

Low Carbon Pulse - Edition 41 – June 2022

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 atmosphere, 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**".

Low Carbon Pulse – Long Form Version of Edition 41 – Published on July 4, 2022.

The researcher and author of each edition of Low Carbon Pulse is Michael Harrison.

- **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 interessional 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 to 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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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 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.

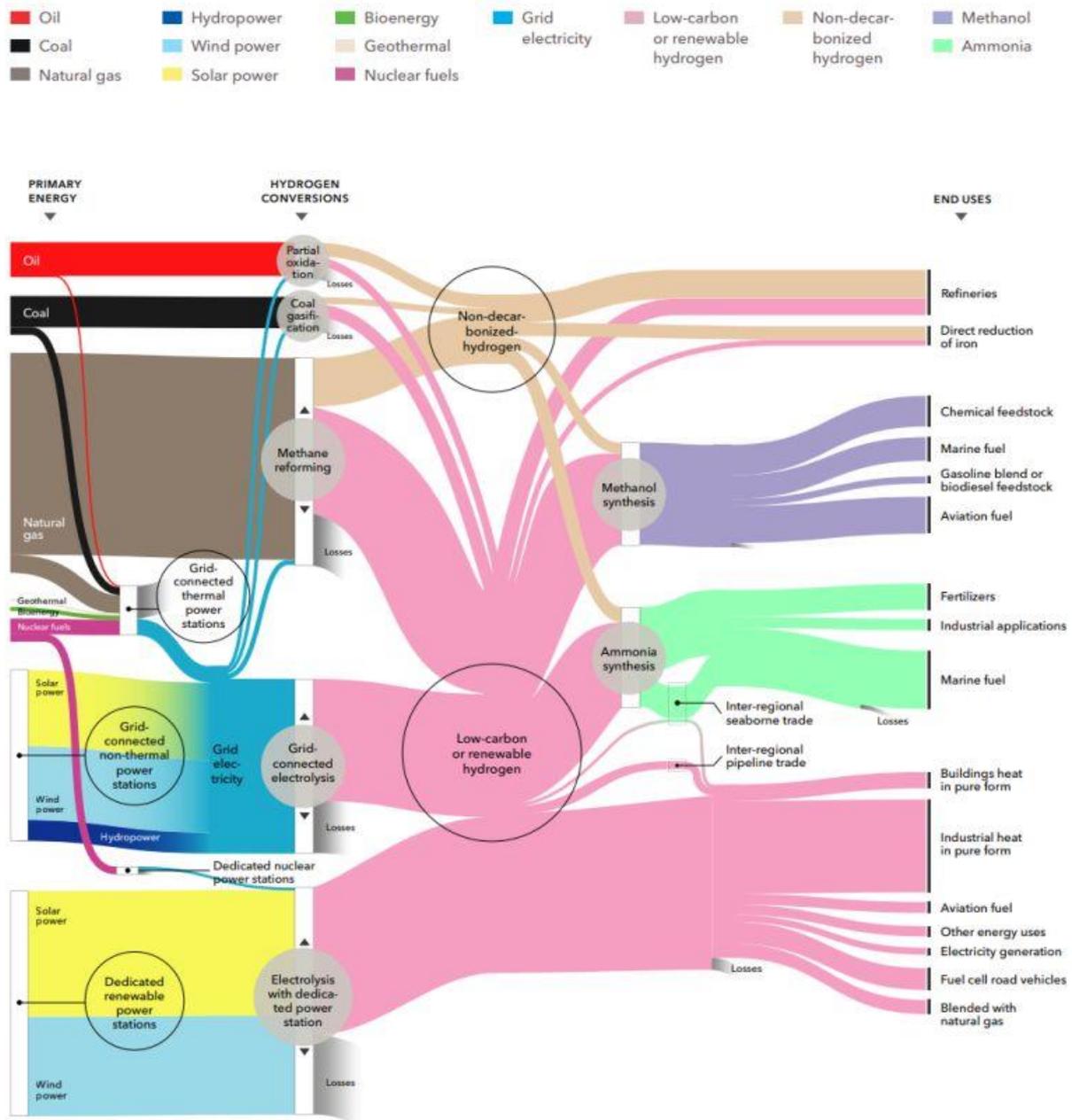
Early on the morning of **June 28, 2022**, **Environment and Climate Change Ministers** from the European Union's 27-Member States "agreed to introduce a 100% **CO₂ emissions** reduction target by 2035 for new cars and vans", accommodating the position of Germany to allow the use of "**CO₂ neutral fuels**". 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, but also 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.

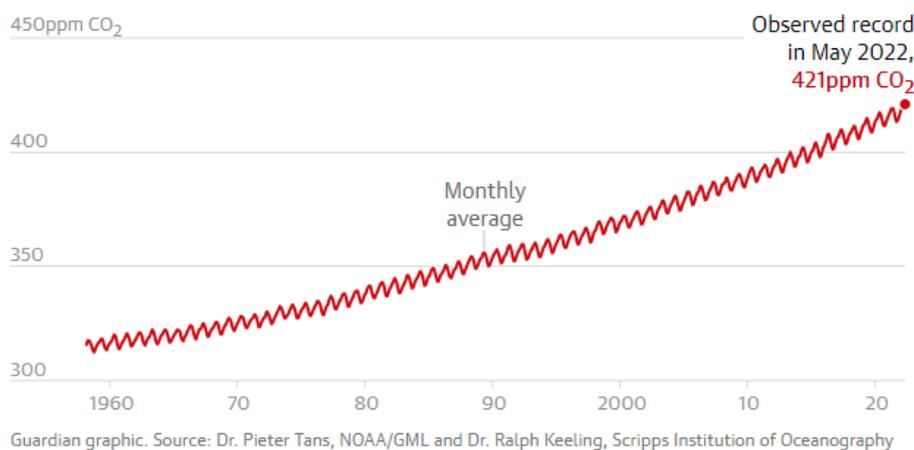
Climate change reported and explained:

*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 since 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

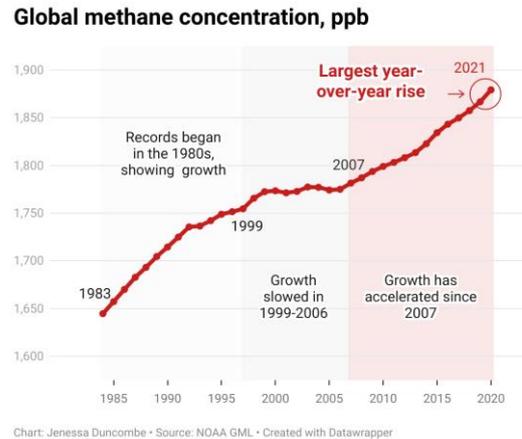
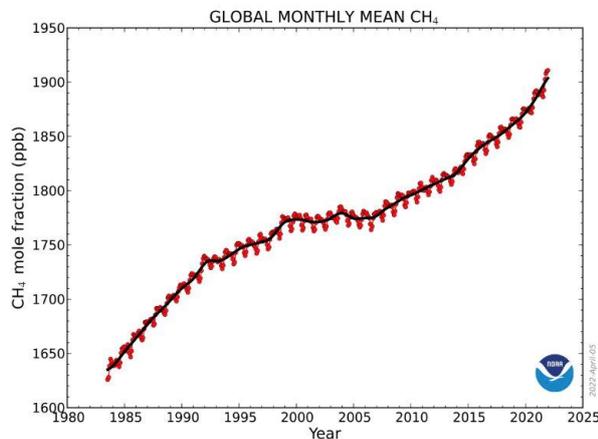


Source: [The Guardian](#)

- **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 **11** 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](https://www.irena.org) 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](https://www.aramco.com) its inaugural sustainability report [Energy security in a sustainable world](https://www.aramco.com). 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](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**.
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](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. 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](https://www.hydrogen-central.com) reported that **TÜV Rheinland** (a global leading technical service provider) had [announced](https://www.hydrogen-central.com) 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. **Edition 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:

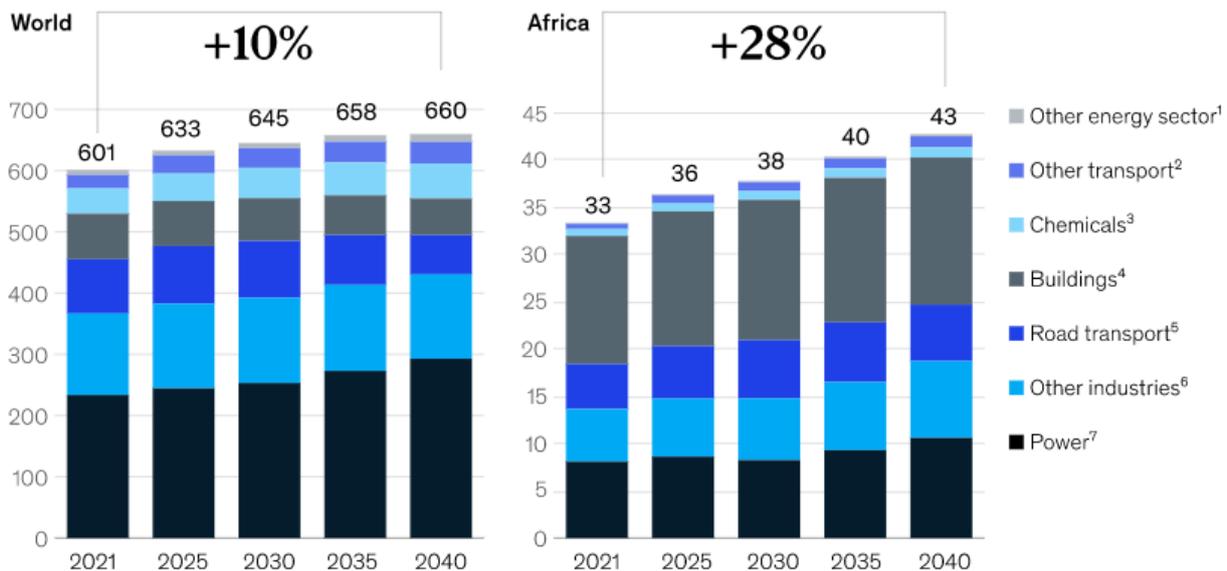
This section considers news items within the news cycle of this **Edition 41** of *Low Carbon Pulse* relating to Africa. Africa remains the continent with the most developing countries, the most **Least Developed Countries** and the most countries vulnerable to climate change, and the continent with 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**).

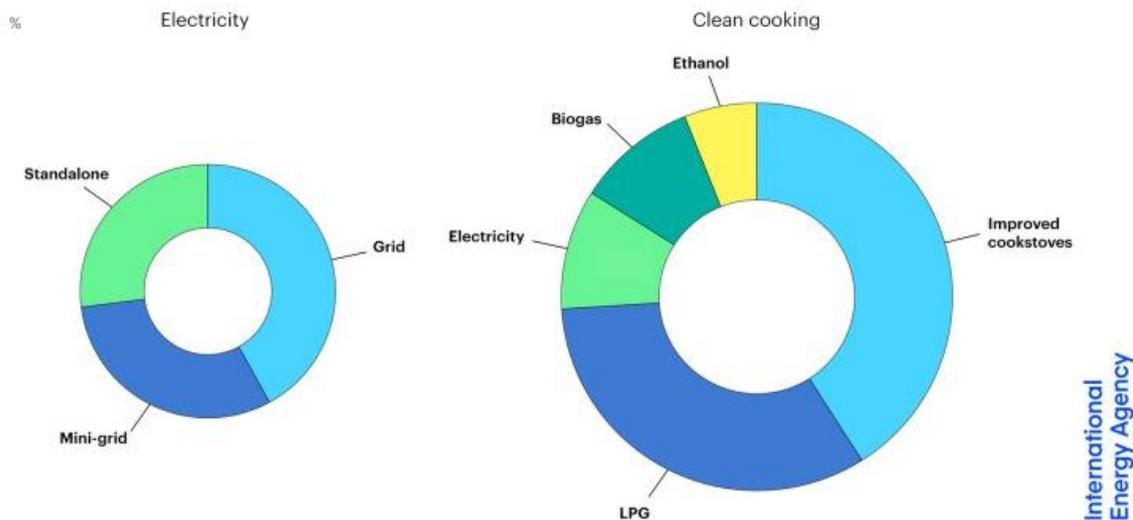
By way of a short summary the key themes identified in the **AEO**:

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 the 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 **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](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 widely reported 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 station, 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.

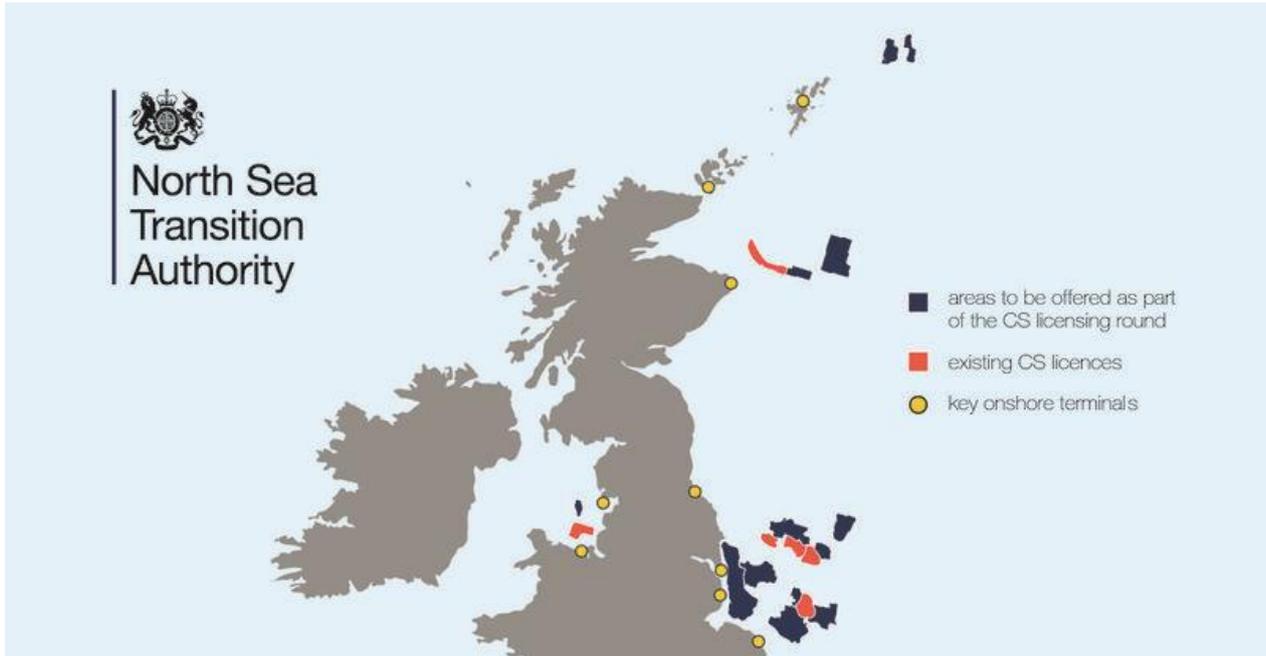
- **PRC photovoltaic solar revolution:** On **June 30, 2022**, it was reported widely that in 2021 of the **54.9 GW** of photovoltaic solar capacity installed in the **PRC**, **21.6 GW** was **residential roof-top photovoltaic solar**.

