology buses it is stated that use increases efficiency through more efficient energy management, with electrical energy provided more flexibly from a combination of battery and fuel-cells.

The key components of a hydrogen powered and propelled vehicle using fuel-cell and battery technology are the battery, the fuel-cell, the hydrogen fuel containment tank, the electric motor and the power control system. The fuel-cell, with oxygen from the environment, and the hydrogen from the containment tank, produce electrical energy, and the power control system determines whether the electrical energy is to be stored in the battery or is to be used directly to power and to propel the bus, while at the same time ensuring that the there is sufficient electrical energy stored within the battery.

While this is the main benefit, the combined hybrid battery and fuel-cell technology bus can provide power and propulsion simultaneously to provide increased power, critically, during acceleration.

- **How do fuel-cells work?**

One of the questions that the author of Low Carbon Pulse is asked most frequently is to explain how fuel-cell technology works. On **August 12, 2022**, the author came across the following diagram, which provides a clear and excellent answer:



- **Industrial Vehicles and Trucks:**

- **Road loaded:** On **August 9, 2022**, **H2 View** (at <https://www.h2-view.com>, under **5,000 hydrogen-powered trucks purchased in 'low single-digit' billion euro deal**) reported that **GP Joule** has announced on **August 8, 2022**, that it would purchase **5,000 40 metric tonne** hydrogen powered and propelled trucks from **Clean Logistics** through 2027. The trucks will use heavy semi-trailer tractor units combining fuel-cell and battery electric technologies. For **GP Joule**, the acquisition and deployment of the trucks will enable it to provide customers with a one-stop supply / value chain, with **GP Joule** to procure and to produce Green Hydrogen, to develop and to deploy hydrogen fuelling / refuelling stations, and to offer trucks to haulage companies. A business model matching supply and demand.
- **Retrofitting trucks:** On **August 9, 2022**, **Fuel Cell Works** (at <https://www.fuelcellworks.com>, under **TECO 2030: the Market for Hytruck Concept**), reported on the European truck market and the plans of **TECO: 2030** (see **Edition 31** of Low Carbon Pulse) to mobilise its **HyTruck** concept. Currently there is around 6.2 million trucks in use across the European Union, each with an average life-cycle of 13 years. The **HyTruck** concept is to retrofit existing trucks with fuel-cell and battery electric technologies to achieve zero-emission hydrogen haulage. In 2021, 96.5% of new truck sales were diesel powered and propelled, 0.1% motor spirit, and 3.4% other fuels, with GHG emissions from diesel powered and propelled truck accounting for around 6% of total EU GHG emissions, and 25% of GHG emissions arising from road transport.

- **Recharging and refuelling infrastructure:**

- **Air Liquide to supply Viva:** **Edition 36** of Low Carbon Pulse reported the planned development and deployment by **Viva Energy Australia** of a **New Energies Service Station** located at a site in **Geelong, Victoria**. On **August 4, 2022**, it was reported widely that **Air Liquide** is to supply hydrogen to **Viva Energy Australia**, being the first hydrogen fuelling / refuelling station that **Air Liquide** is to supply in Australia.
- **Jet Charges WA:** On **August 10, 2022**, it was reported widely that the Government of Western Australian had awarded **Jet Charge** the contract to deploy 98 EV chargers at 49 locations in Western Australia. The EV chargers will be deployed from Kununurra in the north of Western Australia, to Esperance in the south, and to Eucla in the east, with 6,600 kms of coverage.

- **Trains:**

- **Alpha Project on track:** On **August 1, 2022**, it was reported widely that **Ofgem** is to provide funding support, from its **Strategic Innovation Fund**, to enable the progress of the **Alpha Project**, a pilot project under which Green Hydrogen is to be used to power and to propel prototype fuel-cell technology trains, as part of the plan to replace diesel powered and propelled trains across the Scottish rail network by 2035. For previous reporting on this initiative, see **Edition 37** of Low Carbon Pulse.
- **FCH2RAIL commences dynamic testing:** **Edition 42** of Low Carbon Pulse reported on static tests by **CAF** in respect of the static testing of the electrical energy generation system of **FCH2RAIL**. During the week commencing **August 8, 2022**, it was reported widely that **CAF** is to commence dynamic testing of its train on track. The results of the static and dynamic tests will allow a clear view to be reached on the use of a hydrogen powered and propelled train in contrast to the use of diesel powered and propelled trains. (See **Editions 26** and **35** of Low Carbon Pulse for other reporting in respect of **FCH2RAIL**.)

