

Low Carbon Pulse - Edition 34

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 34** of Low Carbon Pulse – sharing significant current and recent news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from Monday January 24, 2022 to Sunday February 6, 2022 (inclusive of each day). It is hoped that the Friday edition of this **Edition 34**, to be published in February 11, 2022, will contain the Report on Reports for November and December 2021, but given the size of the Report on Reports it is possible that it will be published separately.

Please click [here](#) for the **Second Low Carbon Pulse Compendium** containing **Editions 29 to 33** (covering October 6, 2021 to January 23, 2022) and [here](#) for the **First Low Carbon Pulse Compendium** (containing **Editions 1 to 28**, covering October 6, 2020 to October 5, 2021). 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 Belated Lunar New Year:

A happy lunar new year to all readers of Low Carbon Pulse! Wishing you all a healthy and prosperous year of the Tiger! Gong xi fa cai!

Content of this Edition 34:

As the length of Low Carbon Pulse has increased, it has become apparent that a list of contents might assist the reader. Clicking on the contents list will take the reader to the section clicked:

LIST OF CONTENTS: EDITION 34 OF LOW CARBON PULSE			
Pages 2 & 3:	Timeline for 2022	Pages 17 to 18:	Carbon Accounting, Carbon Capture, Carbon Capture and Use and CDR;
Pages 3 & 4:	Legal and Regulatory Highlights	Page 18:	Carbon Credits, Hydrogen Markets & Trading
Pages 5 & 6:	Climate change reported and explained	Pages 18 to 20:	E-fuels and Future Fuels;
Pages 6 & 7:	GCC Countries	Page 20:	Green Metals / Minerals, Mining and Difficult to Decarbonise Industries
Pages 8 & 9:	Africa, India and Indonesia; Japan & ROK	Page 20:	Cities, Clusters, and Hubs and Corridors and Valleys, and Giga-Factories
Page 9:	PRC and Russia	Page 21:	Wind round-up, on-shore and off-shore;
Page 10:	Europe and UK; and Americas	Pages 21 and 22:	Solar, Sustainability and NZE Waste;
Pages 11 to 13	France and Germany; and Australia	Pages 22 to 24:	Land Mobility / Transport
Pages 13 & 14:	Blue Green Carbon Initiatives & Biodiversity	Pages 24 to 26:	Ports Progress and Shipping Forecast
Pages 15 and 16	Bioenergy and Heat Recovery	Page 26:	Airports and Aviation
Pages 16 & 17:	BESS & HESS (and other energy storage)	Page 26:	NZE Publications

Low Carbon Pulse – Edition 34 – February 8, 2022.

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

Timeline for 2022:

- **Key conferences and publications: Edition 33** of Low Carbon Pulse identified events that may influence or impact progress to **NZE**. While the events identified will not be the only events that will influence or impact progress, they are events on the radar of the author as likely to do so. Each event, and progress in respect of each event, will be covered in Low Carbon Pulse as outlined below.

As noted in **Edition 33** of Low Carbon Pulse:

- The date of the **Fifth United Nations Conference on Least Developed Countries (LDC5)**, scheduled to be held from January 23 to 27 2022, remains to be rescheduled;
- During February 2022 the International Panel on Climate Change (**IPCC**) was expected to have updated, and pretty much finalised, the **Summary for Policymakers** contained in the **Sixth Assessment Report – Climate Change 2021, The Physical Science Basis** published in August 2021 (and reported on in **Edition 24** of Low Carbon Pulse) (**2021 Report**). It is understood that this continues to be the plan.
- From February to September 2022 the **IPCC** will progress finalisation of its first comprehensive assessment report (**IPCC's Sixth Assessment Report**) since the **IPCC's** Fifth Assessment Report.

The **IPCC's Sixth Assessment Report** will be based on reports from three Working Groups, I, II and III detailed as follows:

- the findings of **Working Group I** (Physical Science Basis) as to the physical impact of climate change in the **2021 Report** (reported on in **Edition 24** of Low Carbon Pulse);
- the assessment of **Working Group II** (Impacts, Adaption and Vulnerability) on the impact of climate change; and
- the assessment of **Working Group III** (Mitigation of Climate Change) on the mitigation of the effects of, and progress to limit emissions causing, climate change.

The **IPCC** has alerted the media that from noon CET on February 28, 2022, the authors of Impacts, Adaption and Vulnerability (Working Group II's contribution to the **IPCC's Sixth Assessment Report**) will be available for interviews, tending to indicate that the report of Working Group II will be completed by the end of February.

If the report of **Working Group II** is published by the **end of February 2022** as scheduled, **Edition 37** will cover that report. If the report of **Working Group III** is published **during April 2022** as scheduled, **Edition 39** or **40** of Low Carbon Pulse will report on it.

Further, the **IPCC** has invited feedback on the first draft of the Synthesis Report of the **IPCC's Sixth Assessment Report**, the period to give feedback open through to March 13, 2022 (**Synthesis Report**).

In **September**, the **IPCC** will publish the **Synthesis Report**. The **Synthesis Report** will synthesise and integrate materials contained in the Assessment Reports from each Working Group, and in three Special Reports (**Global Warming of 1.5°C**, **Climate Change and Land** and **The Ocean and Cryosphere in a Changing Climate**). The **Synthesis Report** will be in two parts, the **Summary of Policymakers (SPM)** and the **Longer Report**. Neither part of the **Synthesis Report** will be anywhere near the length of each Working Group Report and each Special Report.

- **Edition 36** of Low Carbon Pulse will report on the inaugural **Middle East and North Africa Week**, organised under the auspices of the United Nations Framework Convention on Climate Change (**UNFCCC**), scheduled to be held from **February 28 to March 3 2022**, hosted by the United Arab Emirates (**UAE**).
- **Edition 37** of Low Carbon Pulse will report on the **IUCN Africa Protected Areas Congress (APAC)** scheduled to take place in Kigali, Rwanda from **March 7 to 12 2022**. **APAC** is the first continent-wide meeting of African leaders, interest groups and citizens, convened to focus on action required to establish and to preserve protected areas.
- **Edition 41** of Low Carbon Pulse will report on:
 - the **UN Biodiversity Conference** (or **COP 15**) rescheduled to take place in Kunming, Peoples Republic of China (**PRC**) from **April 25 to May 8 2022**;
 - the **XV World Forestry Congress** scheduled to take place held in Seoul, Republic of Korea (**ROK**) from **May 2 to May 6, 2022**, under the theme of **Building a Green Healthy and Resilient Future with Forests**; and
 - the **15th United Nations Conference on Diversification** scheduled to take place in the Côte d'Ivoire from **May 9 to May 21, 2022**.
- **Edition 43** of Low Carbon Pulse will report on the **Stockholm+50** conference to take place in Sweden from **June 2 and 3, 2022**.
- **Edition 44** of Low Carbon Pulse will report on:
 - the **G7 Summit** scheduled to take place at Schloss Elmau, Bavaria, Germany from **June 26 to 28, 2022**;
 - the **World Urban Forum 11** scheduled to take place in Katowice, Poland from **June 26 to 30, 2022**; and
 - the **UN Ocean Conference** rescheduled to take place in Lisbon, Portugal from **June 27 to July 1, 2022**.

In addition, **Edition 44** will detail which editions of Low Carbon Pulse (during the balance of 2022) will report on:

- the **World Conference on Climate Change & Sustainability** which will take place in Frankfurt, Germany, from **August 22 to 24, 2022**;
- the **77th session of the UN General Assembly** which will take place in New York City, New York State, the United States, from **September 13 to 27, 2022**;
- the **Synthesis Report** which is scheduled to be published by **IPCC** during September 2022;
- the **17th G20 Summit** which will take place in Bali, Indonesia, on **October 30 and 31, 2022**; and
- the 27th session of the Conference of the Parties (**COP-27**), which will take place in Sharm El-Sheikh, South Sinai, Egypt from **November 7 to 18, 2022**. As with **COP-26**, Low Carbon Pulse will identify the key issues and themes ahead of **COP-27**.

- **By the end of Q1:**

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

The demand for carbon credits appears to be increasing at pace, in particular in the **Voluntary Carbon Market / Voluntary Carbon Credit Market**.

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

Previous editions of Low Carbon Pulse have covered the uses of words and phrases in this context, critically, the concept of carbon neutrality. Ultimately, decarbonisation is required, and decarbonisation takes time, and needs to be achieved across Scope 1, 2 and 3 emissions. To buy time, while still reducing **GHG** emissions on a net-basis, corporations buy carbon credits.

In the stand-alone article, the author of Low Carbon Pulse will outline Carbon Credits, Article 6 and the Paris Rulebook, and the near, medium and long term role of Carbon Credits, including as deforestation is curtailed and ceases, and afforestation and reforestation continues, and as there appear to be increasingly calls for the regulation of the **Voluntary Carbon Market / Voluntary Carbon Credit Market**.

By way of reminder, **Edition 32** of Low Carbon Pulse noted that a publication entitled, [Why was it so significant that COP-26 completed the Paris Rulebook?](#) contained a high-level summary of the significance of the **Paris Rulebook** as follows:



- **Taxonomy and regulatory perspective included:**

The standalone article will include a taxonomy of terms used in the arena of carbon credits, and relevant more broadly.

In addition the standalone article will include perspectives on the need for the regulation of carbon credits and carbon credit markets, including to address the fact that not all carbon credits are created equal. These perspectives will tie back to Article 6 of the Paris Agreement and the Paris Rulebook.

Legal and Regulatory highlights:

*This section considers news items that have arisen within the news cycle of this **Edition 34** of Low Carbon Pulse in respect of laws and regulation, and broader policy settings, in each case describing substance, progress and impact.*

- **EU policy settings to achieve 55 by 30:** **Edition 32** of Low Carbon Pulse reported that on December 15, 2021, a package of legislation and policy settings was released by the European Commission (**EC**) providing a framework to decarbonise gas markets, to promote hydrogen production and use, and to reduce **CH₄** emissions.

This framework provided comprises a regulation and a directive - see links to each: [Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the internal markets for renewable and natural gases and for hydrogen](#) and [Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on common rules the internal markets in renewable and natural gases and in hydrogen](#).

- **EU Green Taxonomy:** In addition, **Edition 32** of Low Carbon Pulse reported on the adoption of the **EU Green Taxonomy** and that its adoption and application may mean.
 - **EU Green Taxonomy adopted:**

On December 9, 2021, the first climate delegated act (the **EU Taxonomy Climate Delegated Act**) was approved by the **EC**, and became law on January 1, 2022, confirming the adoption of the **Technical Screening Criteria**. Among other things, the **EU Green Taxonomy** provides:

 1. a basis by reference to which corporations may report; and
 2. **CO₂-e** intensity benchmarks for the energy sector (that are neutral as to technology) of 100 g **CO₂-e/kWh** as making a substantial contribution to climate mitigation, and 250 g **CO₂-e/ kWh** giving rise to significant harm.
 - **What this does not mean and what is its practical application?**

As noted in **Edition 32**, the effect of the **EU Taxonomy Climate Delegated Act** is that the **EC** must use the **EU Green Taxonomy** to assess climate change adaptation and climate change mitigation activities, including to do no significant harm across environmental objectives.

Effectively, the **EU Green Taxonomy** does not define what technology must be used (hence it is neutral as to technology), but the technology used for the purposes of prescribed activities will be assessed against the **Taxonomy**, including the benchmarks, critically that of carbon intensity.

While the **EC** did not acknowledge formally that the **EU Green Taxonomy** might include natural gas or nuclear energy sources, informally the **EC** flagged that it might: Mr Frans Timmermans: " ... *nuclear and transition gas play a role in energy transition ... [but] that does not make them green*".

(A link is attached to the ec.europa.eu [website](#) that contains relevant materials under **EU taxonomy for sustainable activities**.)
 - **Badging natural gas and nuclear energy:**

Edition 32 of Low Carbon Pulse noted that: "**The EC will determine how to badge natural gas and nuclear energy by the end of 2021**".

 - On January 1, 2022:

the **EC** began consulting with the Member States Expert Group on Sustainable Finance and the Platform on Sustainable Finance in respect of the draft text of a **Taxonomy Complementary Delegated Act** covering natural gas and nuclear activities (see **EC** press release entitled **EU Taxonomy: Commission begins expert consultations on Complementary Delegated Act covering certain nuclear and gas activities**). Consultation is required in respect of all Delegated Acts under the Taxonomy Regulation;

The **EC** stated that:

"The EU Taxonomy guides and mobilises private investment in activities that are needed to achieve climate neutrality in the next 30 years ...

*The Taxonomy provides for energy activities that enable Member States to move towards climate neutrality ... **the Commission considers that there is a role for natural gas and nuclear [power] as a means to facilitate the transition towards a predominantly renewable-based future** [the **EC Position**]. Within the Taxonomy framework, this would mean classifying these energy sources under clear and tight conditions (for example, gas must come from renewable sources or have low emissions by 2035), in particular as they contribute to climate neutrality".*
 - On January 21, 2022, the consultation process ended. Following the end of the consultation process, the **EC** analysed the contributions made during the consultation process, ahead of the adoption formally of the **Taxonomy Complementary Delegated Act**. The **EC** has noted that in addition to the expert consultation process "it listened to feedback from the European Parliament".
 - On February 2, 2022, the **EC** presented the **Taxonomy Complementary Climate Delegated Act**. As foreshadowed the **Taxonomy Complementary Climate Delegated Act** covers specified natural gas and nuclear activities.

In the context of the presentation of the **Taxonomy Complementary Climate Delegated Act**, the **EC** noted:

"The text sets out clear and strict conditions, under Article 10(2) of the Taxonomy Regulation [see the link above], subject to which certain [natural gas and nuclear] activities can be added as transitional activities to those already covered by the first Delegated Act on climate mitigation and adaptation applicable since 1 January 2022..."

"To ensure transparency, the Commission as today amended the **Taxonomy Disclosures Delegated Act** to that investors can identify which investment opportunities include [natural gas or nuclear] activities and make informed choices..."
 - **Next steps:** The European Parliament and the European Council have four months to scrutinise, and to object to, the **Taxonomy Complementary Climate Delegated Act**.

Given the majorities required to object, it should be assumed that the **Taxonomy Complementary Climate Delegated Act** will become law.
- **Standalone article about EU Taxonomy:**

The format of Low Carbon Pulse does not allow detailed coverage of the various regulations relevant to progress to **NZE** across the **EU**.