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**.*

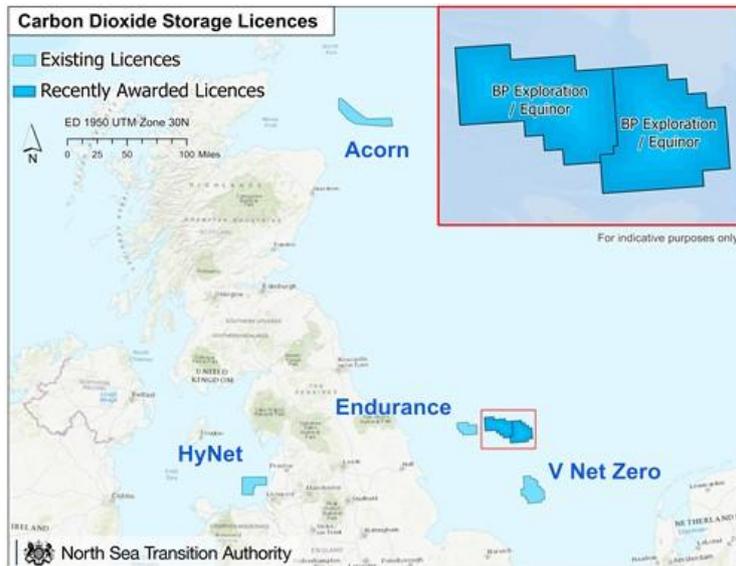
- **FlightPath to the Future:** On **May 26, 2022**, the UK Department of Transport announced a new policy setting for the aviation sector, [Flightpath to the Future](#). The **Flightpath to the Future** has a ten-point plan for the future of aviation as follows: **1.** Recover and sustainably grow the 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."



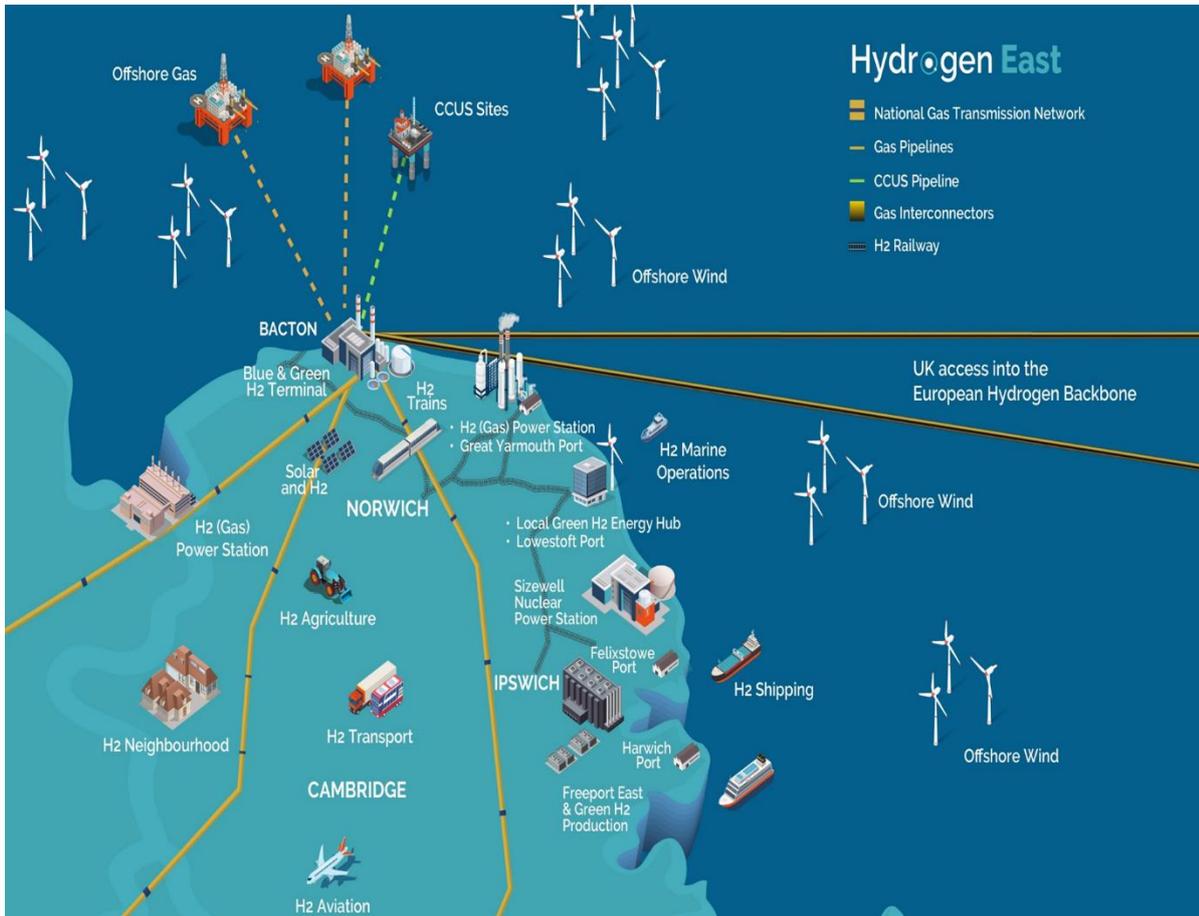
- **Scotland's role in Europe: Edition 32** of Low Carbon Pulse reported on activity to assess the development of the hydrogen production capacity in Scotland, including the [Scot2Ger](#) initiative (assessing the basis for development of hydrogen production capacity in Scotland to produce Green Hydrogen 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.

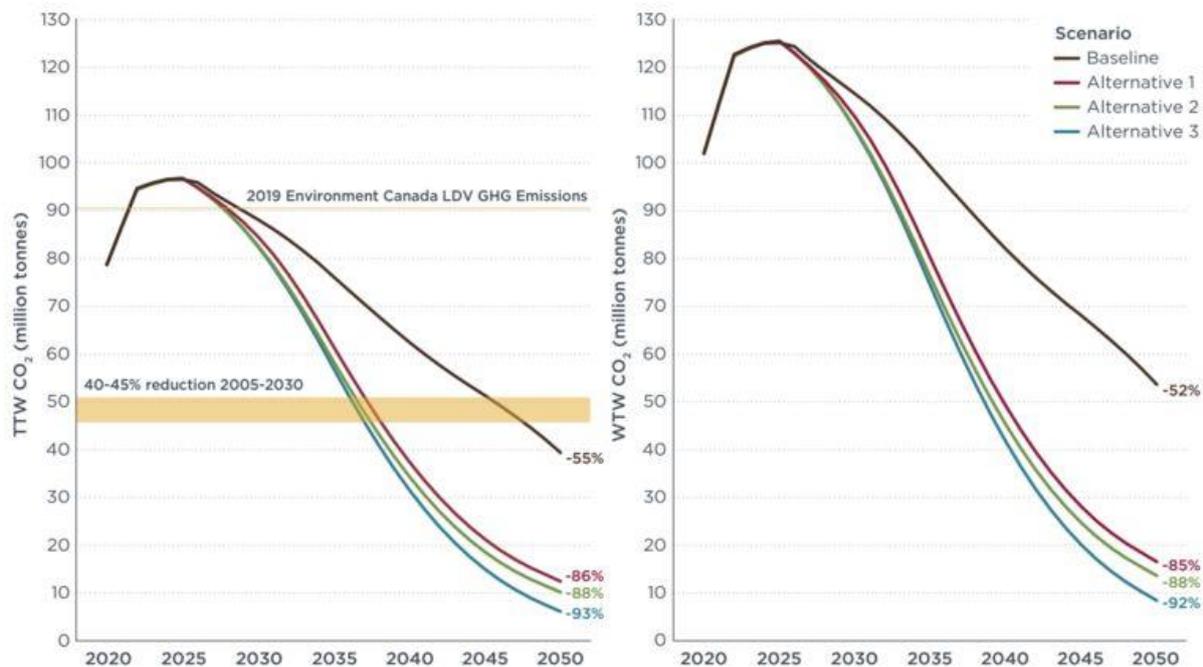


Figure 6. TTW and WTW CO₂ emissions from Canada's LDV fleet between 2020 and 2050. The data labels in 2050 show the percent reduction from 2021 emissions. WTW emissions include TTW emissions and upstream emissions from fuel production, refining, and distribution, as well as electricity generation.