Ports Progress and Shipping Forecast:

- **Ferries and other craft:**

- **ERGO ARGO FOR CARGO:** On **August 9, 2022**, **Splash 247** (at <https://splash247.com>, under **Shippers sign up for revolutionary hydrogen-powered box-carrying hydrofoil**) reported that **Boundary Layer Technologies** had announced that key Fortune 500 corporations will be "launch partners" for its zero-emission

freight service to launch in 2025. The freight service will be provided using a high-speed, hydrogen powered and propelled hydrofoils named **ARGOs**.

- **LNG to NH₃**: On **August 9, 2022**, **Offshore Energy** (at <https://www.offshore-energy.biz>, under **NYK inks deal to convert LNG-fuelled tugboat to ammonia**), reported that **NYK Group** is to convert a tugboat (operated by NYK Group corporation, Shin-Nippon Kaiyosha Corporation), in Tokyo Bay, to use ammonia for power and propulsion, with the conversion scheduled for completion in 2024.
- **Venice last mile hydrogen delivery service: H2 View** (at <https://www.h2-view.com>, under **Venice waterways welcome a hydrogen-powered delivery service**) reported that on **August 10, 2022**, **Nippon Express Italia** announced that it had launched a last mile delivery service us hydrogen powered and propelled vessels to make deliveries within Venice, Italy.

- **Green Corridors:**

- **Port of Rotterdam to Port of Singapore**: On **August 2, 2022**, two of the world's giant port authorities, the **Port of Rotterdam Port Authority (PORA)** and the **Maritime and Port Authority of Singapore (MPA)** announced that they are to establish the longest **Green and Digital Corridor** in the world. For these purposes, the **MPA** and **PORA** have signed a memorandum of understanding so as to promote and to enable lower, low and zero carbon shipping along the Green Corridor.

For a fuller report please view **Maritime and Port Authority of Singapore and Port of Rotterdam to establish world's longest Green and Digital Corridor for efficient and sustainable shipping**, at <https://www.zerocarbonshipping> and **Singapore and Rotterdam to Establish 'World's Longest' Green Shipping Corridor** at <https://gcaptain.com>. For previous news items on Green Corridors in Low Carbon Pulse, please see **Editions 30, 34** and **35**.

By way of reminder:

- **Edition 30** of Low Carbon pulse reported on Green Shipping Corridors as follows:

"Clydebank Declaration: On November 10, 2021, the **Clydebank Declaration** was agreed at **COP-26**. The **Clydebank Declaration** emphasises the importance of limiting "the increase in global average temperature to **1.5°C** above pre-industrial levels", expressed great concern that if "no further action is taken, international shipping emissions are expected to represent 90% to 130% of 2008 emissions levels by 2050", and recognised that "a rapid transition in the coming decade to clean maritime fuels, zero-emission vessels, alternative propulsion systems, and the global availability of landside infrastructure to support these, is imperative for the transition to clean shipping".

In addition the signatories to the **Clydebank Declaration** committed facilitate the development of **Green Shipping Corridors**, with at least six **Green Shipping Corridors** by "the middle of this decade ... [and] many more corridors ... by 2030". A **Green Shipping Corridor** is a route between two or more ports that are "zero-emission maritime routes".

The signatories to the **Clydebank Declaration** are: Australia, Belgium, Canada, Chile, Denmark, Fiji, Finland, France, Germany, Republic of Ireland, Italy, Japan, Republic of the Marshall Islands, Morocco, the Netherlands, Norway, Spain, Sweden the UK, and the US.

- **Edition 34** of Low Carbon Pulse reported the Los Angeles and Shanghai Green Corridor as follows:

"On January 28, 2022, or thereabouts, it was reported widely that the Port of Los Angeles, the Port of Shanghai and **C40 Cities** (a global network of mayors taking action to confront climate change), are to create the first transpacific Green Shipping Corridor between the US and the **PRC**.

It is difficult to overstate the significance of the establishment of the first transpacific Green Shipping Corridor between the US and the **PRC**. The US and the **PRC** have the largest bilateral trading relationship globally, and the ports of Los Angeles and the Shanghai are key gateways to the seaborne trade, which accounts for the vast majority of trade."