In anticipation of the expiry of the four month scrutiny and objection period expiring without an effective objection to the **Taxonomy Complementary Climate Delegated Act**, the author of Low Carbon Pulse will provide a summary of the key regulations and their effect over coming months in a standalone article.

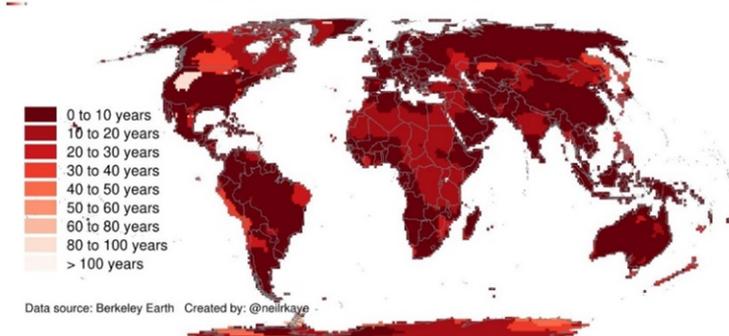
Climate change reported and explained:

This section considers news items within the news cycle of this **Edition 34** 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.

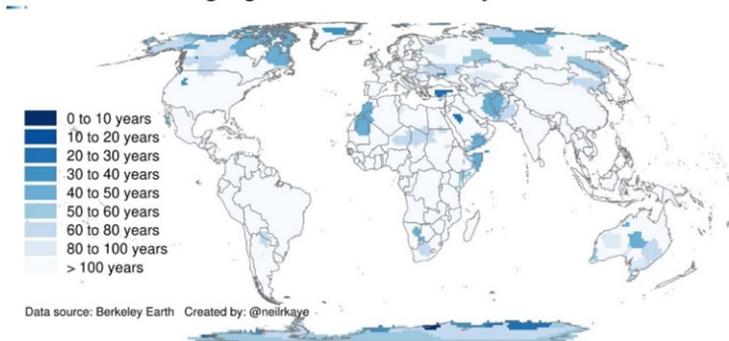
- **How long ago were the coldest and hottest years:**

The following maps demonstrate how long ago it was since each area of the world experienced its coldest and warmest years. These maps were developed by scientist Mr Neil Kaye.

How long ago was the hottest year on record

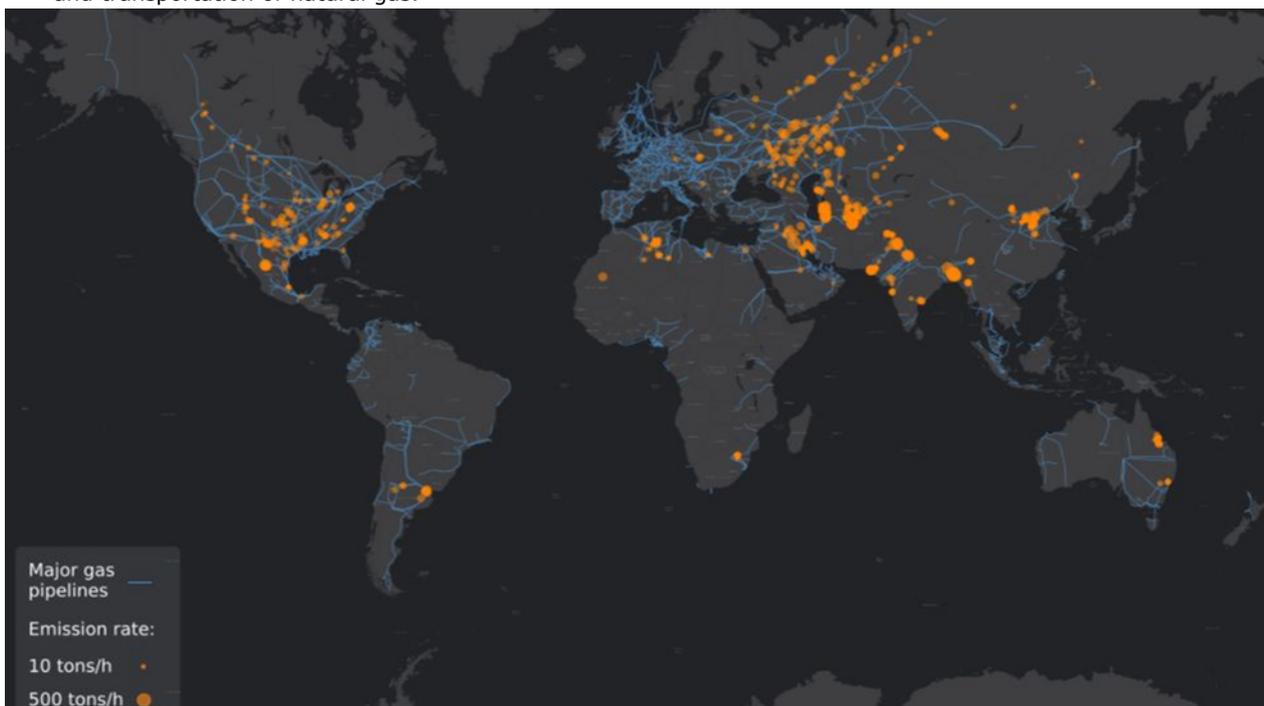


How long ago was the coldest year on record



- **Fugitive emission:**

- **Background:** Towards the end of the week beginning 31 January 2022, a number of news reports arose accompanied by the following representation of fugitive methane (**CH₄**) emissions. It is estimated that up to 6% of total **GHG** emissions globally arise from fugitive emissions from energy production, including on the production and transportation of natural gas.



- **Edition 24** of Low Carbon Pulse (based on the information from the **2021 Report**) noted that the reduction in **CH₄** emissions is important because the global warming potential of **CH₄**, as a **GHG**, in terms of potency per tonne, is greater than carbon dioxide (**CO₂**): a molecule of **CH₄** has a half-life of 9 years, compared to **CO₂** with a half-life of 100 years. Over 20 years, **CH₄** traps up to 84 times as much heat energy as **CO₂**.
- **Edition 27** of Low Carbon Pulse reported that on September 17, 2021, the **EC** and US announced a pledge (the **Global Methane Pledge**), given jointly, to reduce **CH₄** emissions by nearly a third within the next decade. **Editions 28** and **29** have reported on countries that have signed up to the Global Methane Pledge. The number of countries that have signed the Pledge is 103 as at February 4, 2022. While many countries have signed the Pledge, work needs to be done to implement the Pledge, considerable work.
- **Edition 29** of Low Carbon Pulse reported on International Energy Agency (**IEA**) **Curtailing Methane Emissions from Fossil Fuel Operations (CCH4R)**. The headline from the **CCH4R** is that the reduction in methane (**CH₄**) emissions is "among the most impactful ways to combat near-term climate change".

The **CCH4R** notes that:

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

- **News Coverage:**

The reason for the level of news coverage is tied to the publication in [Science](#) of a study undertaken by atmospheric scientist, Mr Thomas Lauvaux (at the Laboratory of Climate and Environmental Sciences, University of Scalay, France). The study identified and mapped "ultra-emitting" events, i.e., where a mass of greater than 25 tonnes of **CH₄** was released to the climate system. Mr Lauvaux used imagery from the Tropospheric Monitoring Instrument (TROPMI) for the purposes of the study.

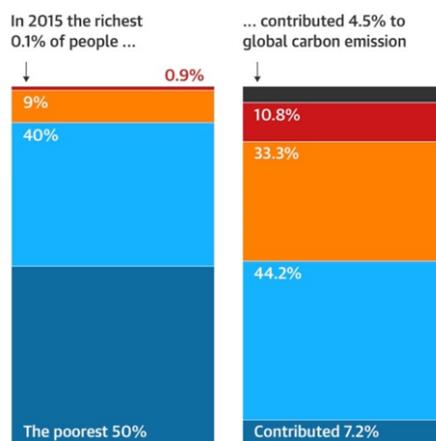
The coverage in The Economist noted that, "Two thirds of the ultra-emitting events were co-located with oil and gas production sites and pipelines, the rest came from coal production, agricultural or waste-management facilities".

The causes and sources of **CH₄** emission are known. The work of Mr Lauvaux is important because it locates areas for immediate action, and it raises the spectre that a greater mass of **CH₄** is being released to the climate system than previously estimated. There is more to do, and there is more to measure.

An [npr.org](#) article provides a fuller analysis of the underlying data and process under [A satellite finds massive methane leaks from gas pipelines](#).

- **The Guardian Graphic:** While it is known that developed countries have contributed to the mass of **CO₂** in the climate system overtime to a much greater extent than countries that are developing, The Guardian has produced a graphic that conveys a message that to many folk may not be a surprise.

The wealthiest 10% of people are responsible for nearly half the world's CO2 emissions



Guardian graphic. Source: Emissions-inequality.org

Note: The author has included the graphic to promote thinking, but has not verified that which it conveys.

GCC Countries:

This section of Low Carbon Pulse considers news items within the news cycle of this **Edition 34** 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.

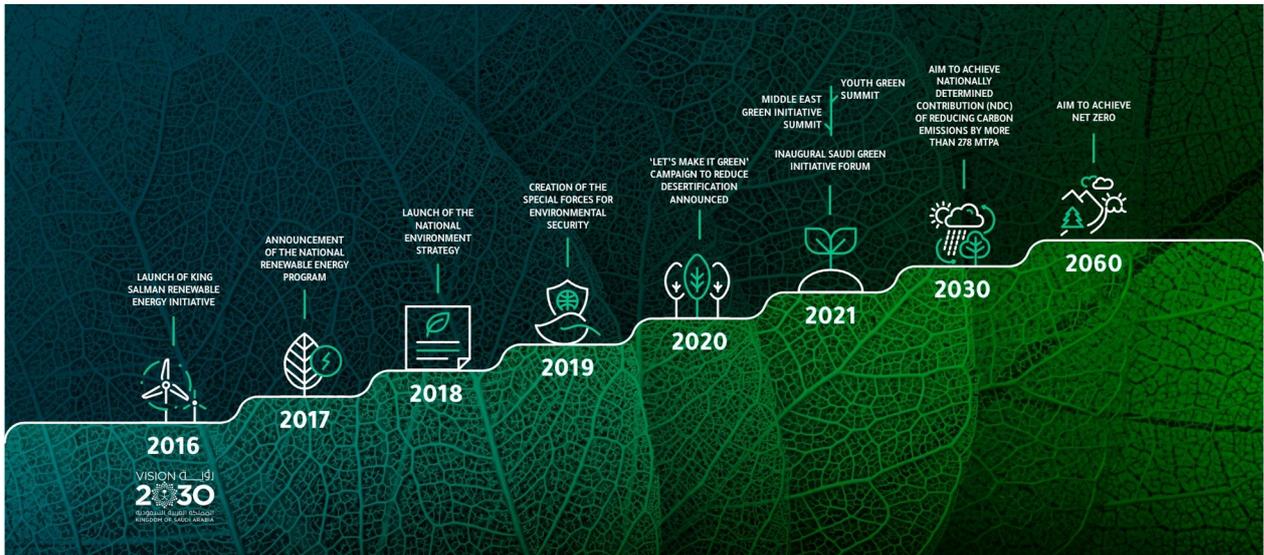
- **Background on Blue Carbon and Green Carbon initiatives:**

After a bumper pack of news during the period from December 17, 2021, to January 23, 2022 (see **Edition 33** of Low Carbon Pulse), there have been fewer news items in the news cycle for **Edition 34** of Low Carbon Pulse. Given these dynamics, this **Edition 34** covers the policy settings in the Kingdom of Saudi Arabia (**KSA**) and United Arab Emirates (**UAE**) to afforest and to restore the Blue Carbon and Green Carbon capacity within the Middle East, and to address environmental degradation generally.

- **KSA:**

The Saudi Green Initiatives (**SGI**) is intended to improve the quality of life and to protect future generations in the Kingdom of Saudi Arabia, and to support **KSA** in becoming an international leader in sustainability. All activities by Saudi Arabia to combat climate change comes under the auspices of the **SGI**.

The following timeline provides a helpful overview of the key elements of **SGI**:



The **SGI** comprises the following commitments and the initiatives are aligned with the three overarching targets to realise a green future: **1.** Reducing GHG Emission; **2.** Greening Saudi Arabia; and **3.** Protecting Land and Sea. In October 2021, at the **SGI Forum**, [60 initiatives](#) were unveiled, representing SAR 700 billion (or USD 190 billion) of investment.

In addition to initiatives aimed at achieving overarching targets within Saudi Arabia, the **SGI** commits Saudi Arabia to:

- [Global Ocean Alliance](#) – intended to protect at least 30% of global ocean in Marine Protected Areas and to achieve other effective area-based conservation measures;
- [Global Methane Pledge](#) – intended to reduce **CH₄** emissions by a third by 2030; and
- [Middle East Green Initiative](#) – intended to address climate change through regional collaboration (announced in March 2021) – including the 50 billion tree initiative across Middle East.

The initiatives outlined at the **SGI Forum** build on the commitments from April 2021 to conserve and to restore, and then to manage, sustainably, one billion hectares of land by 2040 and to plant 10 billion trees (effectively rehabilitating and restoring 200 million hectares of degraded land).

In the context of the target of planting 1 trillion trees (see [Edition 33](#) of Low Carbon Pulse) globally to restore degraded land, the **KSA** is committed to achieving 4% of this global target.

As part of the broader 2021 plan to conserve and to restore, and then to manage, sustainably one billion hectares of land by 2040, 30% of the land mass of the **KSA** (600,000 million km²) is to be conserved within protected areas, with particular focus on coastal environments.

- **UAE:**

On February 4, 2022, the **UAE** celebrated its 25th National Environment Day, two days after World Wetlands Day (see below under **WorldWetlandsDay**). The theme for the current year is Climate Action Now.

Responding to climate change and environmental degradation is not new in the UAE:

1. In 1989 **UAE** ratified the Vienna Convention for the Protection of the Ozone Layer, and its Montreal Protocol;
2. In 1995 **UAE** joined the United Nations Framework Convention on Climate Change (**UNFCCC**);
3. In 2005 **UAE** ratified the Kyoto Protocol;
4. In 2015 **UAE** became a party to the Paris Agreement; and
5. in 2023 **UAE** will host 28th session of the Conference of the Parties (**COP-28**).