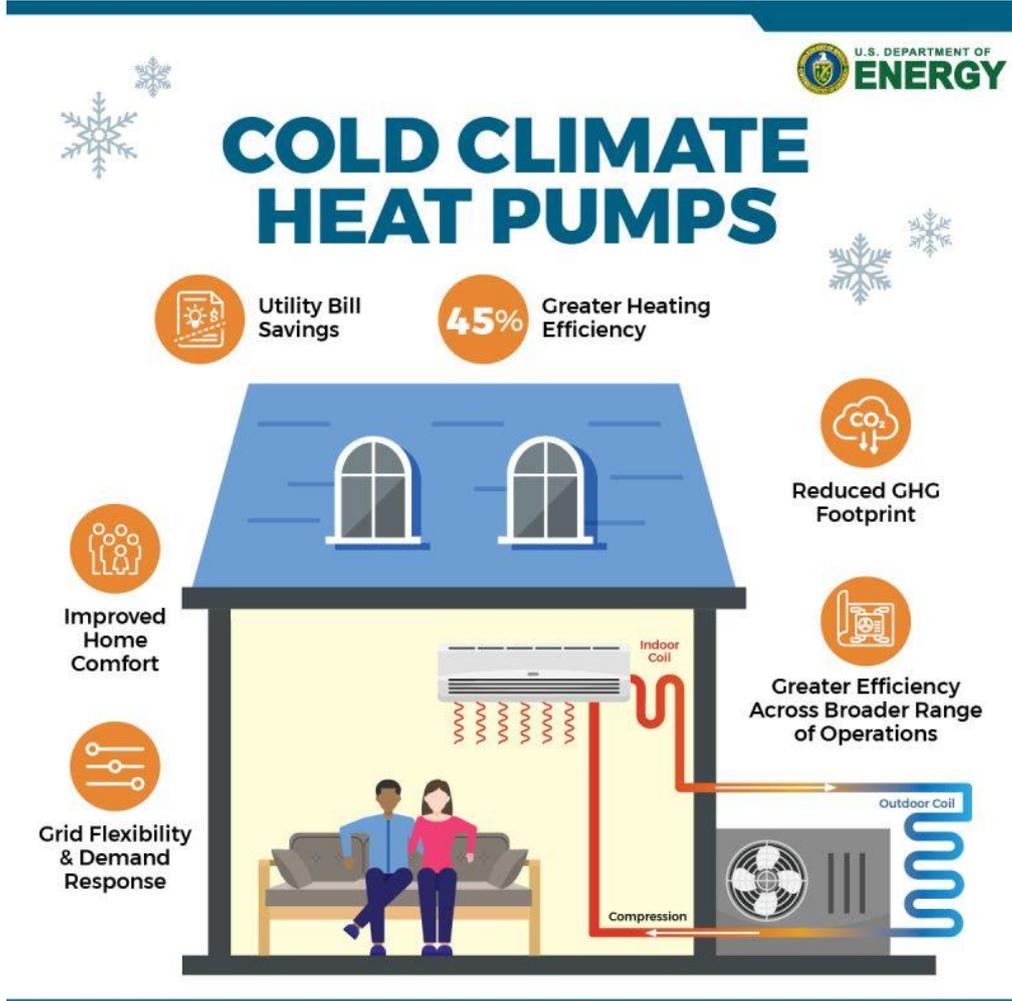
Source: [Canada's Path to 100% zero-emission light-duty vehicle sales: regulatory options and greenhouse gas impacts](#)

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 **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 noted 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 plant in **Podari, Romania**, of second-generation **biofuel** using feedstock sourced from **agricultural residues**. The biofuel produce at the Pordari plant are 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 has been 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 expect, 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** (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)** have 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**.
- **GIG and Bluestone 2 GW program:** On **June 22, 2022**, it was reported widely that the **Green Investment Group** (part of Macquarie Group) and **Bluestone Energy** had entered into a joint development agreement to develop and to deploy up to **2 GW** of **BESS** in the UK.

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 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]".

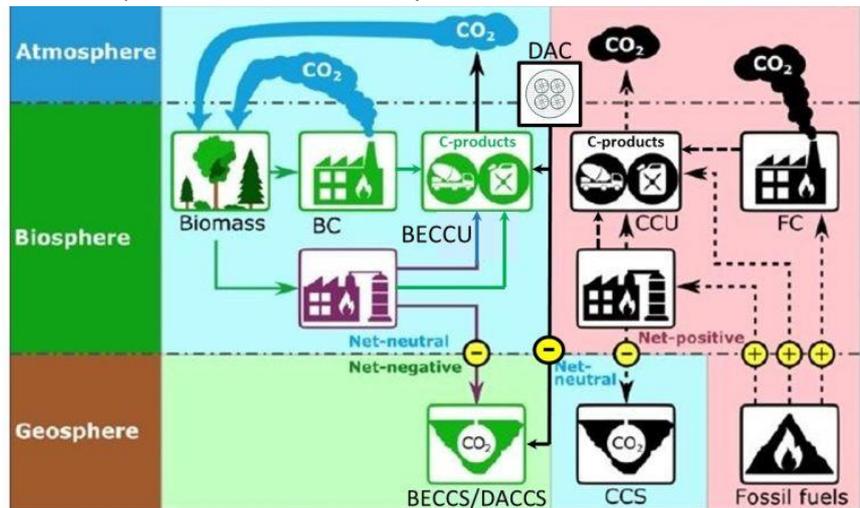


- CNOOC CCS commissioned:** On **June 23, 2022**, [energyvoice.com](https://www.energyvoice.com) reported that the **China National Offshore Oil Corporation (CNOOC)** had commissioned the first offshore carbon capture and storage project to store **CO₂** permanently below the seabed.
- CCS / CCUS commences 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 directly capture and store **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 electrolysers, 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.

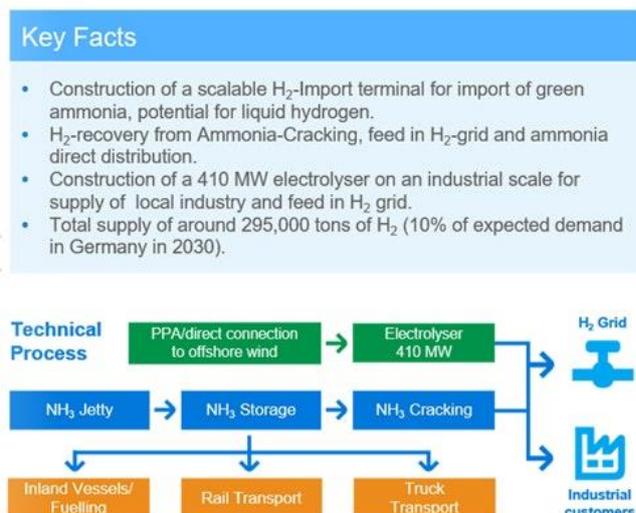
• Wilhelmshaven Hub:

- **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](#).



- **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 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 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.

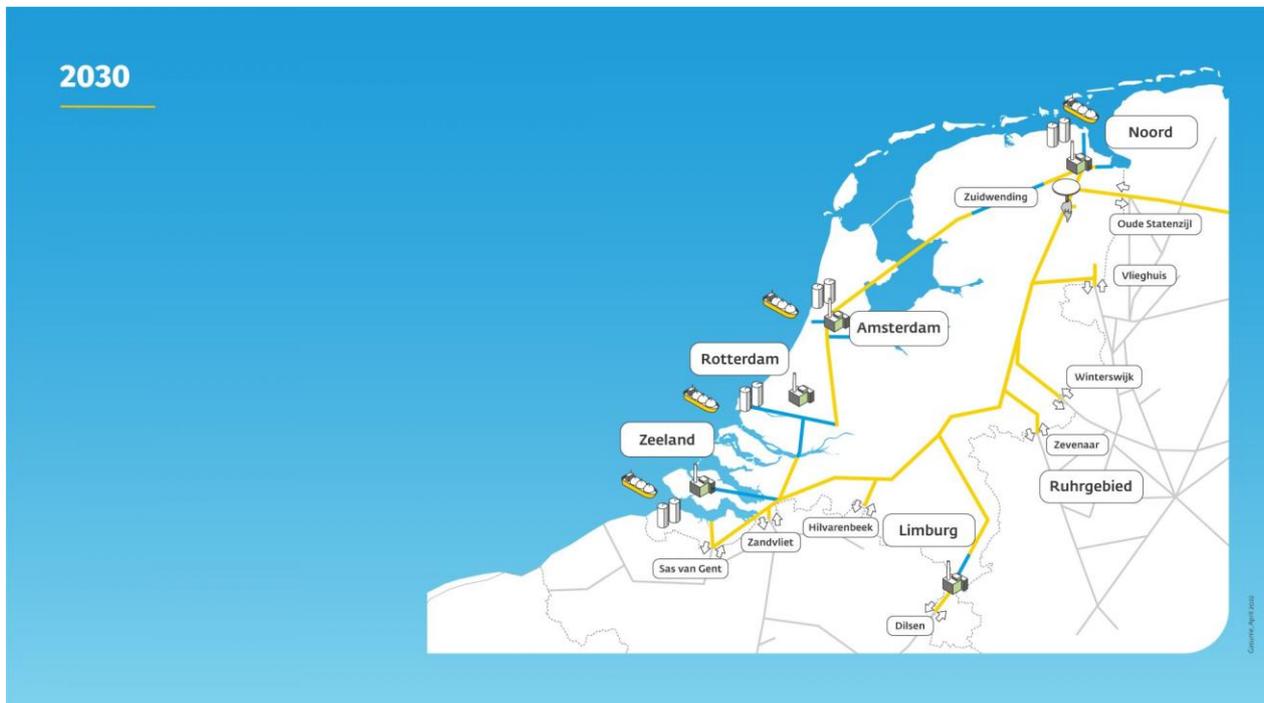
By way of reminder: **Edition 22** of Low Carbon Pulse (under **Hydrogen Storage**) reported that:

"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 **Aldbrough natural gas storage capacity (Aldbrough 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), 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.

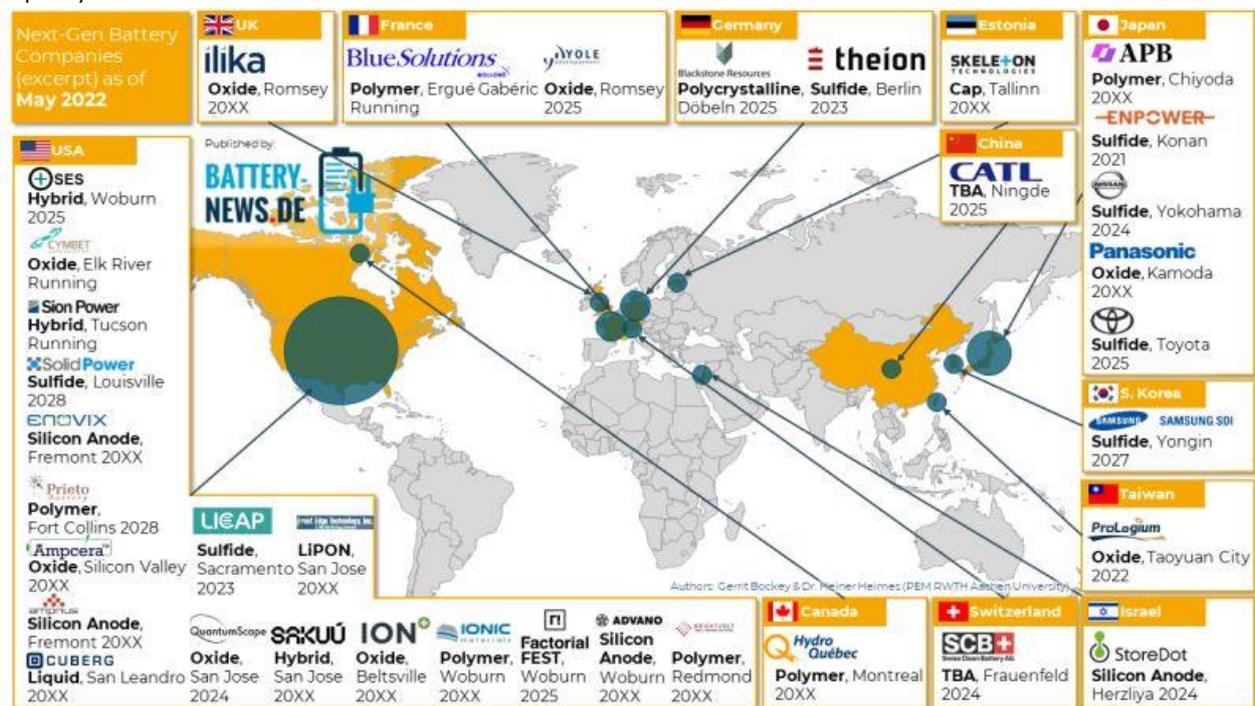
- **BASQUEVOLT energised:** On **June 10, 2022**, batteriesnews.com reported that **BASQUEVOLT** had been launched. **BASQUEVOLT** is a **€700 million** initiative to manufacture **solid-state** batteries, with the intention to manufacture batteries with combined capacity of **10 GWh** by **2027**.

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 TWh** 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.

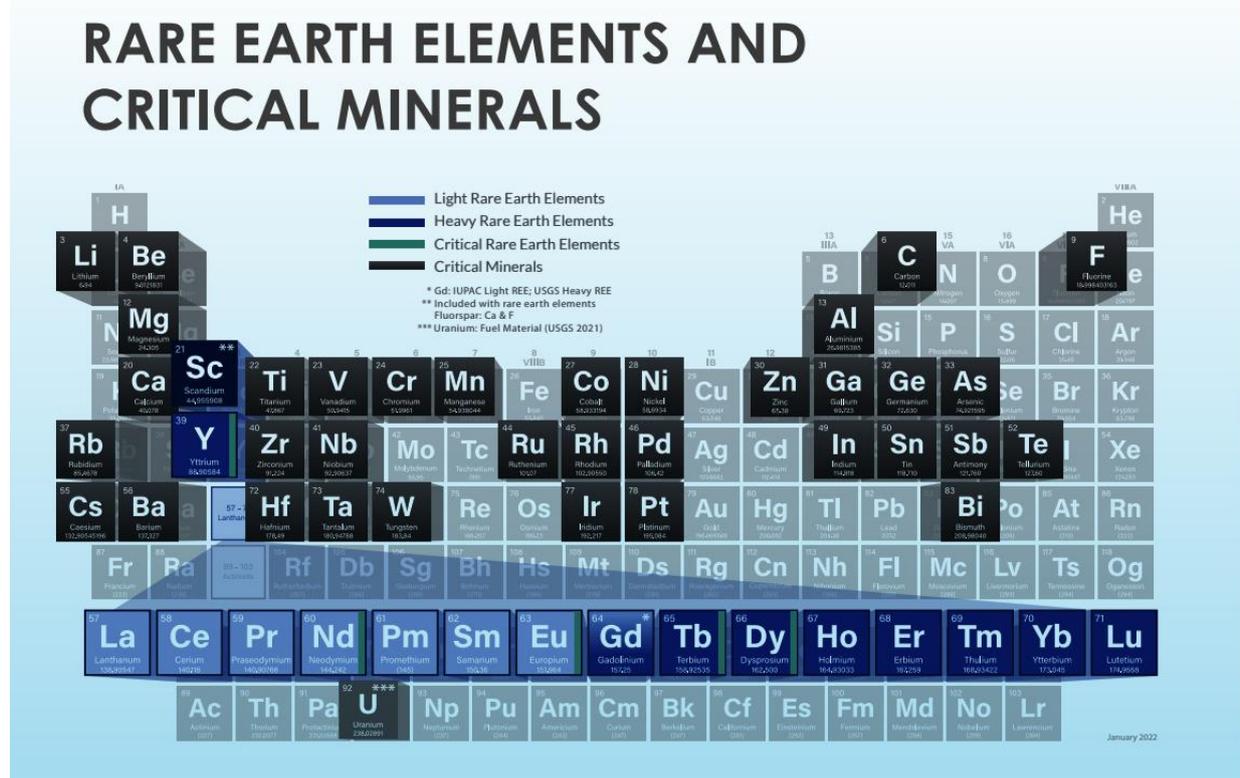
The doubling of exchange capacity will give the interconnector **1 GW** of exchange capacity, thereby facilitating the integration of more renewable electrical energy sources across Greece and Italy.

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**.