- **Green Ports:**

- On **August 1, 2022**, the **Port of Amsterdam** and **Duisport** signed a memorandum of understanding to expand their existing cooperation to develop jointly a hydrogen supply / value chain and hinterland network. It is understood that the hydrogen supply / value chain will provide end-to-end capacity for producers and carriers of Green Hydrogen between the two ports.
- On **August 8, 2022**, **H2 View** (at <https://www.h2-view.com>, under 'Multi-hundred megawatt' hydrogen hub plans for UK's busiest port) reported that **ScottishPower** (owned by Iberdrola) had revealed plans to develop, build and operate a 'multi-hundred megawatt' Green Hydrogen production facility at the **Port of Felixstowe**, Suffolk, England. Hydrogen Director for Scottish Power, Mr Barry Carruthers, said: "*This strategically important project could potentially create a clean fuels hub that could unlock nationally significant decarbonisation for the region, as well as playing a role in international markets*".

- **Green shipping:**

- **LPG and LAG carriers ordered:** Various editions of Low Carbon Pulse have reported on the use dual-purpose / use carriers – liquified petroleum gas (**LPG**) and liquified ammonia gas (**LAG**), and the likelihood of increased development and use. On **August 5, 2022**, [off-shore-energy.biz](https://www.offshore-energy.biz) (under **Kawasaki books order for LNG-powered newbuild from NYK**) reported that **Kawasaki Heavy Industries (KHI)** had concluded a shipbuilding contract with for a **86,700 m³** LPG / LAG carrier with **Nippon Yusen Kabushiki Kaisha (NYK)**. As reported the LPG / LAG carrier is equipped to carry LPG and LAG at the same time, but in separate containment tanks (having separate systems). The LPG / LAG carrier is schedule for delivery in 2025, and follows an order from Kumiai for a like carrier, with an option for another.

KHI stated: "*The advantage of this dual-purpose vessel is its capability to carry simultaneously LPG, which is already used as a low-carbon energy source, and NH₃, new fuel contributing to the establishment of a decarbonized*

society. Another feature is the greater capacity of the cargo tanks as compared to conventional carriers, which was achieved without changing significantly the vessel's length, breadth or other main specifications".

[**Note:** As noted in previous editions of Low Carbon Pulse, while **NH₃** is carbon free on oxidation it gives rise to nitrous oxide (**N₂O**) which is a **GHG**, being one of the three well-mixed **GHGs**, along with **CO₂** and **CH₄**]

- **PETRONAS and signs with six ROC corporations:** On **August 2, 2022**, it was reported widely the **PETRONAS** had signed a memorandum of understanding (**MOU**) with **GS Energy Corporation, Lotte Chemical Co, Samsung Engineering, Samsung Heavy Industries, SK Earthon and SK Energy**. Under the **MOU**, the parties are to assess carbon storage sites within Malaysia, and assess the entire **CO₂** supply / value chain, including the cross-border import of **CO₂** into Malaysia.
- **All abroad for carbon capture:** On **August 5, 2022**, **Splash 247** (at <https://splash247.com>, under **Cosco and Dalian develop tankers with carbon capture tech**) reported that **Dalian Shipbuilding Industry Co (Dalian)** and **Cosco Shipping Energy Transportation (Cosco)** had developed two types of tankers equipped with carbon capture and storage systems. The two types of tankers are a very large crude carrier (**VLCC**) and a **suezmax**, each of which has obtained approval in principle (AIP) issues by **ABS, CCS and DNV**.
- **More sails:** On **August 10, 2022**, it was reported that **BHP** is to work with **Norse Power Oy Ltd** and **Pan Pacific Copper Co Ltd** to assess the installation of a wind-assisted propulsion system on a combination carrier trading between Chile and Japan.
- **More methanol:** On **August 10, 2022**, it was reported widely that **MAN Energy Solutions** and **Stena Teknik** are to work together, with **Proman**, to retrofit **MAN 48/60** engines to make them dual-fuel compatible, diesel and methanol. For these purposes, these leading corporations have signed a memorandum of understanding.