While the key policy setting in the **UAE** may be said to arise under **The National Climate Change Plan** of the **UAE**, there are many initiatives that are progressing the decarbonisation of:

1. Electrical energy generation;
2. Increased energy efficiency;
3. Transportation, to ensure sustainable transportation (see the **Abu Dhabi Transportation Mobility Management Strategy**, **Surface Transport Mast Plan (Abu Dhabi)**, **Dubai Autonomous Transportation Strategy**, and **Dubai Green Mobility initiative**);
4. Sustainable Environment and Infrastructure ([UAE Vision 2021](#) focuses on improving air quality, treatment of waste, and preserving water resources, consistent with the [National Agenda](#)).

Africa:

*This section considers news items within the news cycle of this **Edition 34** of Low Carbon Pulse relating to Africa. Africa remains the continent with 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.*

- **Botswana-Namibia 5 GW Green Hydrogen project:**

Edition 26 of Low Carbon Pulse (**under Green Hydrogen from Namibia**) stated that Germany was to partner with Namibia to allow the production and export of Green Hydrogen from Namibia and transportation and import into Germany at a price of USD 1.8 per kg.

Namibia has world class renewable energy resources, with over 3,500 hours of sun each year, and strong wind resources. These world class resources are considered close to ideal for the production of Green Hydrogen at a price of between €1.50-2 per kg. It was estimated that up to 1.7 million metric tonnes per annum of Green Hydrogen could be produced by 2030. This mass of Green Hydrogen production delivered into Germany would be close to sufficient to decarbonise the German iron and steel industry given its current rate of production.

On January 31, 2022, pv-magazine.com reported that plans for a Green Hydrogen Project in Botswana and Namibia had expanded from 1 GW to 5 GW to be powered by photovoltaic solar electrical energy. Further detail will be reported in due course.

- **Egypt 1 GW Waste to Hydrogen project:**

Sibling publication, [Hydrogen for Industry \(H24I\)](#) provides an overview of the potential and science behind the use of waste and waste water to derive and to produce hydrogen.

On February 2, 2022, it was reported widely that H2-Industries is to develop a USD 3 billion, 1 GW, waste to hydrogen production facility at East Port-Said, Egypt (in the Suez Canal Economic Zone). It is understood that H2-Industries is to use organic and inorganic waste streams, and waste water, as feedstock for the production of clean hydrogen.

It is understood that the waste to hydrogen production facility will process up to 4 million metric tonnes a year of feedstock, from which up to 300,000 metric tonnes of clean hydrogen will be derived each year.

- **Rwanda and TotalEnergies energised:** At the end of January and start of February 2022 it was reported widely that the Rwanda Development Board and TotalEnergies had signed a memorandum of understanding to collaborate in the development of range of energy projects. It is understood that the energy projects contemplated include hydro-electric generation, electric and energy storage systems, and a Nature Based Solutions for carbon storage.

India and Indonesia:

*This section considers news items within the news cycle of **Edition 34** 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.*

- **Air Liquide and Pertamina looking at clean hydrogen projects:** On January 24, 2022, h2-view.com reported that Air Liquide and Pertamina had signed a memorandum of understanding (**MOU**) to assess the basis upon which Indonesian industry may be decarbonised, and how Air Liquide and Pertamina may work together in a manner aligned with the achievement of **NZE** by 2060 across Indonesia. As might be expected, it is reported that the **MOU** will focus on the decarbonisation of the activities of Pertamina across Indonesia, including the use of clean hydrogen.

- **Giga-scale electrolyser capacity:** On January 27, 2022, h2-view.com, reported that HydrogenPro and Larsen & Toubro intend to work jointly to establish a joint venture to expand electrolyser manufacturing capacity in India and to promote the use of hydrogen in India.

While at the memorandum of understanding stage, the plans appear reasonably developed in terms of the electrolyser technology (the alkaline water electrolyzers of HydrogenPro) and site identification.

- **Reliance hub plans:** At the end of January and start of February 2022 it was reported widely that Reliance Industries (leading conglomerate, headquartered in India) intends to invest up to USD 75 billion in renewable energy infrastructure, including for the purposes of powering electrolyzers to produce Green Hydrogen.

It has been suggested that all of the renewable energy infrastructure may be dedicated to the production of Green Hydrogen. Mr Gagan Sihu, director at the Centre of Energy Finance, at New Delhi based think-tank CEEW, said that: "Reliance is preparing itself to capture the entire value chain of the green hydrogen economy".

- **India Hydrogen Alliance – January 2022:** Attached is the link to the January edition of [India H2 Monitor – January 2021](#). As noted in previous editions of Low Carbon Pulse, we intend to include the link rather than repeat the context of the **India H2 Monitor**.

Japan and Republic of Korea (ROK):

*This section considers news items within the news cycle of this **Edition 34** 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.*

- **Hyosung on song:** On February 4, 2022, hydrogenfuelnews reported that Hyosung Group (an industrial conglomerate) is to invest USD 835 million in the development and deployment of Green Hydrogen production facilities in South Jeolla Province.

- **HESC:** The big news (covered in **Editions 32** and **33**) has been the successful passage of the **MV Suiso Frontier** to Australia, loading of liquid hydrogen, and its return to Kobe, Japan (see under **Australia, If you say so**): the final piece in the jig-saw puzzle that is the Hydrogen Energy Supply Chain (**HESC**) from Australia to Japan.

As will have been apparent from previous editions of Low Carbon, Japanese corporations are essential to all links in the **HESC**, and the progress, and the success, of its development.

As noted in **Edition 10** of Low Carbon Pulse:

"Among other things, the Hydrogen Energy Supply Chain uses the Kawasaki Heavy Industries (**KHI**) designed and built **LHG** carrier (the Suiso Frontier) to deliver **LHG** to the **KHI** designed and built **LHG** terminal at Kobe, Japan.

The Hydrogen Energy Supply Chain project showcases cooperation and dedication of Japanese and Australian corporations. The corporations involved in the **HESC Project** are **KHI**, Electric Power Development Co., Ltd (J-Power), Iwatani Corporation, Marubeni Corporation, Sumitomo Corporation, and AGL Energy, investing in Australian end of the supply chain, and Shell, ENEOS Corporation and Kawasaki Kisen Kaisha, Ltd (K-Line), investing in the Japanese end of the supply chain."

PRC and Russia:

*This section considers news items that have arisen within the news cycle of this **Edition 34** of Low Carbon Pulse relating to the **PRC** and Russia, being countries that give rise to the most and the fourth most **GHG** emissions.*

- **Russia able to become leading Hydrogen exporter:** On January 27, 2022, [h2-view.com](https://www.h2-view.com) stated that the Tass News Agency had reported on comments from Russian President, Mr Vladimir Putin, while meeting with Italian business leaders. It is understood the President Putin said that: "Russia can become one of the world's largest hydrogen producers and exporters by 2035."

Consistent with statements made previously, President Putin noted that the development of hydrogen production capacity reflects the intention "to reach net zero by 2060, simultaneously keeping sustainable economic growth".

- **Hydrogen Production commences:**

- **In time for the Beijing Winter Olympics:** On January 28, 2022, it was reported widely that Shell has commenced production of Green Hydrogen at its 20 MW Zhangjiakou facility, in northern China. The development of the Zhangjiakou facility has been undertaken and completed by Shell in joint venture with Zhangjiakou City Transport Construction Investment Holding Group.

The commencement of the production of Green Hydrogen is timely, with the Beijing Winter Olympics starting on February 4, 2022. After the Olympics, the Green Hydrogen from the Zhangjiakou facility will be used to power and to propel commercial and public transport vehicles in the Beijing-Tianjin-Hebei region, with the hydrogen production capacity of the facility to increase from 20 MW to 60 MW over the next two years or so.

It has been reported that all 26 Olympic venues for the Beijing Winter Olympics are powered by renewable energy. As noted in **Edition 33** of Low Carbon Pulse, this includes the use of over 700 hydrogen fuel cell vehicles.

- **In time for Christmas, 2021:** In early February, in the context of news reports about the commencement of production of Green Hydrogen at the 20 MW Zhangjiakou facility, BloombergNEF noted that on December 22, 2021, commencement of production of hydrogen commenced at the 150 MW Baofeng Energy Group electrolyser (a chemical manufacturer), in Ningxia, north central China. The commencement of production at the Baofeng Energy Group facility had rather gone under the radar.
- **Hydrogen Production expected:** For the time being, the 150 MW Baofeng Energy Group electrolyser is the largest deployed, but Sinopec (one of the big three Chinese oil and gas state-owned corporations) is developing a 260 MW alkaline electrolyser production facility in Xinjiang, north west China.
- **Off-shore wind at gale force:** **Edition 33** of Low Carbon Pulse (under **Gorges Day**) reported that on December 25, 2021, the China Three Gorges (**CTG**) connected to the transmission grid three off-shore wind field projects, together with combined installed capacity of 3.1 GW, the 1.1 GW Jiangsu Rudong, the 300 MW Jiangsu Dafeng H8-2 and the 1.7 GW Yangjiang Shapa.

The **CTG** connection of 3.1 GW was illustrative of the level of off-shore wind generation capacity installed in the **PRC**. On January 26, 2022, [Forbes.com](https://www.forbes.com) reported that in 2021 the **PRC** connected more off-shore wind than "every other country in the world had managed to install in the last five years".

Data from the PRC's **National Energy Administration** indicate that a little under 17 GW of off-shore wind capacity was installed in 2021. Of the total global installed off-shore wind capacity of 54 GW, the **PRC** has 26 GW.

- **CCS Project completed:** On January 31, 2022, it was reported widely that Sinopec had completed the first 1 million metric tonnes per year CCUS. The article in [hydrocarbonprocessing](#) (under **Carbon+Intel: Sinopec completes China's first megaton scale CCUS project**) provides the background and facts and stats.

The speed of the development of the project is marked. **Edition 21** of Low Carbon Pulse reported as follows:

"On July 5, 2021, China Petrochemical Corporation (**Sinopec**) announced the development of a CCUS project (reportedly the largest in the **PRC**, megaton-scale). The project is to use the Sinopec Qilu-Shengli Oilfield for CCUS, taking **CO₂** arising and captured from Sinopec's Oil refinery, in Shandong province, and to inject that **CO₂** into 73 wells to the Qilu-Shengli Oilfield as part of an enhanced oil recovery (**EOR**). It is understood the **Sinopec** is considering the development of further CCUS projects."

- **Natural gas deal:** On February 4, 2022, it was reported widely that the **PRC** and Russia had agreed to the sale and purchase of natural gas (Gazprom selling natural gas to CNPC purchasing), to be delivered via a new natural gas pipeline. It is understood that the contract is a 30 year contract for 10 billion m³ of natural gas a year.

This is not a first: Russia is already delivering natural gas via the Power of Siberia pipeline (in addition to liquefied natural gas (LNG)).

Leaving to one side the geo-political dimensions of the natural gas deal, in the context of **NZE**, what is telling is the term of the deal (30 years) and apparent increase in the quantity of natural gas to be delivered from Russia to the **PRC**: it is understood that by 2025 38 billion m³ of natural gas was to be delivered each year via the Power of Siberia Pipeline. The new natural gas deal appears to take the natural gas sales to 48 billion m³ a year by 2025.

Europe and UK:

*This section considers news items that have arisen within the news cycle of this **Edition 34** of Low Carbon Pulse relating to countries within the European Union (EU) and the EU itself (as an economic bloc) and the UK given geographical proximity, and similar policy settings and progress towards NZE. In combination, countries comprising the EU give rise to the most GHG emissions after the Peoples Republic of China (PRC) and the US. The UK is a top-twenty GHG emitter, but has been a front-runner in progress towards NZE.*

- **EU across-borders:** On January 26, 2022, ec.europa.eu (under [EU invests over €1 billion in energy infrastructure in support of the Green Deal](#)) reported that EU member states have agreed on a EC proposal to invest €1.037 billion in five cross border infrastructure projects under the Connecting Europe Facility (CEF).
The largest amount of funding from the CEF is the €657 million to support the development of the EuroAsia Interconnector project to connect Cyprus with the European Grid – see **Editions 23** and **32** of Low Carbon Pulse.
Other projects receiving funding support from the CEF are the Baltic Synchronisation Project Phase II to support the improvement of integrity and stability of the grid in Poland and upgrading transmission infrastructure in Estonia, Latvia and Lithuania (€170 million), the Aurora Line to support the development of a third transmission line between Finland and Sweden (€127 million), the Chiren Expansion to increase natural gas storage capacity in Bulgaria (€78 million) and Northern Lights Project Phase II which is to receive €4 million for a study to assess the expansion of the CO₂ transportation and storage capacity of the North Lights Project (see **Editions 11, 20, and 31** of Low Carbon Pulse).
- **EU gross electrical energy:** pv-magazine.com reported (under [Solar the fastest growing European clean power source](#)) on the [data](#) released by Eurostat on electrical energy consumption across the EU. The data was released on January 26, 2022. The headline is that renewable electrical energy contributed 37% to gross electrical energy consumption in 2020. Photovoltaic solar continues as the fastest growing renewable energy source in the EU.
- **Final UK GHG national statistics:** On February 1, 2022, the UK Government, Department for Business, Energy & Industrial Strategy, published, from National Statistics, (**Final UK greenhouse gas emissions national statistics: 1990 to 2020**). The publication will be considered in the January and February Report on Report to be contained in the Appendix to **Edition 38** of Low Carbon Pulse.
- **UK establishes a Hydrogen Policy Commission:** At the end of January it was reported widely that a Hydrogen Policy Commission (HPC) has been established for the purposes of identifying and avoiding policy setting and implementation pitfalls.
The first scheduled task of the HPC is to undertake an assessment of the UK Hydrogen Strategy (UK H2S) released on August 17, 2021 (and reported on in **Editions 25** and **26** of Low Carbon Pulse, and the [Report on Reports – Edition 1](#)). In this context, consistent with many commentators, the HPC will assess whether or not the UK H2S is ambitious enough.
- **UK launches CfD change consultation process:** On February 4, 2022, the UK Government launched an open consultation process [Contracts for Difference \(CfD\): proposals for changes to supply chain plans and CfD delivery](#). The consultation process ends at 11.45 pm on March 15, 2022.
- **UK CCS and CCUS business model update:** On December 21, 2022, the UK Government, Department for Business, Energy & Industrial Strategy published updates on the proposed commercial frameworks for transport and storage, power and industrial carbon capture business models – [Transport and storage business model: January 2022 update](#) and [Transport and Storage – heads of terms: January 2022 update](#).
- **Edition 33** of Low Carbon Pulse contemplated that this **Edition 34** of Low Carbon Pulse would cover in detail the applications made for funding to develop **Track 1 Clusters**. To manage the length of this **Edition 34**, all being well this update will be provided in **Edition 35**.