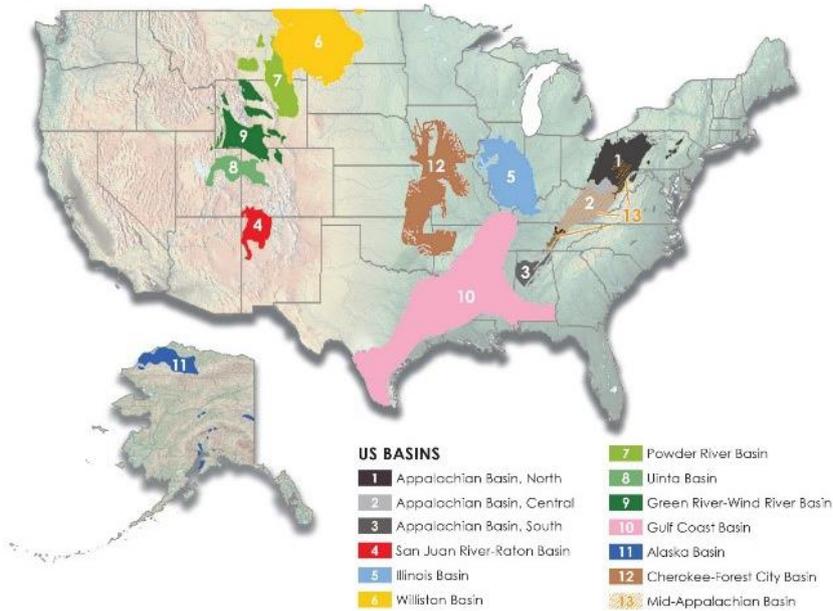
LANTHANIDE REES								
Light REE	Cerium	Europium	gadolinium	Lanthanum	neodymium	Praseodymium	promethium	samarium
Heavy REE	dysprosium	Erbium	Holmium	Lutetium	Terbium	Thulium	Ytterbium	
NON – LANTHANIDE REES								
Scandium				Yttrium				

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.



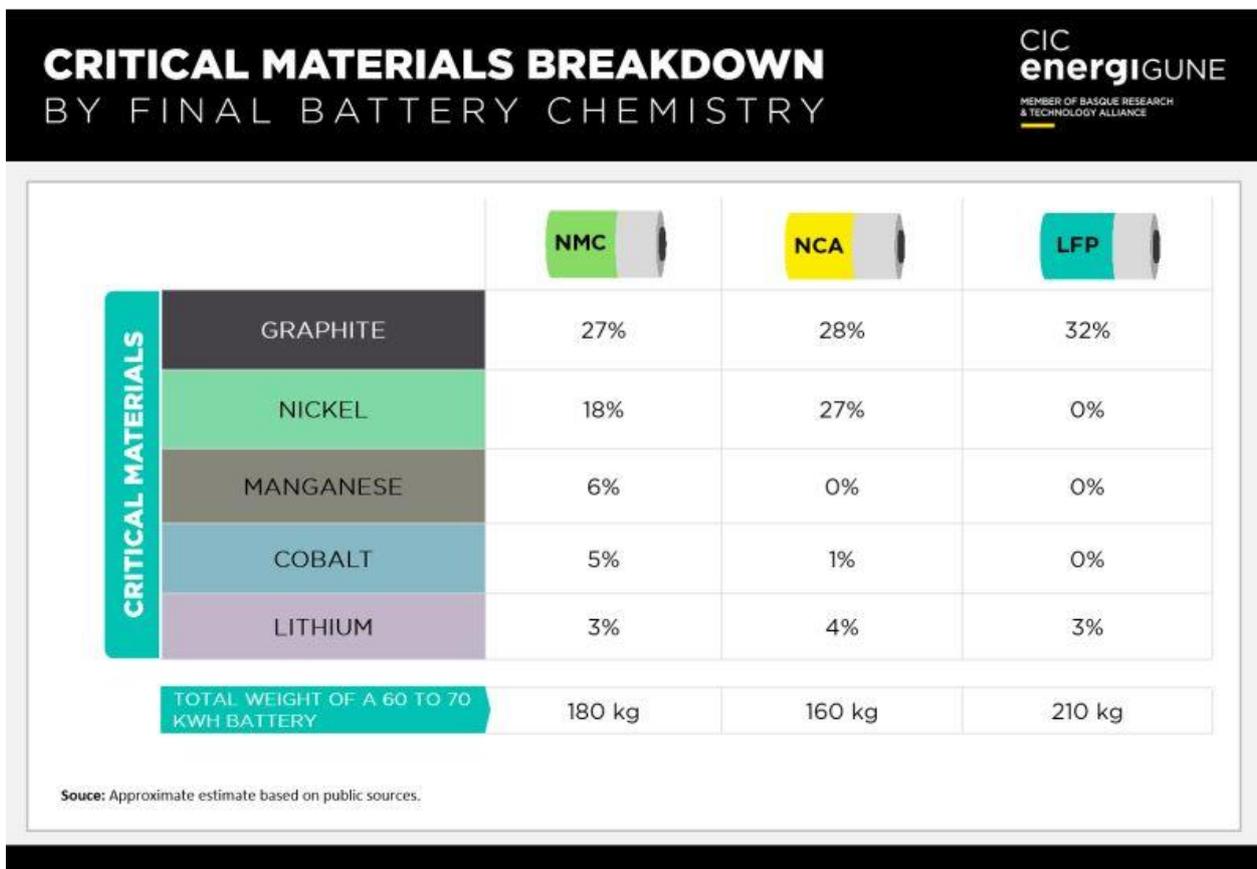
This puts the author of Low Carbon Pulse in mind of the following map-graphic taken from an **NETL** report.

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 auction 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.4coffshore.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 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 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 developed 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**.

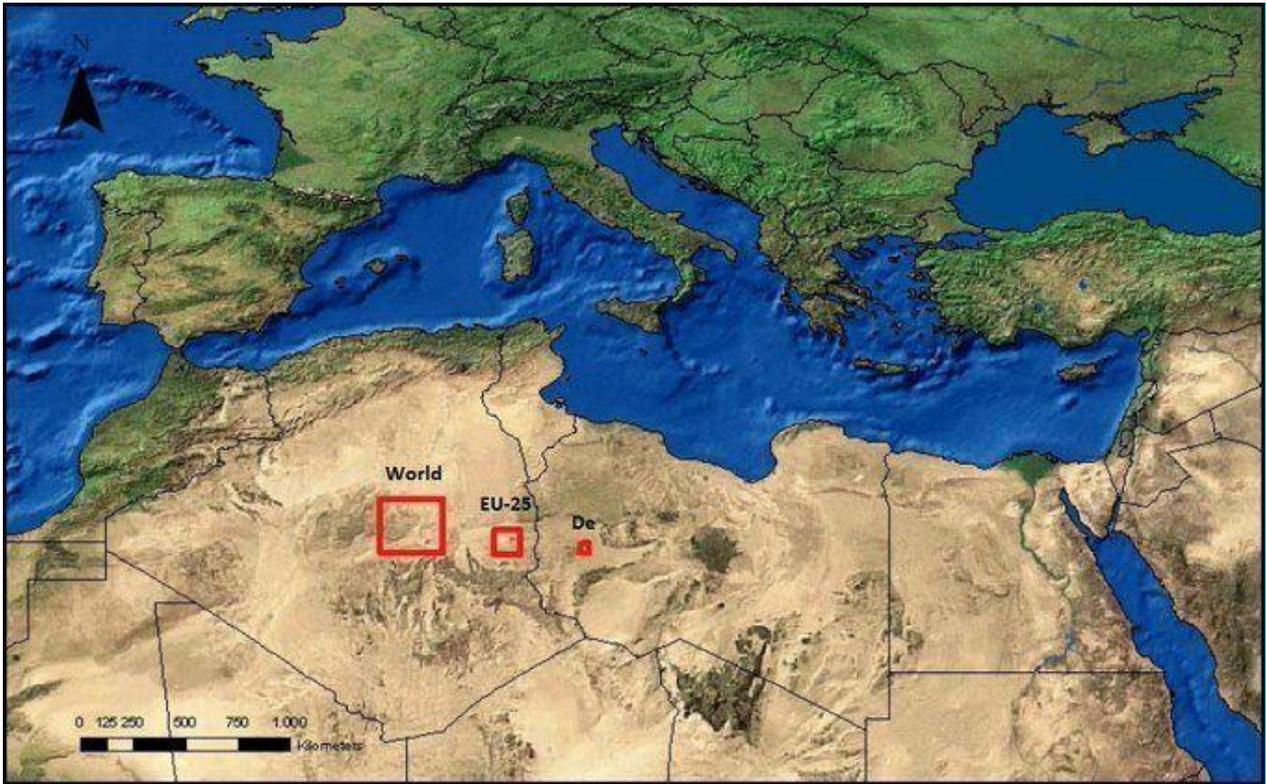
The photovoltaic solar farm (the **Witznitz Energy Park**) will make use of an area that has been little-used in recent times.