Airports and Aviation:

- **Lufthansa and Shell bind over SAF:** On **August 1, 2022**, **Shell** announced (at <https://shell.com>, under **Shell and Lufthansa Group sign non-binding Memorandum of Understanding for sustainable aviation fuel (SAF supply)**) that it and **Lufthansa** are exploring the supply of up to **594 million gallons (1.8 million metric tonnes)** of **SAF**. **Shell** would produce the **SAF** using four different approved technology pathways using feedstock from a broad range of sustainable sources.
- **American Airlines invests in ZeroAvia:** On **August 3, 2022**, **ZeroAvia** announced (at <https://www.zeroavia.com>, under **American Airlines Announces Investment in Hydrogen-Electric Engine Developer ZeroAvia**) that **American Airlines** (the world's largest airline) had invested in **ZeroAvia** and signed a memorandum of understanding under which it may order up to **100 ZeroAvia** hydrogen-electric engines (intended to power and to propel regional jet engine aircraft).
- **Brisbane Airport timeline accelerated:** On **August 5, 2022**, it was reported (at <https://newsroom.bne.com.au>, under **Brisbane Airport accelerates net zero target by 25 years**) that **Brisbane Airport Corporation (BAC)** had "slashed its net zero emissions deadline by 25 years, in a bold move to improve the planet", with the aim to each net zero emissions by 2025, in contrast to 2050.

The Chief Executive Officer of **BAC**, Mr Gert-Jan de Graff, said that: "*BNE is more than an airport. We are a sustainability leader. We want to create a world-leading Airport City that future generations can be proud of, because of how we acted today, to protect the community of tomorrow*".

The accelerated net zero target is in respect of Scope 1 and 2 emissions. To achieve net zero in respect of Scope 1 and 2 emissions, **BAC** has committed to transition to 100% renewable electrical energy, to operate all electric vehicles and to develop an onsite carbon removal project within its Biodiversity Zone (being an area of 285 hectares within the precinct of BNE airport to preserve biodiversity, and "to act as an improved carbon removal asset").

In addition, **BAC** is committed to sourcing 50% of its water from recycled sources, and to achieve zero waste to landfill by 2030.

BAC is a signatory to the **Clean Skies for Tomorrow** initiative, under which it is committed to the acceleration of the supply and use of **SAF** by 2030, and has recently become a signatory to the Mission Possible Partnership Aviation Strategy (see **Edition #** of Low Carbon Pulse).

- **bp aims to start producing green jet fuel:** Taking up the theme of **SAF** from the previous piece, **bp** is to produce **SAF** at its Perth Future and Renewable Fuels refinery in Perth, Western Australia.

NZE reports

Please see below a list of reports that have been reviewed for Editions 39 to 46 of Low Carbon Pulse. This list includes the publishing organisation, title/subject matter, and link.

ORGANISATION	TITLE / SUBJECT MATTER	EDITION
Department of Business, Energy and Industrial Strategy (BEIS)	<u>Atmospheric Implications of Increased Hydrogen Use</u>	39
Department of Business, Energy and Industrial Strategy (BEIS)	<u>Hydrogen investor roadmap: leading the way to net zero</u>	39
Department of Business, Energy and Industrial Strategy (BEIS)	<u>CCUS Investor Roadmap – Capturing Carbon and a Global Opportunity</u>	39
Department of Business, Energy and Industrial Strategy (BEIS)	<u>UK Low Carbon Hydrogen Standard: emissions reporting and sustainability criteria</u>	39
European Hydrogen Backbone (EHB)	<u>European Hydrogen Backbone – April 2022</u>	39
Global Wind Energy Council (GWC)	<u>Global Wind Report 2022</u>	39
Government of United Kingdom	<u>Policy Paper – British energy security strategy</u>	39
Institute of Energy Economics at the University of Cologne (EWI)	<u>Development of Hydrogen Market in Eastern Germany – An Infrastructure analysis based on regional potentials and demand</u>	39
International Energy Agency (IEA)	<u>Direct Air Capture – A key technology for net-zero</u>	39
International Energy Agency (IEA)	<u>Sustainable Recovery Tracker – Monitoring Progress towards sustainable recoveries from the Covid-19 crisis</u>	39
International Energy Agency (IEA)	<u>Gas Market Report, Q2-Analysis, including Global Gas Review 2021</u>	39
International Energy Agency (IEA)	<u>Belgium 2022 – Energy Policy Review Report</u>	39
International Renewable Energy Agency (IRENA)	<u>Decarbonising end-use sectors: Green hydrogen certification</u>	39
International Renewable Energy Agency (IRENA)	<u>Renewable Capacity Statistics 2022</u>	39
McKinsey & Co	<u>Global Energy Perspective 2022</u>	39
National Renewable Energy Laboratory (NREL)	<u>Bioqas Potential in the United States (Fact Sheet), Energy Analysis</u>	39
The World Bank	<u>Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition-Technical Paper</u>	39
Clean Air Task Force (CATF)	<u>A European Strategy for Carbon Capture and Storage</u>	40
European Commission (EC)	<u>EU Save Energy Communication</u>	40
European Commission (EC)	<u>draft Delegated Acts</u>	40