Americas:

*This section of considers news items that have arisen within the news cycle of this **Edition 34** 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.*

- **More thinking about a NZE electrical energy network:** **Edition 29** of Low Carbon Pulse reported (under **Oversize is the right size**) on [research](#) done Caldeira on the size and shape of renewable electrical energy capacity, and energy storage capacity, development in the US.

In summary:

"The headline from the research is that in some countries it should be possible to match renewable electrical energy to load by the installation of a combination of photovoltaic solar and wind renewable electrical energy capacity having in combination equalling 150% of standard generation capacity and with nearly four hours of BESS capacity. This combination will result in load matched by dispatch in respect of all but 200 hours in a 8,760 hour standard electrical energy year."

In January 2022, the National Renewable Energy Laboratory (NREL) of the US Department of Energy published [Grid Operational Impacts of Widespread Storage Deployment](#) (one of a number of publications in a series about the [Storage Future](#)).

The study contains a number of scenarios as progress is made to NZE by 2050. One of the scenarios is a Reference Scenario. Under the scenarios there is a range of energy storage capacity development – a 213 GW to 932 GW range, with an average energy storage duration ranging from 4.7 to 6.5 hours.

The January and February Report on Reports will consider the NREL study in detail. The January and February Report on Reports will comprise the Appendix to **Edition 38** of Low Carbon Pulse.

France and Germany:

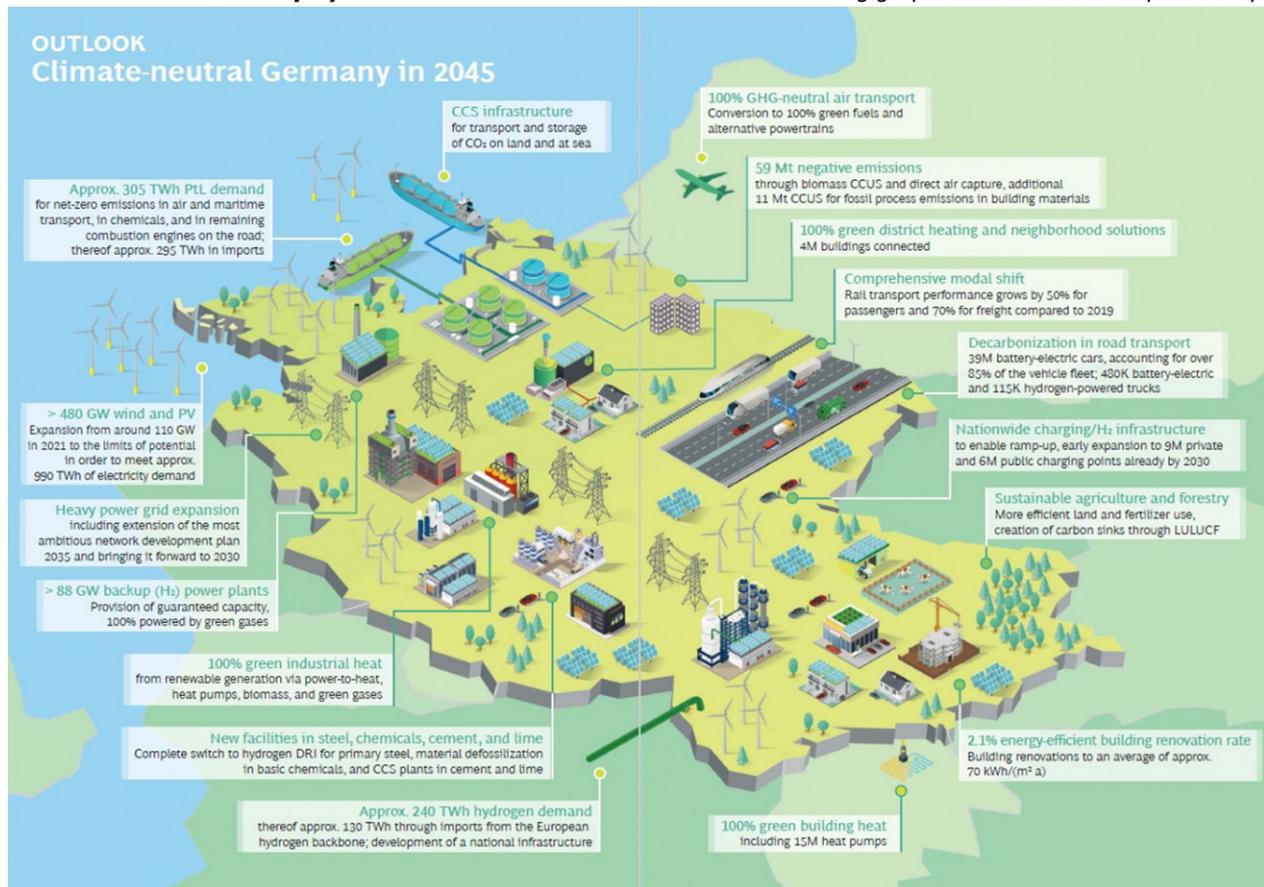
This section considers news items within the news cycle of this **Edition 34** of Low Carbon Pulse relating to France and Germany.

- **Hamburg continues progress:**

A number of previous editions of Low Carbon Pulse have covered initiatives in respect of Hamburg and the Port of Hamburg – see **Editions 9, 12, 13, and 32** of Low Carbon Pulse.

On February 4, 2022, it was reported widely that the Hamburg Port Authority (**HPA**) and Air Projects (one of the big three global industrial gas corporations with Air Liquide and Linde) are working to develop a comprehensive hydrogen supply / value chain across the Port of Hamburg. Given the location of the Hamburg and the Port of Hamburg, and other activities within Hamburg and more broadly across northern Europe the supply / value chain initiative might be expected to support supply and demand development.

- **Carbon Neutral Germany by 2045:** The author has come across the following graphic which tells a complete story:

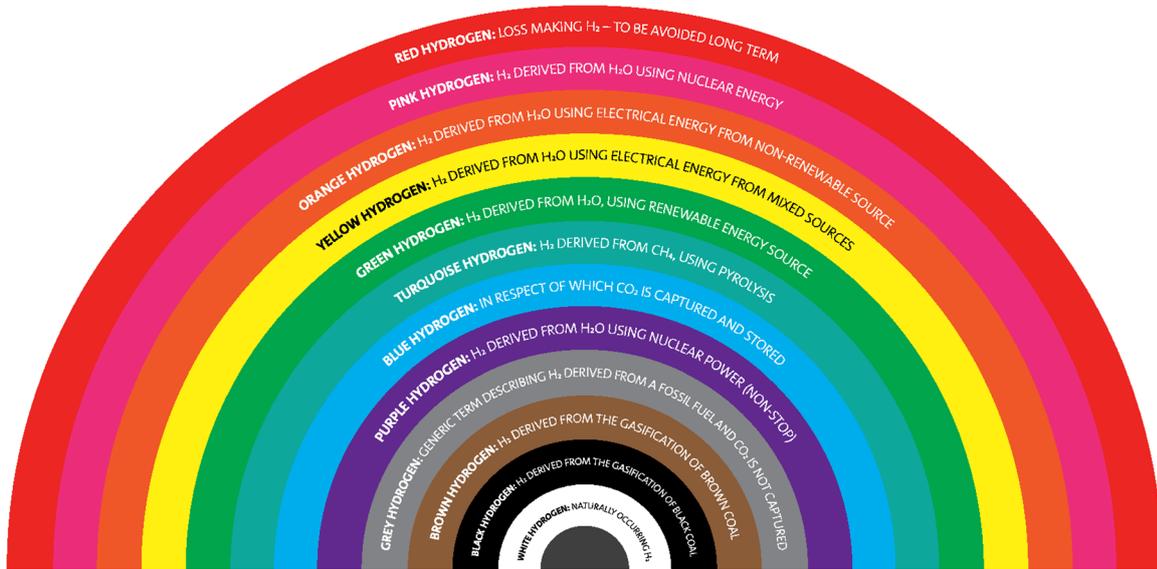


Australia:

This section of considers news items that have arisen within the news cycle of this **Edition 34** 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.

- **Northern Territory (NT) in the mix:** On January 25, 2022, [pv-magazine-australia](https://www.pv-magazine-australia.com/news/northern-territory-hydrogen-ambitions-grow-as-frv-signs-agreement-with-aussie-exploration-company) (under **NT hydrogen ambitions grow as FRV signs agreement with Aussie exploration company**) provides an overview of the development of hydrogen production **projects** in the **NT**, with a focus on the Hexagon Energy's hydrogen project. Hexagon Energy (Hexagon Energy Materials Limited) is reported to have signed a non-binding memorandum of understanding with FRV (a renewable energy project development corporation). Future editions of Low Carbon Pulse will follow progress.
- **A new gold rush:** On February 2, 2022, [pv-magazine-australia](https://www.pv-magazine-australia.com/news/natural-hydrogen-exploration-boom-snaps-up-one-third-of-south-australia) (under **Natural hydrogen exploration "boom" snaps up one third of South Australia**) reports on the phenomenon of prospecting for natural hydrogen arising in the context of a range of geological and geothermal settings. Natural hydrogen, described as White Hydrogen in the Ashurst Hydrogen Rainbow, appears to have been given a new moniker, Gold Hydrogen.



Ashurst Hydrogen Rainbow ©Ashurst 2021

Note: Some authors / commentators use Purple Hydrogen to refer to the production of hydrogen using coal or petcoke gasification using CCS to capture the CO₂ arising.

In South Australia, White Hydrogen is being referred to as Gold Hydrogen, reflecting the rush to acquire exploration licenses

While it remains to be seen whether the "mining" of Gold Hydrogen can be undertaken to scale commercially, Australia has a range of geological and geothermal settings in which natural hydrogen arises.

For further background on natural hydrogen in the Australian context, see the **CSIRO** (Commonwealth [of Australia] Scientific and Industrial Research Organisation, being the national science agency of Australia), report [Hydrogen in Australian natural gas: occurrences, sources and resources](#).

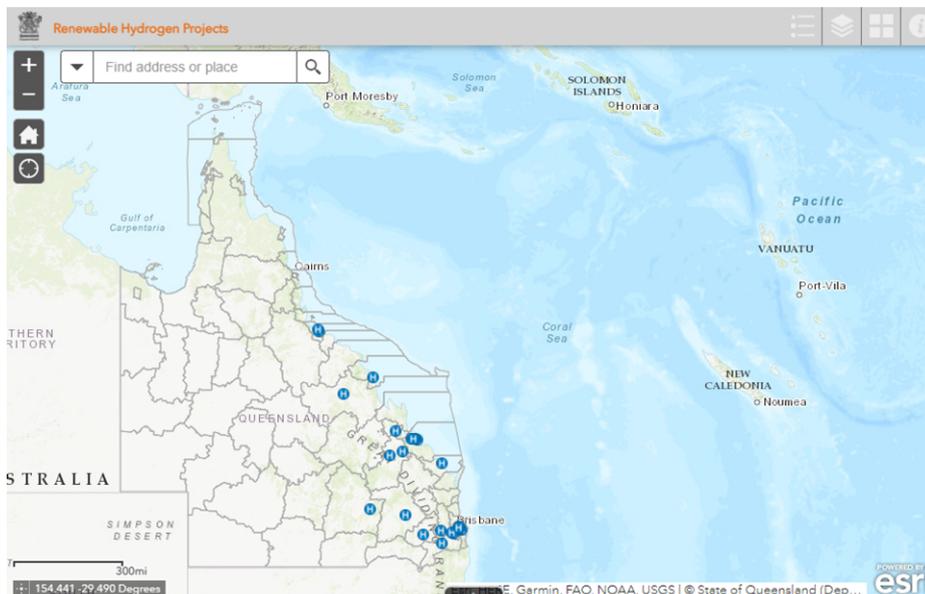
- **If you say so: Edition 32** of Low Carbon Pulse reported that it was likely that the **MV "Suiso Frontier"** (see Editions 2, 8, 10 and 17 of Low Carbon Pulse) built by Kawasaki Heavy Industries Limited (**KHI**), and owned by HySTRA, would travel to Australia during December 2021 to load, to transport and to deliver to Kobe, Japan, the first cargo of liquid hydrogen (**LH₂**) as the Hydrogen Energy Supply Chain (**HESC**) project progresses (see Editions 10 and 12 of Low Carbon Pulse).

On December 24, 2021, the **Suiso Frontier** left Japan, docking at the Port of Hastings, Victoria, Australia, on January 20, 2022. The arrival of the **Suiso Frontier** was marked by an arrival ceremony. The arrival of the **Suiso Frontier** marks the final piece in the jigsaw puzzle called the **HESC**.

The concept of the **HESC** was developed in 2015 (long before hydrogen plans, road maps and strategies became common), and involved forward thinking folk committing to the development of the **HESC**, including forward-thinking by the Federal Government of Australia, in particular the funding support that it provided.

On January 31, 2021, the **Suiso Frontier** departed the Port of Hastings, Victoria, Australia headed back to Kobe.

- **Queensland Hydrogen Map:** As covered in previous editions of Low Carbon Pulse, the State of Queensland, Australia, is hosting many hydrogen and ammonia project developments. On February 4, 2022, the Department of State Development provided [background](#) and launched a map of the project development across the hydrogen supply / value chain.



- **South West REZ interest: Edition 30** of Low Carbon Pulse reported that: "On November 1, 2021, it was reported widely that the NSW Government had invited registrations of interest for its third renewable energy zone (**REZ**) – the **South West REZ**. There are three more **REZs** to come to market, the **Illawarra REZ** and the **Hunter-Central Coast REZ**. Please click [here](#) to view the NSW Government's electricity roadmap.