- **Prime Infrastructure Holdings plans 3.5 GW photovoltaic solar farm:** On **June 10, 2022**, [pv.magazine-australia](https://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**.

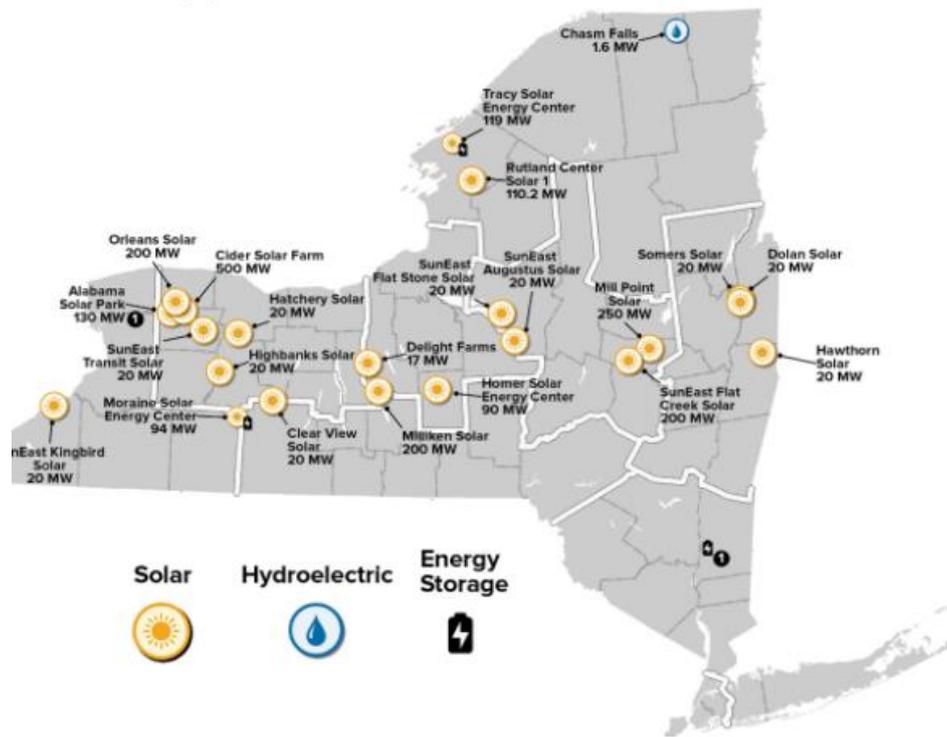


Source: [Sven Wiechert](#)

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 energy 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 the **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 be 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 **FCT** trucks. On **September 16, 2021, IVECO** and **Nikola** (leading fuel cell technology corporation) announced the development of a new **FCT** truck manufacturing facility in **Ulm, Germany**. The first **FCT** truck to be manufactured at the Ulm facility will be the **Nikola Tre** battery-electric and **FCT** 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.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 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](#) 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) published [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% overtime.

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.

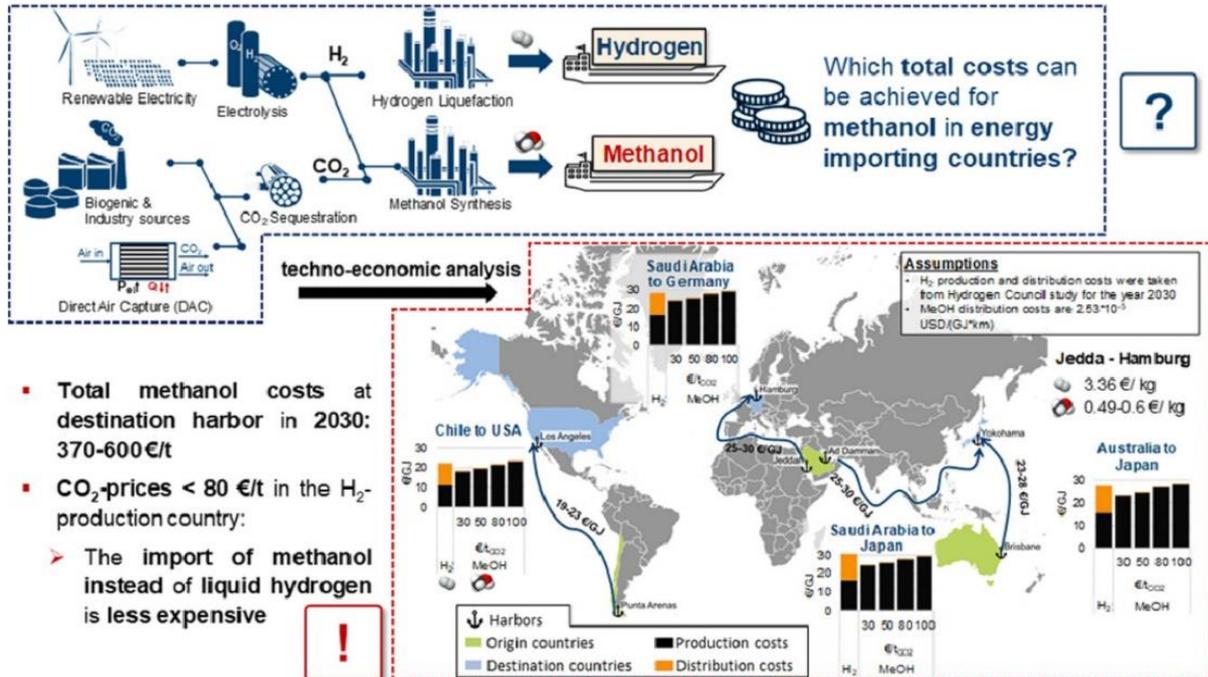
- **Ports need to be supercharged:** On **June 24, 2022**, [offshore-energy.biz](https://www.offshore-energy.biz) reported that the UK ports sector has called on the UK Government "to supercharge the delivery of energy network infrastructure to ports with new research and a transformational funding programme". 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:** It has been 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.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)**. 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 its vessels in Finland and Sweden.

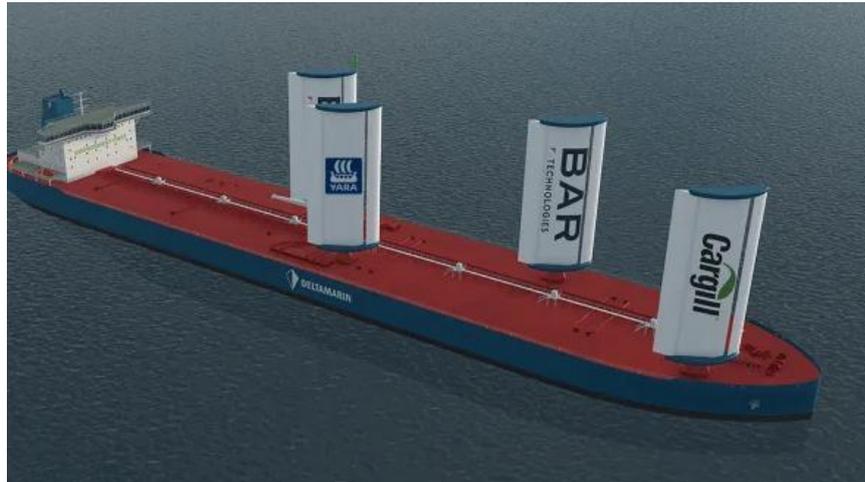
As announced by Neste: "The ISCC PLUS certified marine fuel enables up to 80% reduced greenhouse gas emissions over the life cycle compared to fossil fuels ...".