ORGANISATION	TITLE / SUBJECT MATTER	EDITION
European Commission (EC) and the European Investment Bank (EIB)	<u>Unloading the hydrogen economy - stimulating investment across the hydrogen value chain</u>	40
Global CCS Institute	<u>State of the Art: CCS Technologies 2022</u>	40
Green Hydrogen Organisation	<u>The Green Hydrogen Standard</u>	40
International Energy Agency (IEA)	<u>Renewable Energy Market Update – May 2022 – Outlook for 2022 and 2023</u>	40
International Energy Agency (IEA)	<u>Global EV Outlook 2022</u>	40
International Energy Agency (IEA)	<u>Southeast Asia Energy Outlook 2022</u>	40
International Energy Agency (IEA)	<u>Enhancing China's ETS for Carbon Neutrality: Focus on the Power Sector</u>	40
International Energy Agency (IEA)	<u>Renewable Energy Market Update: Key Findings</u>	40
International Renewable Energy Agency (IRENA)	<u>Global Hydrogen Trade To Meet The 1.50C Climate Goal – Part I – Trade Outlook for 2050 and way forward</u>	40
International Renewable Energy Agency (IRENA)	<u>Global Hydrogen Trade To Meet The 1.5°C Climate Goal – Part II – Technology Review of Hydrogen Carriers</u>	40
International Renewable Energy Agency (IRENA)	<u>Global Hydrogen Trade To Meet The 1.50C Climate Goal – Part III – Green hydrogen supply cost and potential</u>	40
International Renewable Energy Agency (IRENA)	<u>Critical Materials for Energy Transition: Rare Earth Elements – Technical Paper 2/2022</u>	40
International Renewable Energy Agency (IRENA)	<u>Innovation Outlook: Renewable Ammonia</u>	40
Microsoft	<u>Accelerating the Journey to Net Zero – A Blue Print for Australia</u>	40
MIT Energy Initiative	<u>The Future of Energy Storage</u>	40
National Renewable Energy Laboratory (NREL)	<u>Bioogas Potential in the United States (Fact Sheet), Energy Analysis</u>	40
The Oxford Institute for Energy Studies (OIES)	<u>The role of CCUS in decarbonising the cement industry: A German case study</u>	40
World Bank	<u>State and Trends of Carbon Pricing 2022</u>	40
World Metrological Organisation (WMO)	<u>State of the Global Climate 2021</u>	40
bp	<u>Statistical Review 2022</u>	41
Department for Business, Energy & Industrial Strategy (BEIS)	<u>Carbon Capture, usage and storage (CCUS): business models</u>	41
DNV	<u>Hydrogen Forecast to 2050 – Energy Transition Outlook 2022</u>	41
Ember	<u>New Generation – Building a clean European electricity system by 2035</u>	41
European Association of Energy Storage (EASE)	<u>Energy Storage Targets 2030 and 2050</u>	41