NSW REZS – THE STORY SO FAR...	
Central West Orana REZ – interest expressed by the private sector to develop 27 GW of renewable electrical energy capacity	New England REZ – interest expressed by the private sector to develop 34 GW of renewable electrical energy capacity

On November 11, 2021, [pv magazine](#), reported that Australia's first coordinated renewable energy zone is to be built in the central west of NSW, the **Central-West Orana REZ**.

The **Central-West Orana REZ** will deliver up to 3 GW of renewable electrical energy into the grid. The development of the **Central-West Orana REZ** is aligned with the NSW Government policy setting of the development and deployment of 12 GW of renewable electrical energy and 2 GW of BESS by 2030.

It is understood that the **Central-West Oran REZ** was preferred as the first **REZ** to be developed because of the level of investment in renewable electrical energy development already underway in the Central-West region.

It will be interesting to follow the developing of the NSW **REZ** development as Australia's most populous State progresses to the development and deployment of 12 GW of renewable electrical energy capacity across the State (see **Edition 4** of Low Carbon Pulse)."

On February 4, 2022, the NSW Government reported that it had received registrations of interest (**ROI**) for the **South West REZ** in respect of 34 GW of renewable electrical energy capacity.

The CEO of Energy Corporation NSW, Mr James Hay said that the level of ROIs received from industry was "outstanding". Mr Hay said that: "There were 49 registrations totalling over 34 GW from potential generation and storage projects – 13 times the intended capacity for the South-West REZ, which will be no less than 2.5 GW".

Low Carbon Pulse has noted on a number of occasions, that the States and Territories of Australia continue to blaze a trail to **NZE**. This is another instance of this trail blazing, noting always, that the private sector is key to the continued progress to **NZE**.

Blue and Green Carbon Initiatives and Biodiversity:

*This section considers news items that have arisen within the news cycle of this **Edition 34** Low Carbon Pulse relating to the Blue Carbon and Green Carbon initiatives and Biodiversity.*

WETLANDS A CALL FOR ACTION

NATURAL WETLANDS ARE DISAPPEARING THREE TIMES FASTER THAN FORESTS

- 35% of global wetlands lost in 55 years (1970-2015)
- 85% lost since 1700s

WHAT LOSS OF WETLANDS MEANS

FOR PEOPLE

- Water scarcity
- Exposure to flooding and extreme weather events
- Lost livelihoods and well-being
- Food insecurity

FOR THE PLANET

- Biodiversity decline
- Increased carbon and methane emissions
- Loss of natural freshwater filtration

TAKE THREE ACTIONS

- VALUE WETLANDS**: BIODIVERSITY HOTSPOTS, FRESH WATER STORES, CARBON SINKS, SOURCE OF LIVELIHOODS
- STOP DRAINING**: THE LIFE FROM WETLANDS USE WISELY
- REWET REFOREST RESTORE WETLANDS**

SOME WETLANDS TO LOVE

PEATLANDS Peatlands-Marathon Forstland Basin - Peru	CORAL REEFS Great Barrier Reef - Australia	MANGROVES Sundarbans - Bangladesh
MARSHES Okavango Delta - Botswana	FLOOD PLAINS Paraná - Brazil, Bolivia, Paraguay	ESTUARIES Severn Estuary - UK
COASTLINES Amalfi Coast - Italy	SWAMPS Everglades - USA	BOGS Cuvoita Centralis - Republic of Congo

VALUE - MANAGE - RESTORE - LOVE

#WorldWetlandsDay #ActForWetlands www.worldwetlandsday.org

World Wetlands Day 2 February 2022
Wetlands Action for People and Nature

- **WorldWetlandsDay:** Wednesday February 2, 2022, was World Wetlands Day. As noted in previous editions of Low Carbon Pulse, "wetlands" is a generic term that includes mangrove swamps, bogs, estuaries, lakes and lagoons, marshes and mud-flats that experience perennial or seasonal flooding.

[Copernicus.eu](#) (under [Working for our wetlands](#)) provides a helpful summary of the initiatives and issues that are relevant to wetlands.

To mark World Wetlands Day the summary to the left of the key actions required to preserve wetlands was released. While it does not do justice to the range and complexity of the action required, it provides a helpful summary.

For the author, the voyages of discovery of "world days continues": **Edition 32** of Low Carbon Pulse noted that December 5 is world soil day.

- **Visual Capitalist Graphic:** Previous editions of Low Carbon Pulse have include diagrams and graphics from the Visual Capitalist, which are consistently excellent, and not infrequently brilliant. In the context of wetlands, and their importance, the following graphic is an brilliant addition to the Visual Capitalist catalogue:

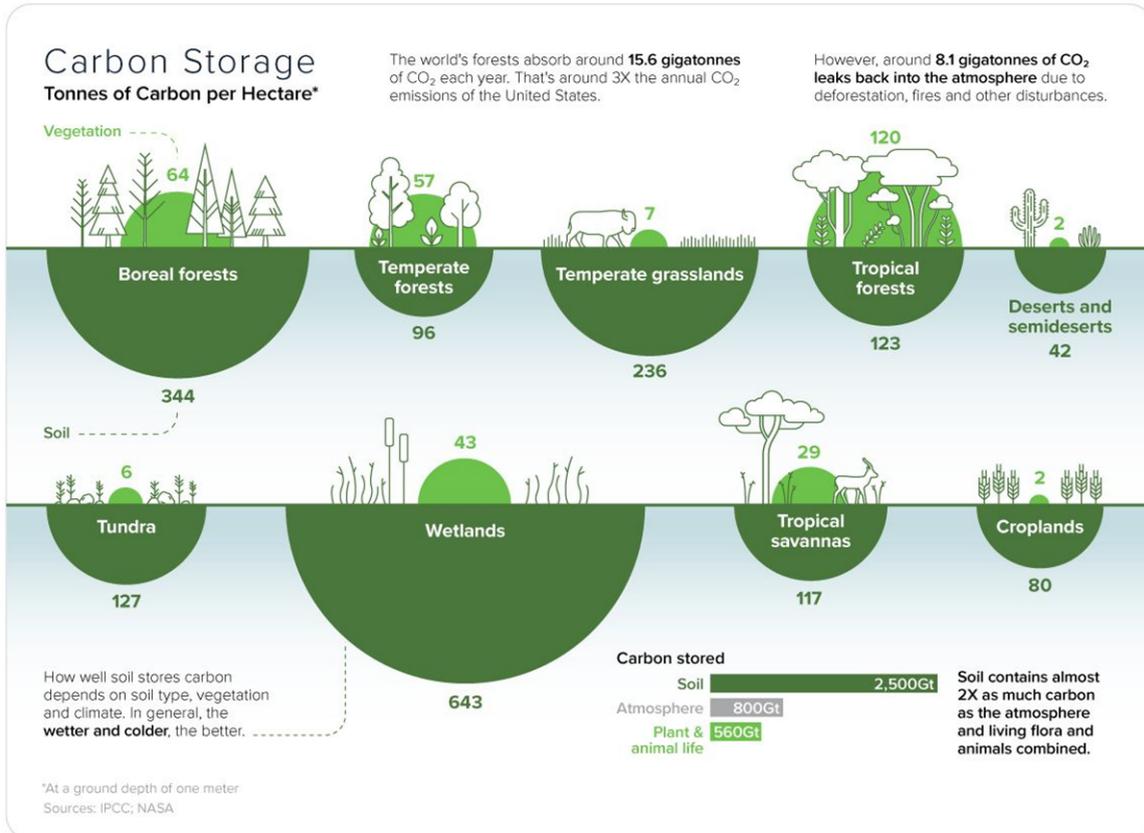
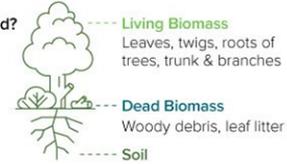
Carbon Storage in Earth's Ecosystems

Achieving net-zero by 2050 depends on the Earth's natural carbon sinks.

Forests play a critical role in regulating the global climate. They absorb carbon from the atmosphere and then store it, acting as natural carbon sinks.

Where is Carbon Stored?

There are various carbon pools in a forest ecosystem.



Carbon Streaming is protecting the Earth's natural carbon sinks with carbon credit streams across the following REDD+ projects:



Rimba Raya
Borneo, Indonesia
~64,000 hectares



Cerrado Biome
Brazil
~11,000 hectares



MarVivo Blue Carbon
Baja California Sur, Mexico
~22,000 hectares



Learn more at
CARBONSTREAMING.COM

NEO: **NETZ**
OTCQB: **OFSTF**
FSE: **M2Q**



/visualcapitalist
 /visualcapitalist
 @visualcap
 @visualcap
 visualcapitalist.com

Bioenergy and heat-recovery:

This section of considers news items that have arisen within the news cycle of this **Edition 34** 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 (derive 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.

- **TotalEnergies and Veolia team to go green:**

On February 2, 2022, TotalEnergies announced (under **TotalEnergies and Veolia Join Forces to Accelerate the Development of Biomethane**) that it is had agreed with Veolia to produce biomethane from waste and waste water treatment facilities in more than 15 countries.

TotalEnergies and Veolia will co-invest in projects with the target of producing 1.5 terawatt-hours of biomethane hours by 2025.

While Europe and the US are leading the way in the production and use of biomethane (including in the US as renewable natural gas (**RNG**)), the derivation and production of biomethane from organic waste streams represents a key part of global progress towards **GHG** reductions and **NZE**, in particular if the **CO₂** arising from the deviation and production of biomethane can be captured.



BIOENERGY IN GASEOUS FORM

Biogas: a mixture of **CH₄** and **CO₂**, arising from the decomposition of organic matter, including derived or produced from anaerobic digestion.

Biomethane: **CH₄** in near pure form, derived or produced from upgrading **Biogas** or gasification of biomass. Biogas and Biomethane are Biogases.

Bio CNG: Biogas or Biomethane that is compressed.

Bio LNG: Biomethane that is liquified.

- **Europe – ever increasing progress to use of biomethane:** On February 3, 2022, [NGVA Europe](#), released information that outlined the growth in the use of biomethane, in compressed form as bio-CNG, in the transport sector across Europe. The information from NGVA Europe is accompanied by a helpful map.



At the start of 2022 there are 4,110 CNG and 499 LNG refuelling stations across Europe.

Both BIO-CNG and Bio-LNG are produced from biomethane. The Secretary General of **NGVA** Europe (**NGVA** standing for **Natural and Bio Gas Vehicle Association**) in promoting the information provided by **NGVA** Europe said: "These impressive numbers prove that biomethane is a rapidly growing reality, able to support the transition to climate neutrality and the objectives of the European Green Deal in a very effective, efficient and especially realistic way ...".

BESS and HESS (and energy storage):

*This section considers news items that have arisen within the news cycle of this **Edition 34** of Low Carbon Pulse relating to battery electric storage systems (**BESSs**) and hydrogen energy storage systems (**HESSs**). In addition to **BESSs** and **HESSs**, other forms of energy storage systems are covered, including use of compressed air energy storage (**CAES**) and pumped storage. In this context, long duration energy storage (**LDES**) is considered, being energy technology that is able to allow the off-take electrical energy out of storage for a duration of more than four hours. In the brave new world described in **Edition 13** of Low Carbon Pulse: "**BESS** storage of 10/12/24 hours is being contemplated for business users, and up to 72 hours for telecommunications companies, including to guard against the consequences of land-borne weather events".*

- **PG&E amasses BESS capacity:** On January 25, 2022, [energy-storage.news](#) reported that California Utility, Pacific Gas and Electric (**PG&E**), proposes to procure 1.6 GW / 6.4 GWh of new **BESS** capacity through the development and deployment of nine large-scale projects. This procurement is intended to respond to the mandate of the California Public Utilities Commission (**CPUC**) in June 2021 to procure 11.5 GW of electrical energy capacity from **GHG** free sources. **PG&E** is one of three investor owned utilities (together with and community choice aggregators) required to contract for **GHG** free sources that must come on line between 2023 and 2026. Under the **CPUC** mandate, **PG&E** is required to procure 2.302 GW of electrical energy capacity from **GHG** free sources. The procurement of 1.6 GW / 6.4 GWh of new **BESS**, discharges all but 702 MW (or 0.702 GW) of electrical energy capacity from **GHG** free sources.
- **Vistra expands BESS capacity:** On January 25, 2022, [energy-storage.news](#) reported that Vistra Energy (Texas headquartered integrated power generation and utility corporation) intends to add a further 350 MW / 1,400 MWh of **BESS** capacity to the Moss Landing Energy Storage Facility located in Monterey Bay, California which has 400 MW / 1,600 MWh of existing **BESS** capacity (300 MW / 1,200 MWh coming on line at the end of 2020, and 100 MW / 400 MWh having coming on line in August 2021).

With the expansion to 750 MWh / 3000 MWh of **BESS** capacity, the Moss Landing Storage Facility will continue to be the biggest **BESS** globally. It is reported that **PG&E** has signed a 15 year resource adequacy agreement for the expanded **BESS** capacity.