- **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, though 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."

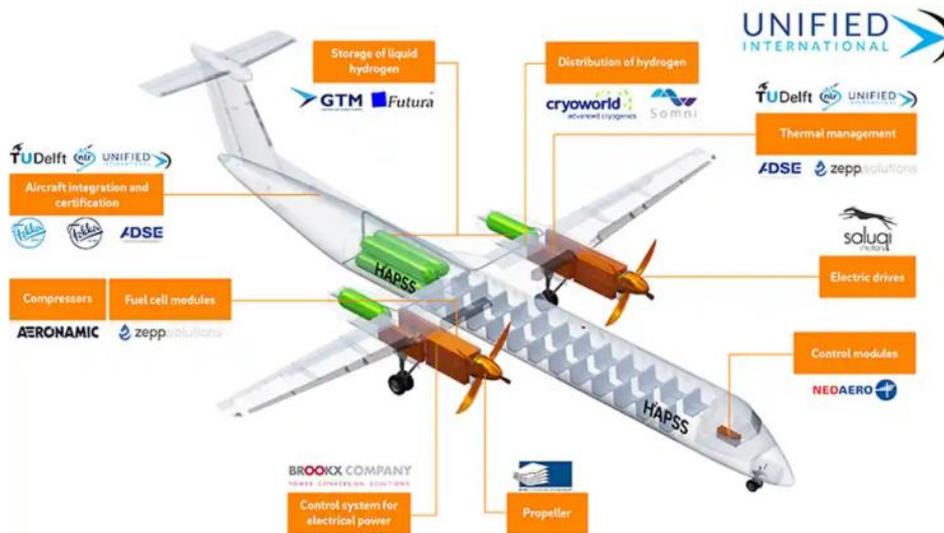
- **CO₂ carrier capacity:** On **June 16, 2022**, [Reuters](https://reuters.com) reported that **Shell** (leading global international energy corporation) intends to develop **CO₂ carriers** with **12,000 m³** capacity, moving to **36,000, 40,000 and 70,000 m³**. Along with **Equinor** and **TotalEnergies**, **Shell** is developing the Northern Lights project (as part of the Longship project), on 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 considerably greater than **CO₂** by metric tonne equivalence. This reminder is placed alongside 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 million 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**.
 - One **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 **SAFire 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**, **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**.
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 than 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 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 electrolysers:**

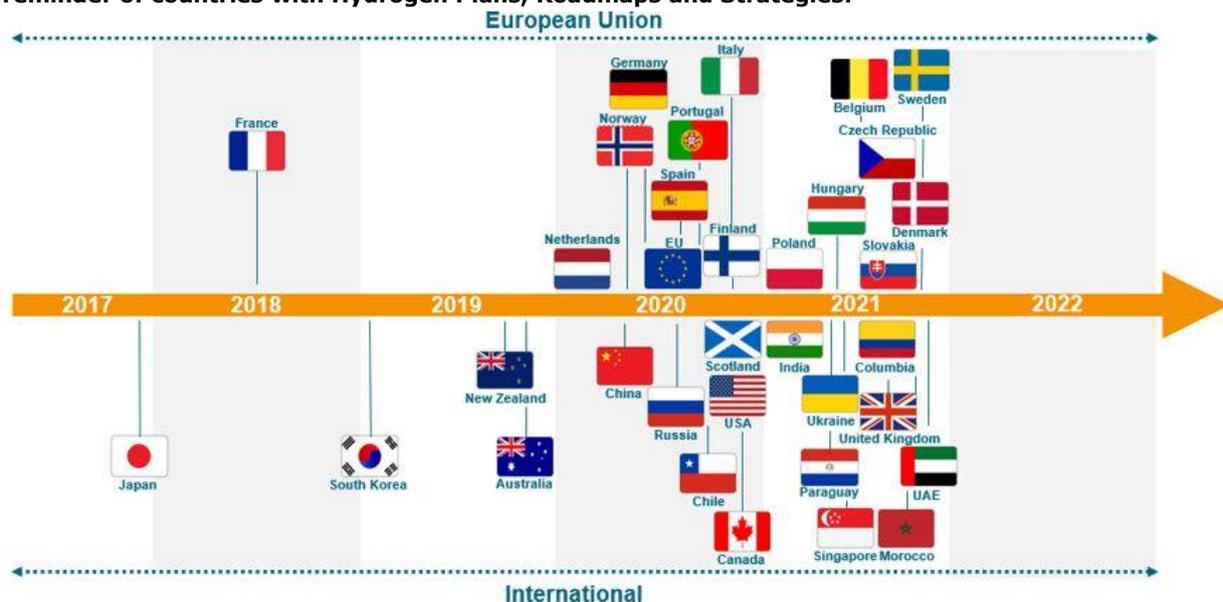
At the moment around 61% of electrolysers use **AE** technology and around 30% use **PEM** technology.

ANATOMY OF AN ELECTROLYSER	
Alkaline electrolysers (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) electrolysers 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** electrolysers 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 electrolysers 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 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



NZE Publications:

At the end of each edition of Low Carbon Pulse, publications mentioned or reviewed in the edition are listed, by organisation, title / subject matter, and link:

ORGANISATION	TITLE / SUBJECT MATTER
bp	<u>Statistical Review 2022</u>
Department for Business, Energy & Industrial Strategy (BEIS)	<u>Carbon Capture, usage and storage (CCUS): business models</u>
DNV	<u>Hydrogen Forecast to 2050 – Energy Transition Outlook 2022</u>
Ember	<u>New Generation – Building a clean European electricity system by 2035</u>
European Association of Energy Storage (EASE)	<u>Energy Storage Targets 2030 and 2050</u>
European Commission (EC)	<u>Proposal for a Regulation of the European Parliament and of the Council on nature restoration</u>
Guidehouse	<u>Imports will be a cornerstone for Meeting Germany's Hydrogen Demand</u>
International Council on Clean Transportation (ICCT)	<u>Vision 2050: Aligning Aviation with the Paris Agreement</u>
International Energy Agency (IEA)	<u>Tracking SDG7: The Energy Progress Report 2022</u>
International Energy Agency (IEA)	<u>The value of urgent action on energy efficiency</u>
International Energy Agency (IEA)	<u>Achieving Net Zero Heavy Industry Sectors in G7 Members</u>
International Energy Agency (IEA)	<u>Africa Energy Outlook 2022 – World Energy Outlook Special Report</u>
International Energy Agency (IEA)	<u>World Energy Investment 2022</u>
International Energy Agency (IEA)	<u>Nuclear Power and Secure Energy Transitions</u>
International Energy Agency (IEA)	<u>Norway 2022: Energy Policy Review</u>
International Renewable Energy Agency (IRENA)	<u>Renewable Energy for Agriculture: insights from Southeast Asia</u>
International Renewable Energy Agency (IRENA)	<u>Powering Agri-food value Chains with Geothermal Heat: A Guidebook for Policy Makers</u>
Jacobs Engineering	<u>Airports as Catalysts for Decarbonisation</u>
Ministry of Environment Egyptian Environmental Affairs Agency	<u>National Climate Change Strategy 2050</u>
MIT Energy Initiative	<u>The Future of Energy Storage</u>
National Energy Technology Laboratory (NETL)	<u>Rare Earth Elements and Critical Minerals</u>
REN21	<u>Renewables 2022 Global Status Report</u>
REN21	<u>Global Status Report 2022 - Key Messages for Decision Makers</u>
Saudi Aramco	<u>Energy security for a sustainable world</u>
Shell	<u>Achieving A Carbon-Neutral Energy System in China by 2060</u>
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>
Wetlands International	<u>We need wetlands: The urgent call for global wetlands targets</u>

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We bring together lawyers of the highest calibre with the technical knowledge, industry experience and regional know-how to provide the incisive advice our clients need.



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