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Guidehouse	<u>Imports will be a cornerstone for Meeting Germany's Hydrogen Demand</u>	41
International Council on Clean Temperature (ICCT)	<u>Vision 2050: Aligning Aviation with the Paris Agreement</u>	41
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International Energy Agency (IEA)	<u>The value of urgent action on energy efficiency</u>	41
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International Renewable Energy Agency (IRENA)	<u>Renewable Energy for Agriculture: insights from Southeast Asia</u>	41
International Renewable Energy Agency (IRENA)	<u>Powering Agri-food value Chains with Geothermal Heat: A Guidebook for Policy Makers</u>	41
Jacobs Engineering	<u>Airports as Catalysts for Decarbonisation</u>	41
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MIT Energy Initiative	<u>The Future of Energy Storage</u>	41
National Energy Technology Laboratory (NETL)	<u>Rare Earth Elements and Critical Minerals</u>	41
REN21	<u>Renewables 2022 Global Status Report</u>	41
REN21	<u>Global Status Report 2022 - Key Messages for Decision Makers</u>	41
Saudi Aramco	<u>Energy security for a sustainable world</u>	41
Shell	<u>Achieving A Carbon-Neutral Energy System in China by 2060</u>	41
The International Council on Clean Transportation (ICCT)	<u>Canada's Path to 100% zero-emission light-duty vehicle sales: regulatory options and greenhouse gas impacts</u>	41
Wetlands International	<u>We need wetlands: The urgent cast for global wetlands targets</u>	41
American Bureau of Shipping (ABS)	<u>Setting the Course to Low Carbon Shipping – Zero Carbon Outlook</u>	42-45
Asian Development Bank (ADB)	<u>Integrating Nature-Based Solutions for Climate Change Adaptation and Disaster Risk Management – A Practitioner's Guide</u>	42-45
Ceres and Clean Air Task Force	<u>Benchmarking Methane and other GHG Emissions of Oil and Natural Gas Production in the United States</u>	42-45
Cities Climate Finance Leadership Alliance	<u>Cities Climate Finance Leadership Alliance published Financing Net Zero Carbon Buildings – A background and scoping paper</u>	42-45

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Commonwealth Scientific and Industrial Research Organisation (CSIRO)	<u><i>Our Future World – Global megatrends impacting the way we live over coming decades</i></u>	42-45
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	<u><i>Hydrogen Business Guide – Bilateral energy partnerships in development countries and emerging markets</i></u>	42-45
Environmental Defense Fund	<u><i>Impact of the Voluntary Carbon Market on Tropical Forest Countries – Implications for Corresponding Adjustments</i></u>	42-45
Environmental Defense Fund	<u><i>Financial Opportunities for Brazil from reducing Deforestation in the Amazon</i></u>	42-45
European Commission	<u><i>Taxonomy Delegated Act 2021</i></u> <u><i>Taxonomy Delegated Act Proposed amendment</i></u>	42-45
European Commission Directorate-General for Research and Innovation	<u><i>The Vital Role of Nature-Based Solutions In a Nature Positive World</i></u>	42-45
European Commission Joint Research Centre (JRC) JRC Technical Report	<u><i>Technologies to Decarbonise the EU Steel Industry</i></u>	42-45
Gas for Climate	<u><i>Biomethane production potentials in the EU</i></u>	42-45
Global CCS Institute	<u><i>The Economics of Direct Air Carbon Capture and Storage</i></u>	42-45
Government of Queensland	<u><i>The Hydrogen Industry Workforce Development Roadmap 2022-2023</i></u>	42-45
House of Lords Economic Affairs Committee	<u><i>Investing in energy: price, security and the transition to net zero</i></u>	42-45
HSBC	<u><i>Scope 3 emissions: The largest piece in the net zero jigsaw</i></u>	42-45
International Energy Agency (IEA)	<u><i>Gas Market Report Q3-2022</i></u>	42-45
International Energy Agency (IEA)	<u><i>Solar PV Global Supply Chains</i></u>	42-45
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International Energy Agency (IEA)	<u><i>Electricity Market Report – July 2022 Update</i></u>	42-45
International Institute for Sustainable Development (IISD)	<u><i>Ocean Conference Final: Earth Negotiations Bulletin</i></u>	42-45
International Renewable Energy Agency (IRENA)	<u><i>Global Hydrogen Trade to Meet the 1.5°C Climate Goal – Part I – Trade Outlook for 2050 and Way forward</i></u>	42-45
International Renewable Energy Agency (IRENA)	<u><i>Renewable Power Costs in 2021</i></u>	42-45
International Renewable Energy Agency (IRENA)	<u><i>Renewable Energy Statistics 2022</i></u>	42-45
International Renewable Energy Agency (IRENA)	<u><i>Scenarios for the Energy Transition – Experience and good practice in Latin America and the Caribbean</i></u>	42-45
International Renewable Energy Agency (IRENA)	<u><i>China's route to carbon neutrality: Perspectives and the role of renewables</i></u>	42-45