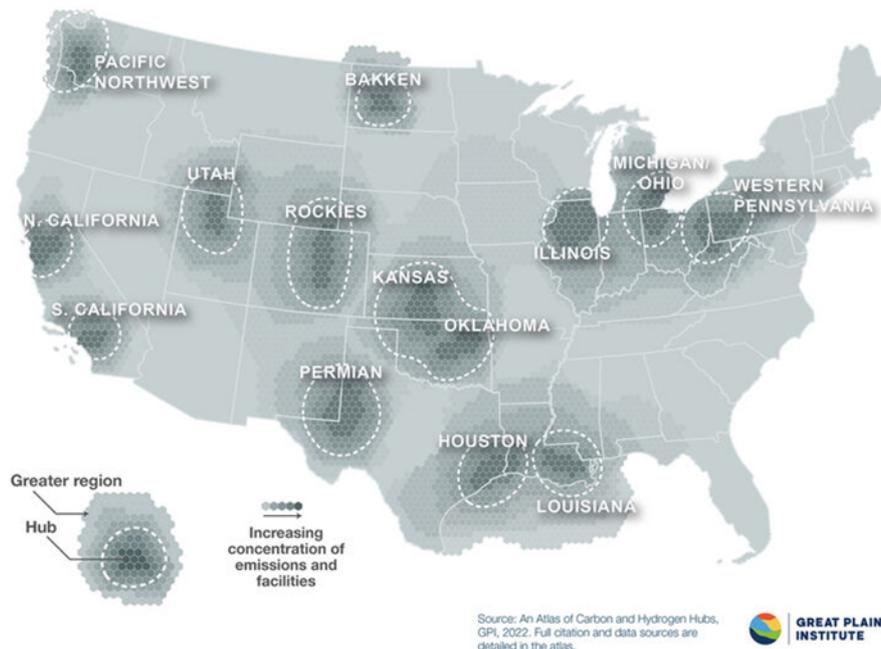
- **Amping up energy storage:** Completing a trifecta of new items from [energy-storage.news](#), on January 27, 2022, [energy-storage.news](#) reported that Amp Energy is to develop and to deploy in Scotland two grid-connected **BESS's**, each of 400 MW / 800 MWh (the **Scottish Green Battery Complex**). The **BESS's** are to be located in Hunterson and Kincardine in central Scotland. It is understood the operation of the two **BESS's** will be optimised using Amp Energy technology Amp X (an AI-driven digital platform).
- **TransAlta to develop BESS in Alberta:** On January 30, 2022, it was reported widely that TransAlta (leading energy corporation) is to develop a 180 MW **BESS** in Alberta, Canada. The 180 MW **BESS** is to be developed and deployed in two stages, and will be charged using renewable electrical energy sourced from an existing TransAlta hydroelectric storage plant.
- **LDES Council membership grows:**
Edition 30 of Low Carbon Pulse reported on the establishment of the Long Duration Energy Storage (**LDES**) Council (**LDESC**) at **COP-26** as follows:
 "On November 4, 2021, the **LDESC** was established to provide guidance to Governments to the transmission grid operators on the objective of working towards global deployment of 85 – 140 TWh of long duration energy storage by 2040. The founding members of the **LDESCs** are (in alphabetical order): Alfa Laval, Ambri, Azelio, Baker Hughes, Breakthrough Energy, BP, CellCube, Ceres, Echogen Power Systems, EnergyDome, Enlighten, EOS, ESS, Inc., Ezinc, Form Energy, Greenko, Highview Power, Malta, Neom, Quidnet Energy, Redflow, Rio Tinto, Siemens Energy, and Stiesdal."
 On February 1, 2022, the LDESC announced that a further 12 corporations had joined as new members: Corre Energy, Enervenue, Google, Kraft Block, Kyoto Group, Magaldi, Microsoft, Orsted, Pumped Hydro Storage, Sumitomo, TORC, and Volt Storage.
 The establishment of the **LDESC** and the continued growth of its membership appears aligned entirely with the progress towards development and deployment of **LDES** across grids, behind the meter, and remotely.
- **LDESC emphasises the importance of LDES:**
 On February 4, 2022, the **LDESC** noted that the role of long duration energy storage will be critical to progress to net-zero electrical energy generation. The **LDESC** points to a [study](#) by researchers at **Stanford University, Stanford Woods Institute for the Environment** (covered in **Edition 31** of Low Carbon Pulse).

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 34** of Low Carbon Pulse relating to carbon accounting and carbon dioxide removal (CDR), including to 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 source of CO₂, preventing release to the climate system. The following provides a helpful overview of carbon capture as things currently stand.*

- **Lehigh Cement and Enbridge close to set:** On January 26, 2022, [Enbridge, Inc](#) (under [Lehigh Cement and Enbridge Agree to Advance a CO₂ storage solution in Alberta](#)) announced that it had signed a memorandum of understanding with Lehigh Cement (a division of Lehigh Hanson Materials Limited) to work together on a carbon solution for Lehigh's cement manufacturing facility in Edmonton, Alberta.
 Lehigh is developing the first full-scale carbon capture, utilization and storage (CCUS) solution in North America for its Edmonton facility to capture up to 780,000 metric tonnes of CO₂ annually. The stated intention is that Lehigh Cement will haul the CO₂ by pipeline, delivering CO₂ hauled to Enbridge for storage.
 Enbridge considers that the CO₂ from Lehigh Cement and Capital Power Corporation, and other industrials, represents an opportunity to store up to 4 million tonnes of CO₂ a year. Enbridge is reported to be applying to develop an open access carbon storage hub in the Wabamun area, west of Edmonton (the **Open Access Wabamun Carbon Hub**).
- **Eni and Holcim combine:** On January 28, 2021, [Eni](#) announced that it was collaborating with Holcim to explore with Holcim the use of Eni technology to produce a material in which CO₂ is fixed permanently and stably, and as such to store CO₂ captured in difficult to decarbonise industries, including cement production. As announced, the Eni technology uses a carbonator in which CO₂ is sequestered in ground Olivine before being incorporated into cement: in other words magnesium silicate is carbonated.
 It is understood that a demonstration plant is to be developed to test the reduction in CO₂ and the integration of carbonators into cement production plants.
- **Battelle and Equinor to explore CCS in Appalachian Basin:** On February 1, 2022, [Battelle](#) (leading science and technology business) announced the signing of a memorandum of understanding (MOU) with Equinor (leading international energy corporation) to advance the development within a tri-state region of Ohio, Pennsylvania and West Virginia of "decarbonisation energy cluster / hub".
 The Country Manager of Equinor US, Mr Chris Golden stated: "The Appalachian Basin is an important energy-producing region that also shows great promise in being a leader for decarbonisation of American industry. Our regional hub vision will meet tomorrow's energy demands while maintaining America's industrial competitiveness with a net-zero scenario".
 A view part of this vision is the use of CCS. The **MOU** provides that Battelle and Equinor are to undertake feasibility studies to assess the potential of the Appalachian Basin to store permanently CO₂ captured.

- **Great Plains, Great Resource and Great Report:** On February 1, 2022, the Great Plains Institute launched **An Atlas of Carbon and Hydrogen Hubs for United States Decarbonisation** [report](#). The report is excellent. The following map provides a helpful overview of the subject matter of the report.



- **Petronas' progress continues:** On January 28, 2022, [Petronas](#) announced that it had signed a memorandum of understanding with Japan Petroleum Exploration Co. Limited (**JAPEX**) to collaborate on **CCS** opportunities, including suitable **CO₂** storage solutions in Malaysia. The first step in this collaboration is to undertake a study jointly on means of capture and transportation of **CO₂** from the Petronas LNG Complex in Bintulu.

By way of reminder:

Edition 33 of Low Carbon Pulse (under **Petronas and Shell alignment**) reported that Petronas and Shell had signed a joint study and collaboration agreement (**JSCA**) to explore opportunities, and to collaborate in respect of those opportunities, for **CCS**, so as to provide Malaysia and the region with **CO₂** storage solutions. As reported, the **JSCA** provides for Petronas and Shell to undertake an integrated **CCS** Area Development Plan study in respect of locations off-shore of Sarawak.

Edition 30 of Low Carbon Pulse (under **ExxonMobil and Petronas teaming**) reported that Petronas had signed a memorandum of understanding with ExxonMobil. Also, in December 2021, Petronas signed a memorandum of understanding with POSCO to assess opportunities for **CCS**.

Carbon Credits and Hydrogen Markets and Trading:

*This section considers news items that have arisen within the news cycle of this **Edition 34** 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 hydrogen markets and trading (bilateral and likely wholesale).*

- **Giving (carbon) credits where additionality:** On February 5, 2022, climatetechv.sustack.com published an excellent article, the by-line for which is **Wrangling the wild west of the voluntary carbon offset market**. The article is well-worth a read, indeed for this interested in the **Voluntary Carbon Market / Voluntary Carbon Credit Market** it may be considered mandatory market reading!

"The world of climate tech overflows with mind-bending technologies. But perhaps the most mind bending of all? The voluntary carbon markets".

This is an early contender for quote of the year.

The issues explored in the article will be covered in the stand-alone article on **Carbon Credits, Article 6 and the Paris Rulebook**.

E-fuels / Future Fuels / Now Fuels:

*This section considers news items that have arisen within the news cycle of this **Edition 34** 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 derive 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.*

- **BloombergNEF hydrogen predications:** While it may be getting a little too far into 2022 to include predictions, the perspective of the good folk at BloombergNEF is always worth sharing. Their predications are as follows: **1.** Electrolyser sales will quadruple, with the **PRC** being the largest market; **2.** The US will see many announcements of many hydrogen production projects, but development of those projects will lag; **3.** New policy settings providing subsidies will spur a boom in the hydrogen market in Europe; **4.** A number of hydrogen corporations will go public

during 2022; **5.** Hydrogen strategies will be adopted by 22 countries in 2022; **6. NZE** will derive demand for hydrogen more than carbon pricing / a cost of carbon; **7.** Industry, in particular heavy industry, will dominate demand for hydrogen; **8.** Globally many announcements about Green Ammonia will be made; **9.** Policy settings will keep Blue Hydrogen supply and demand development on life-support; and **10.** Alkaline electrolyzers will increase their market share over other technologies.

- **Wilhelmshaven Grey Plans:** On January 24, 2022, AtlasInvest (a corporation that invests in both conventional oil and gas and renewable projects) announced plans to develop a €2.5 billion hydrogen facility that will derive hydrogen from methane (i.e., Liquid Natural Gas or LNG) imported from **GCC countries**.

The hydrogen facility will be located within the hinterland of the Port of Wilhelmshaven. It is reported that the hydrogen facility will have capacity to produce up to 500,000 metric tonnes of hydrogen per year. It is understood that CCS / CCUS is not contemplated, and as such the hydrogen produced will be Grey Hydrogen.

By way of reminder, **Edition 14** of Low Carbon Pulse reported that on April 15, 2021, Uniper (German utility giant) planned to develop a hydrogen hub located in Wilhelmshaven (**Green Wilhelmshaven**) comprising a receiving terminal for Green Ammonia, then using a cracker to derive Green Hydrogen. The plans included a 410 MW electrolyser. On full development, it was estimated that the facilities at **Green Wilhelmshaven** would produce up to 295,000 metric tonnes per year of Green Hydrogen.

In **Edition 14** it was noted that the decision of Uniper to develop **Green Wilhelmshaven** may end its plans to import LNG using a floating storage and regasification unit at Jade Bay, in Wilhelmshaven. Given the plans of AtlasInvest, it would seem likely that Wilhelmshaven may become a key Green Hydrogen and Grey Hydrogen Hub.

- **Liquid Wind and Ørsted breeze to deal:** On January 25, 2022, it was reported widely that Liquid Wind AB and Ørsted had contracted for Ørsted to invest in a large-scale e-methanol project in FlagshipOne, in Sweden, with Ørsted taking a 45 equity interest.

FlagshipOne is likely to be the world's first large-scale e-methanol production project, using a 70 MW electrolyser. It is anticipated the FlagshipOne will produce up to 50,000 metric tonnes of e-methanol a year using renewable electrical energy to produce Green Hydrogen and to combine that Green Hydrogen with **CO₂** captured from the combined heat and power plant at Hörneborgsverket, Örnsköldsvik, Sweden. Assuming that a final investment decision is taken during 2022, the expectation is that FlagshipOne will be commissioned by the end of 2024.

For some time Liquid Wind AB has been concentrating on the means to decarbonise the maritime sector, with FlagshipOne being thought to be the first of a number of projects in the pipeline.

For Ørsted, its investment in FlagshipOne emphasises its perspective on Power-to-X.

- **Yara and Linde contract:** 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.

On January 28, 2022, [Yara](#) announced that Yara and Linde Engineering had contracted for Linde (one of the big three industrial gas producers globally, with Air Liquide and Air Products) to develop and to deploy a 24 MW Green Hydrogen production facility at Herøya, using proton exchange membrane (**PEM**) electrolyser technology, with technology provided by ITM Power (UK headquartered leading technology corporations).

It is understood that Green Hydrogen produced will displace, in part, Grey Hydrogen currently used at Yara's ammonia plant: as currently contemplated up to 20,500 metric tonnes of ammonia will be produced annually, sufficient to produce up to 80,000 metric tonnes of fertilizer.

- **ROK corporations in Sarawak:** On January 26, 2022, [Aju Business Daily](#) reported that a consortium of Malaysian and **ROK** corporations are to commence the production of Green Hydrogen, Green Ammonia and Green Methanol in Sarawak, East Malaysia (**H2biscus Green Hydrogen Project**). SEDC Energy, a wholly-owned subsidiary of the Sarawak Economic Development Company (**SEDC**), has signed a memorandum of understanding with leading **ROK** corporations, Lotte Chemical, POSCO and Samsung Engineering.

It is understood that the feasibility study for the **H2biscus Green Hydrogen Project** contemplates annual production of 600,000 metric tonnes of Blue Ammonia, 630,000 metric tonnes of Green Ammonia, and 460,000 metric tonnes of Green Methanol.

Big BESS and Green Hydrogen Hub in NZ: **Edition 33** of Low Carbon Pulse reported that Meridian Energy (leading energy corporation) had announced plans to develop and to deploy the first Big **BESS** in New Zealand (the **Marsden Point BESS**), to be located adjacent to the Marsden Point oil refinery north of Auckland, within the Ruakaka Energy Park (which will be co-located with a utility-scale photovoltaic solar farm).

For some time it has been reported that the Marsden Point oil refinery is scheduled to close in April of this year. Also it has been reported widely that Fortescue Future Industries (**FFI**), a subsidiary of Fortescue Metals Group (founded by Dr Andrew Forrest, AO), is exploring options for the use of the Marsden Point oil refinery as the location for a Green Hydrogen Hub. This is consistent with the use of the Liddell coal-fired power station in the Hunter Valley, NSW, Australia as a Green Hydrogen Hub (see **Edition 32** of Low Carbon Pulse).

- **Project Catalina fully sized:** On February 1, 2022, it was reported widely that Copenhagen Infrastructure Partners (**CIP**) (and **CIP** announced that it was, working with Enagás, Fertiberia, Naturgy, and Vestas) is to develop and to deploy a 2 GW Green Hydrogen production facility in Aragón, north west Spain (**Project Catalina**). **Project Catalina** will source renewable electrical energy from 5 GW on-shore photovoltaic solar and wind sources.

Project Catalina is to be developed in two phases, with Phase I currently progressing. The Green Hydrogen will be hauled from Aragón to Valencia for use as feedstock by Fertiberia (leading ammonia and fertiliser producer) to produce Green Ammonia and fertiliser.

Project Catalina is the second GW scale Green Hydrogen production facility to be announced since the turn of the calendar new year. By way of a reminder, **Edition 33** of Low Carbon Pulse reported on the **SHYNE** project as follows: " ... the Spanish Hydrogen Network (**SHYNE**), a consortium of 33 corporations and organisations, led by Spanish oil

and gas giant Repsol, is to invest €3.3 bn to develop and to install 500 MW of Green Hydrogen production capacity by 2025, and 2 GW by 2030. The installation of 2 GW of Green Hydrogen production capacity by 2030 will satisfy half to the Spanish Government's target of 4 GW (see **Editions 5** and **29** of Low Carbon Pulse)".

The installation of the 2 GW of Green Hydrogen production contemplated by **Project Catalina** combined with the 2 GW contemplated by **SHYNE**, will mean that these projects will match the Spanish Government's target of 4 GW. With other projects announced and planned, Spain appears likely to lead Europe in Green Hydrogen production.

• **BP Australia progressing at Kwinana:**

- **Edition 27** of Low Carbon Pulse (under **BP weighing up Kwinana Energy Hub**) reported that, "BP Australia was undertaking a feasibility study to produce Green Hydrogen at the site of its Kwinana refinery, working with leading renewables energy and hydrogen adviser and participant Macquarie Group.

While this may be regarded as early days, the repurposing of the Kwinana site, and the supportive policies of the Western Australian Government, may be regarded positively, including the possibility of the development of Kwinana as a hydrogen hub and carbon cluster."

- **Waste to fuel:** It is understood that considerable progress has been made that the BP Australia is likely to enter Front End Engineering and Design (**FEED**) to scope and to cost the decarbonisation of the carbon cluster of which Kwinana is a part. Waste based feedstock will be used to produce sustainable / synthetic aviation fuel (**SAF**) and renewable diesel. To produce these biofuels hydrogen will be required, which it is understood will be derived from the production of biogas.
- **And on the other side of the world ... bp wins Aberdeen approval:** On February 3, 2022, it was reported widely that bp is become a joint venture partner of Aberdeen City Council (**ACC**) to develop the first scalable Green Hydrogen production facility in Scotland.
- **And on the other side of the North Sea:** On February 3, 2022, it was reported widely that Copenhagen Infrastructure Partners (**CIP**), Hy2gen, and Trafigura intend to develop a 240 MW electrolyser in Sauda, Norway, to produce Green Hydrogen to be combined with nitrogen to produce Green Ammonia (Iverson e-Fuels AS). It is anticipated that the electrolyser capacity will increase over time.
- **And in Finland ...:** On February 4, 2022, [H2-view.com](https://www.h2-view.com) reported on the development of a Green Hydrogen production facility in Harjavalta, Finland by P2X Solutions. Construction of the facility is to commence in Q3 of 2022.

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

*This section considers news items that have arisen within the news cycle of this **Edition 34** of Low Carbon Pulse relating to the extraction of metals and minerals necessary for the decarbonisation of activities to progress towards achievement of **NZE**, the use of **E-fuels** and **Future Fuels** to power and to propel vehicles used to extract and to transport metals and minerals, and the use of E-fuels and Future Fuels to process and to treat those metals and minerals. Also this section considers the Difficult to Decarbonise industries, including the iron and steel sector.*

- **ArcelorMittal accelerates:** On February 4, 2022, ArcelorMittal announced that it is to accelerate its decarbonisation of iron and steel production in France. The acceleration involves the investment of €1.7 billion at its Dunkirk and Fos-sur-Mer iron and steel mills.

At **Fos-sur-Mer** ArcelorMittal will build an electric arc furnace (**EAF**). The development of the **EAF** is complementary to the development of the ladle furnace announced in March 2021, which the French Government supported under the France Relance recovery plan.

At **Dunkirk** ArcelorMittal will build a direct reduction of iron (**DRI**) plant to produce direct reduced iron / sponge iron using high-temperature heat from hydrogen rather than from coal, and the development of an **EAF** to produce steel. The French Prime Minister, Mr Jean Castex announced the support of the French Government for the acceleration program.

IRON AND STEEL	
Blast Furnace: a high-pressure, high-temperature heat environment, using metallurgical coal, in which iron ore is smelted to produce pig-iron	Electric Arc Furnace: high-voltage electrical energy is applied to graphite electrodes creating a high-temperature environment in which iron ore or scrap metal is melted
Pig Iron: The crude iron used to produce steel	DRI / Sponge Iron: Iron reduced directly from iron ore, using carbon monoxide and hydrogen derived from natural gas or coal, or using Green Hydrogen

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

*This section considers news items that have arisen within the news cycle of this **Edition 34** 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 concentrated and supported (**Hydrogen Corridors and Valleys**); and*
- *giga-factories that fabricate and manufacture photovoltaic solar panels (and associated equipment), wind-turbine blades and towers (and associated equipment), electrolysers (and associated equipment), electric batteries and hydrogen fuel cells, and transmission cabling (including HVDC transmission cabling).*

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

To manage the length of Low Carbon Pulse, news items that have arisen during the last two weeks will be picked up in **Edition 35**.

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

*This section considers news items that have arisen within the news cycle of this **Edition 34** of Low Carbon Pulse relating to the development of wind power generation capacity, on-shore and off-shore (fixed bottom and floating).*

- **Thor's day on a Tuesday:** On January 24, 2022, **RWE**, announced that it had signed the concession agreement with the Danish Government for the Thor off-shore wind field (**TOSW**) project awarded to **RWE** on the drawing of lots on December 1, 2022 - see **Edition 32** of Low Carbon Pulse under "**Luck of the Thor**".

Edition 31 of Low Carbon Pulse reported that:

"On November 25, 2021, the Danish Energy Agency (**DEA**) announced that the award of the 1 GW Thor offshore wind field (**Thor OWF**) project will be decided by a lottery.

It is understood the multiple bidders, including heavy weight consortiums, Copenhagen Infrastructure Partners and SSE, Iberdrola and Total Energies, Ørsted and RWE, Swan Wind (Eneco and European Energy) and Vattenfall, are to draw lots for the award.

The **Thor OWF** project is to be developed by the winner of the lottery without any Government support in the form of a subsidy. The **DEA** announced that: "*More than one bidder has offered to build Thor offshore wind farm with a capacity of 1,000 MW at the minimum price of Dkr0.10 / MWh, and the tender will therefore, in accordance with the tender conditions, be decided by drawing lots*".

The **TOSW** project is scheduled to reach operational completion by 2027, with a total cost of USD 2.3 billion. While the full terms of the concession agreement have not been sighted by the author, it is understood that the Danish Government will earn in the region of USD 400 million.

- **ROCKING off-shore ROK:** On January 25, 2022, [Aker Offshore Wind](#), announced that Aker Offshore Wind, with OW Oceans Winds, in their Korea Floating Wind off-shore wind field project had been granted its first Electricity Business Licence (**EBL**) for 870 MW. The CEO of Aker Offshore Wind, Mr Phillippe Kavagyan stated: "*We are very pleased by this timely grant of the first Electric Business Licence, confirming that strong support that we receive in South Korea to make offshore wind a national ambition.*"

By way of reminder:

- **Edition 25** of Low Carbon Pulse reported that the Green Investment Group Limited (**GIG**) and TotalEnergies had been granted an electricity business licence (**EBL**) from the Ministry of Trade, Industry and Energy. The grant of an **EPL** allows the development, on an exclusive basis, of the first phase (504 MW) of the three phase 1.5 GW off-shore floating wind field project off Ulsan, South Korea; and

- **Edition 26** of Low Carbon Pulse reported that Shell Overseas Investment B.V. had announced its joint venture with CoensHexicon Co. Ltd, with Shell a 80%, CoensHexicon, a 20%, equity participant, to develop and then to operate the 1.4 GW Ulsan **OWF** project (the **MunmuBaram Project**). As reported in **Edition 32** of Low Carbon (under **MunmuBaram licensed**), the **MunmuBaram Project** has been granted an Electricity Business Licence (**EBL**), for its floating off-shore wind field project development.

- **More of OWF for Germany:** **Edition 33** of Low Carbon Pulse reported noted that it was reported widely that the German Federal Maritime and Hydrographic Agency (**BSH**) had commenced updating maritime plans to accommodate an additional 3 GW of off-shore wind field capacity in the German sector of the North Sea.

On January 28, 2022, [offshorewind.biz](#) reported (under **Germany to Auction Off 1,880 MW of Offshore Wind Capacity in 2022.23**) that the **BSH** had approved the suitability of areas N-3.5, N-3.6 and N-7.2 in the German sector of the North Sea for development of off-shore wind fields. The three areas are stated to have wind resources giving a combined capacity of 1,888 MW.

- **OWF for Brazil:** On January 27, 2022, [offshoreWIND.biz](#) reported (under **Brazil Takes Major Step Towards Developing Offshore Wind Potential**) that the Government of Brazil had issued Decree No. 10,946 to allow the implementation of off-shore studies for the purposes of identifying areas suitable for the development of off-shore wind projects. It is understood that the Brazil Ministry of Mines and Energy will undertake the studies, and in due course organising, will have carriage of the preparation of, and running of, auctions for the development of off-shore wind field capacity.

- **Black Sea development:** On January 31, 2022, [offshoreWIND.biz](#) reported that German headquartered renewable electrical energy developer, wpd, planned to develop two off-shore wind fields in the Romanian sector of the Black Sea – the 500 MW Black Sea 1 and the 1,400 MW Black Sea 2 projects. The development of the off-shore wind fields is a natural step for wpd which has been in Romania since 2009 and has 1,300 of on-shore wind farm projects under development in Romania.

Solar and Sustainability (including NZE Waste):

*This section considers news items that have arisen within the news cycle of this **Edition 34** of Low Carbon Pulse relating to the development of solar power generation capacity, on-shore (photovoltaic and concentrated) and floating. Also this section covers 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**.*

- **Giants align strategically:** Many editions of Low Carbon Pulse have covered Ørsted (see **Editions 30, 31, 32 and 33** Low Carbon Pulse) and Salzgitter AG (see **Editions 18 and 23** of Low Carbon Pulse). Both corporations lead in their fields and in progress to **NZE**.

On January 25, 2022, Ørsted (under **Heading for a circular economy – Salzgitter AG and Orsted launch strategic partnership**) announced that it was to work the Salzgitter AG in strategic partnership. For these purposes, the two have signed a memorandum of understanding under which they plan to established closed value chains: Orsted will supply renewable electrical energy from its off-shore wind fields and hydrogen for low carbon steel production, and Salzgitter will supply low carbon steel to Ørsted.

Also the two plan to develop a closed loops to recycle scrap.

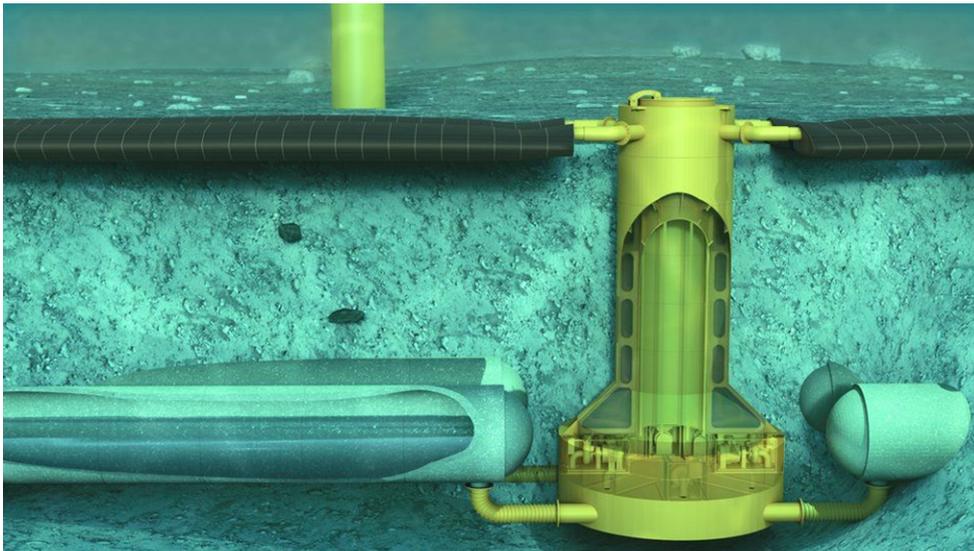
The strategic partnership illustrates once again that the private sector is continuing to progress to the reduction in **GHG** emissions and **NZE**.

- **Solar to hydrogen technology:** On January 25, 2022, [h2-view.com](https://www.h2-view.com) reported that AESA (consulting and engineering corporation) and Fusion Fuel had entered into an agreement under which the solar to hydrogen technology of Fusion Fuel is to be combined with the engineering solutions and technology of AESA. The two corporations intend to combine to offer decarbonisation projects to major industrial corporations on a turnkey basis.
- **Second life given life:** On February 3, 2022, it was reported widely that [GE Renewable Energy](https://www.ge.com/renewable-energy) had signed preliminary agreements with German and French-Swiss corporations to dismantle, shred and co-process blades from on shore wind farms, being blades that are reaching the end of their life-cycle. In addition, GE Renewable Energy has contracted with Veolia North America in respect of blades from on-shore wind farms.
- **Out of our comfort zone:** As regular readers of Low Carbon Pulse will know, Low Carbon Pulse does not tend to cover all new or novel technologies that may become the subject of news items. This said, in the current news cycle a couple of ideas have struck the author as potentially significant:

- **Energy storage in oceans:**

On February 4, 2022, the [BBC](https://www.bbc.com/news/business-58144444), Business News (under [How to store excess wind power underwater](https://www.bbc.com/news/business-58144444)) outlined the development of an Ocean Battery by a Dutch start-up, Ocean Grazer.

A graphic is included below to give a sense of how the Ocean Battery is intended to work.



- **Energy storage in data:**

On February 4, 2022, [pv-magazine.com](https://www.pv-magazine.com) reported that researcher at UC San Diego have proposed the use of excess renewable electrical energy to pre-compute certain types of data, and to store that data on servers to later use (**information batteries**). The core of the idea is to perform, on a speculative basis, computations in large, energy-intensive data centres when renewable electrical energy is available: **information batteries** provide storage through speculative load shifting, anticipating computation to be performed in the future.