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McKinsey & Corporation	<u><i>Making Net-Zero Aviation Possible – An industry-backed, 1.5°C aligned transition strategy</i></u>	42-45
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Mission Possible Partnership	<u><i>Making Net-Zero Aviation Possible – An industry-backed, 1.50C aligned transition strategy</i></u>	42-45
nature geoscience	<u><i>Mapping peat thickness and carbon stocks of the central Congo Basin using field data</i></u>	42-45
National Renewable Energy Laboratory (NREL)	<u><i>Enabling Floating Solar Photovoltaic Deployment</i></u>	42-45
Reserve Bank of India (RBI)	<u><i>Discussion Paper on Climate Risk and Sustainable Finance</i></u>	42-45
Roland Berger and Siemens Energy	<u><i>The MEA Energy Transition Readiness Index</i></u>	42-45
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Sylvera	<u><i>Our Carbon Credit Ratings Framework for REDD+ Projects Reducing Emissions from Deforestation and Forest Degradation Project (REDD+)</i></u>	42-45
The Energy and Resources Institute (TERI)	<u><i>Discussion Paper – Roadmap to India's 2030 Decarbonization Target</i></u>	42-45
UK Department for Business, Energy & Industrial Strategy (BEIS)	<u><i>Business models for engineered greenhouse gas removals: accelerating investment in engineered carbon removals</i></u>	42-45
UK Department for Business, Energy & Industrial Strategy (BEIS)	<u><i>Plans to bolster UK energy security set to become law</i></u>	42-45
UK Department for Business, Energy & Industrial Strategy (BEIS)	<u><i>Energy Security Bill – Building a clean, affordable, home-grown energy system</i></u>	42-45
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UK Department for Business, Energy & Industrial Strategy (BEIS)	<u><i>Feed-In Tariffs & Contracts for Difference schemes and Guarantees of Origin consultation: summary of responses and government response</i></u>	42-45
University of Maryland and the World Resources Institute	<u><i>The Global 2000-2020 Land Cover and Land Use Change Dataset Derived From the Landsat Archive: First Results</i></u>	42-45
Wetlands International	<u><i>The State of Mangroves in the West Indian Ocean</i></u>	42-45
Wood McKenzie	<u><i>Energy super basins: Where the renewable CCS and upstream stars align</i></u>	42-45
WRI India	<u><i>Mumbai Climate Action Plan 2022, Towards A Climate Resilient Mumbai</i></u>	42-45
Wyoming Energy Authority and Cheyenne-Laramie County Corporation for Economic Development	<u><i>Roadmap to Build a Hydrogen Economy</i></u>	42-45
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Key Contacts

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Michael Harrison
Senior Partner, Energy, Resources and Infrastructure
M +65 9728 8562 /+61 439 512 384/
+61 414 968 707
michael.x.harrison@ashurst.com



Richard Guit
Global Co-Head, International Projects
T +65 6602 9153
M +65 9728 7943
richard.quit@ashurst.com



Daniel Reinbott
Partner
T +65 6416 9529
M +65 9728 8672
daniel.reinbott@ashurst.com



Andrew Roche
Partner
T +65 64160272
M +65 97287452
andrew.roche@ashurst.com



Eleanor Reeves
Partner
T +44 20 7859 1210
M +44 7823 340 854
eleanor.reeves@ashurst.com



Caroline Lindsey
Partner
T +61 8 9366 8109
M +61 417 788 649
caroline.lindsey@ashurst.com



Dan Brown
Partner
T +61 7 3259 7149
M +61 401 564 654
dan.brown@ashurst.com



Paul Curnow
Partner
T +61 2 9258 5738
M +61 434 074 591
paul.curnow@ashurst.com



Michael Burns
Partner
T +44 20 7859 2089
M +44 7717 840 646
michael.burns@ashurst.com



Anna-Marie Slot
Global Environmental, Social and Governance Partner
T +44 20 7859 3724
M +44 7788 710 892
anna-marie.slot@ashurst.com



Antony Skinner
Partner
T +44 20 7859 1360
M +44 7917 635 974
antony.skinner@ashurst.com



David Wadham
Office Managing Partner, Tokyo
T +81 3 5405 6203
M +81 90 4828 5191
david.wadham@ashurst.com

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