- **Corporate PPAs top 30 GW:** Over the first week of February a number of news outlets reported on the ever increasing level of commitment of the private sector to renewable electrical energy through the purchase of renewable electrical energy. The most widely reported number comes from BloombergNEF (under Corporate Clean Energy Buying Tops 30 GW Mark in Record Year), which states that in 2021 corporations purchased 31.1 GW of clean power under term corporate PPAs / clean energy contracts, with over 20 GW of clean power being purchased in the US.

Land Mobility / Transport:

*This section of considers news items that have arisen within the news cycle of this **Edition 34** 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:** While news items have arisen during the last two weeks, they will be picked up in **Edition 35**.

- **Cars (including taxis):**

As the 2021 facts and stats continue to be rolled out, the **IEA** reported on **Electric Vehicles sold by automaker in 2021**.

- **Fuel Cell and Battery Technology news:**

Ballard and Chart progress: On February 1, 2022, [Ballard](https://www.ballard.com) and Chart announced that they had tested successfully the use a fuel cell using liquid hydrogen.

Ballard Power Systems and Chart Industries Inc, working together under a memorandum of understanding (signed on February 10, 2021), using a Ballard FCmove TM-HD fuel cell and a Chart liquid onboard hydrogen (**HLH2**) vehicle fuel system, demonstrated that heavy-duty vehicles can be powered and propelled using liquid hydrogen (**LH2**).

This is significant because **LH2** has a mass and volume range advantage over compressed hydrogen (**CH2**). It is understood that the range of a heavy-duty vehicle powered and propelled by **LH2** is more than twice that of a heavy-duty vehicle powered and propelled by **CH2**.

- **Industrial Vehicles and Trucks:**

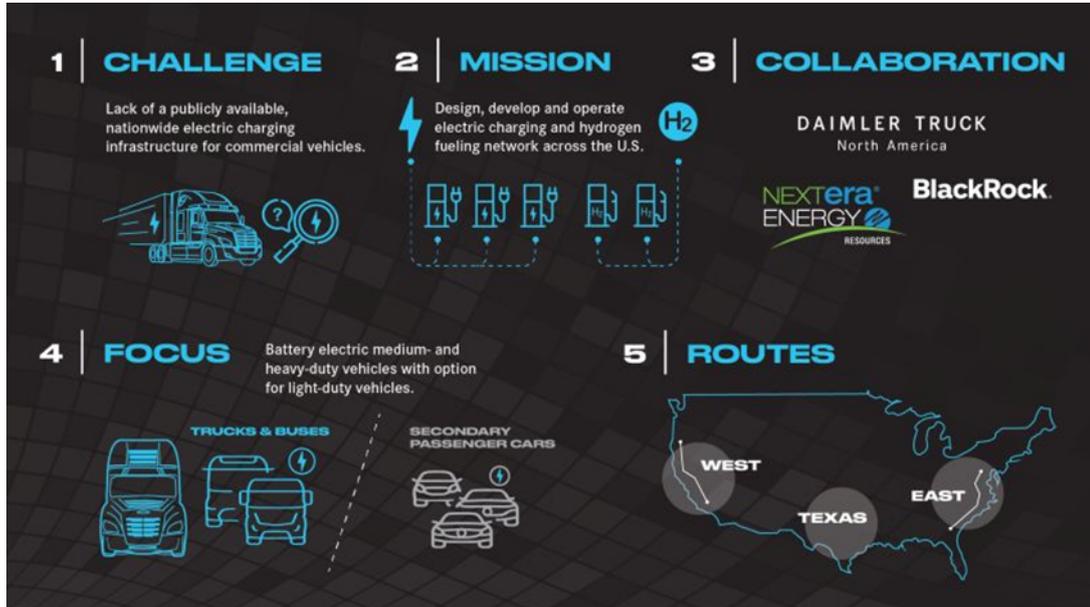
DHL procures Volvo Bio-LNG trucks: On January 27, 2022, biogaschannel.com that DHL in the UK had procured 13 Volvo Bio-LNG trucks as part of the DHL GoGreen plan. The Volvo FH6x2 tractor units have 155 kg bio-LNG tanks giving a maximum range of 1,000 km.

- **Recharging and refuelling infrastructure:**

- **BlackRock, Daimler and NextEra Energy roadside:** On January 31, 2022, it was reported widely that BlackRock Renewable Power, Daimler Truck North America, and NextEra Energy Resources LCC had agreed on principles for the formation of a joint venture to develop and to deploy electric recharging stations and hydrogen refuelling infrastructure.

In passing, it is worthwhile reminding oneself that Daimler Truck AG is developing both a hydrogen fuel cell (GenH2 Truck) and an electric battery truck (eActros).

It is understood that up to USD 650 million in funding is to be provided initially, split equally between electric recharging stations and hydrogen refuelling infrastructure.



- **Hydrogen refuelling infrastructure development in 2021:** On February 2, 2022, Mr Uwe Albercht, published a summary of the number of hydrogen refuelling infrastructure developments that opened during 2021.

The raw facts and stats being, Asia – 89, Europe 37, and North America 13, and 33 countries in which hydrogen refuelling is possible.



- **All in on hydrogen:** On February 4, 2022, hydrogen-central.com reported that ORLEN Group is to invest USD 1.9 billion by 2030 across Poland, the Czech Republic and Slovakia. It is reported that the investment will be made in low to zero carbon hydrogen development projects based renewable energy sources and use of municipal

solid waste to derive hydrogen from waste, and a distribution network involving the development of 100 hydrogen refuelling stations across the three countries.

- **Trains:** News items that have arisen during the last two weeks will be picked up in **Edition 35**.

Ports Progress and Shipping Forecast:

*This section of considers news items that have arisen within the news cycle of this **Edition 34** 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 of 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 floating boats:

- **Having a whale of a time:** In late January 2022, Green City Ferries provided an overview of fast passenger ferries power and propelled by hydrogen, outlining the **Beluga24** – the world's first hydrogen powered and propelled high-speed catamaran ferry. The **Beluga24** has an electric energy option for shorter journeys. Both the hydrogen fuel cell and the electric energy options are designed to carry 150 passengers and 28 bicycles.

As announced the first **Beluga24** is to be used in the Stockholm archipelago, with support from the **EU** funding.

- **Glassy waters:** On January 26, 2022, [High North News](#) (under **Signed Contract Worth Billions for Operating Hydrogen Ferries between Bodo and Lofoten: "World Class Climate Project"**) reported that the Norwegian Public Roads Administration and Torghatten Nord had signed an agreement to operate the first full-scale hydrogen ferry on the Hjelmeland-Skipavik-Nesvik route in Rogaland (on the west coast of Norway), with operation commencing during 2022.

• Hydra meets Ballard:

Edition 23 reported that in late July 2021, the **MF Hydra** (styled as the first liquid hydrogen powered ferry) had been delivered. As reported, the **MF Hydra** is 82.4 metres in length, with capacity for 300 passengers and 80 motor cars. On February 2, 2022, it was reported widely that Ballard Power Systems is to supply two of its 200KW FCwave fuel cell modules to Norled A/S, the owner of the **MF Hydra**.

As will be apparent from the previous news items, during 2022 the **MF Hydra** will start to serve the Hjelmeland-Skipavik-Nesvik route in Rogaland.

- **Hydrogen Hydrofoil:** On January 30, 2022, the [nationalnews.com](#) reported (under **World's first hydrogen-powered hydrofoil to be made in Dubai**), that "the Jet", a hydrofoil, is to be manufactured in Dubai, in the **UAE**. As has been the case with the **MF Hydra**, Low Carbon Pulse will follow the development of the Jet.

• Green Shipping Corridors:

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** commit to 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."

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.

• PORA Highlights and Insights:

- **PORA Highlights:** **Edition 33** of Low Carbon Pulse reported on a Port of Rotterdam Authority (**PORA**) [feature](#) outlining **10 highlights in the energy transition** at the Port of Rotterdam and the extended hinterland of the Port: the projects include the LyondellBasel circular steam project, the heat pipeline from Rotterdam to The Hague, the Porthos project (see **Edition 3** of Low Carbon Pulse and below), the Net Op Zee Hollandse Kust project, the Maasvlakte – Pernis pipeline (see **Edition 30** of Low Carbon Pulse), Green Hydrogen production facilities (see **Edition 27** of Low Carbon Pulse), the Shell biofuel production facility at Pernis (see **Edition 19** of Low Carbon Pulse), and the proposed Neste sustainable fuels production facility (see below).

- **PORA Insights:** On February 1, 2022, the CEO of **PORA**, Mr Allard Castlein (under "**Hydrogen: the challenges of a whole new system**") identifies four key insights as follows: **1.** Green versus Blue Hydrogen: Both Blue and Green Hydrogen are required, with Blue Hydrogen required to fulfil 2030 ambitions, and Green Hydrogen to achieve 2040 and 2050 goals; **2.** A certification system for hydrogen is essential (carbon intensity certification and guarantee of origin), for both Green Hydrogen and Blue Hydrogen, and progress needs to be made promptly; **3.** The Port of Rotterdam is essential for the development of Green Hydrogen and Blue Hydrogen facilities and

infrastructure (including because the Port will be land-fall for off-shore wind electrical energy production, the development, currently, of five electrolysers (together having 500 MW of electrolyser capacity) within the precinct of the Port, and role of the Port in pipeline development); and **4**. The role of **PORA**, together with the Sustainable Energy Council, the City of Rotterdam and the province of Zuid-Holland, in the World Hydrogen Summit.

As noted in previous editions of Low Carbon Pulse (see **Editions 19, 27, 30 and 33**), for some time, the **PORA** has been, and continues to be, aware of the central role that ports, and their hinterlands, have to play in the development of the hydrogen economy.

- **Port of Rotterdam to site bp and HyCC 250 MW electrolyser:** While this news item could be placed here or under **E-Fuels / Future Fuels / Now Fuels**, given the previous piece, it appears best placed here.

On February 1, 2022, it was reported widely that bp and HyCC BV had agreed to develop further their Green Hydrogen production facility Masavlakte in the Port of Rotterdam, the Netherlands (the **H2-Fifty project**).

The Green Hydrogen produced by the **H2-Fifty project** will displace fossil fuel sourced feedstocks used currently by bp at its refinery in Rotterdam.

- **And Rotterdam is not Finished yet:** On January 27, 2022, UPM (a Finnish corporation) announced that it wants to increase its biofuel production capacity, and its preferred location of a new biorefinery is the Port of Rotterdam.
- **Work commences on Neste sustainable fuels production facility:** On February 4, 2022, Neste reported that work had commenced it is Rotterdam refinery to produce Green Hydrogen, at part of the MultiPLHY project.

The MultiPLHY project is an initiative that is enabling Neste to transition to the use of new technologies, including Power-to-X and renewable hydrogen production. The installation of solid-oxide electrolyser cell (**SOEC**) is regarded as an important step in this transition. The MultiPLHY project involves a number of corporations, including CEA (French public research organisation), Engie (leading international energy corporation), Paul Wurth (leading engineering and technology corporation) and Sunfire (leading technology provider, and the provider of the **SOEC**).

By way of reminder: In addition to the projects detailed above, in December 2022 the **Porthos** (Port of Rotterdam CO₂ Transport Hub Off-shore Storage) project contracted with Air Liquide and Air Products, and two of the leading international energy corporations, ExxonMobil and Shell in respect of carbon capture and storage.

The **Porthos** project is one of the flagship CCS projects, being development by the **PORA** and EBN B.V. (a natural gas corporation owned by the Dutch Government), Gasunie (energy network operator in the Netherlands and Northern Germany) in joint venture, comprising the transportation of **CO₂** captured in the Port of Rotterdam (see **Edition 3** of Low Carbon Pulse) using a 22 km submarine pipeline into storage in a depleted gas field with storage capacity for **CO₂** of 37 million metric tonnes. The intention is that the 2.5 million metric tonnes of **CO₂** will be stored each year.

- **LCO₂ Carrier development:** As has been noted consistently in Low Carbon Pulse, while the development of hydrogen, ammonia, methanol and carbon dioxide production and capture technologies is key to progress to **NZE**, as important is the development and deployment of sea-going carriers that can transport these energy carriers from the point of production to the market in which they are to be used.

As noted above in respect of the **MV Suiso Frontier**, progress is being made, but the technology used for the **MV Suiso Frontier** is being scaled up by **KHI**, with containment tanks of 40,000 m³ having already being certified, and plans for four tanks per vessel. Once the technologies are established and tested, sea-going carriers need to be built at a rate consistent with the in tandem growth of the supply and demand for the energy carriers of the future.

On February 2, 2022, it was reported widely that Mitsubishi Heavy Industries (**MHI**) Group unit Mitsubishi Shipbuilding Unit entered into a contract with Sanyu Kisen, based in Kobe, Japan, to build a demonstration test vessel to carry liquified carbon dioxide (**LCO₂**). The **LCO₂** is to be built at the **MHI** Enoura Plant, at **MHI's** Shimonoseki Shipyard Machinery Works.

As has been the case with the development of the **HESC** (see above under **Japan and Republic of Korea**) from Australia to Japan (which developed with a demonstration hydrogen production plant, and the development of hydrogen compression, transportation and liquefaction technologies), the **LCO₂** carrier project is to develop along with CCUS technology and demonstration projects, and **CO₂** transportation projects.

- **Energy carrier production for vessels needs to be accelerated:**

Edition 26 of Low Carbon Pulse reported that on August 24, 2021:

"A.P. Moller – Maersk announced that Maersk had accelerated the rate of its fleet decarbonisation with an order for eight container vessels capable of being powered and propelled using carbon neutral methanol. With each container vessel costing USD 175 million, this is a USD 1.4 billion commitment.

The eight container vessels are to be built by Hyundai Heavy Industries (**HHI**) and delivered in 2024. The multi-vessel shipbuilding contract with **HHI** gives Maersk an option for four additional container vessels. As would be expected, the engines will be dual fuel, to allow the use of both low carbon methanol and low sulphur heavy fuel oil. As noted in previous editions of Low Carbon Pulse, **HHI** has been working on the dual fuel technology for some time with MAN ES and Alfa Laval (see **Edition 21** of Low Carbon Pulse)."

Edition 26 of Low Carbon Pulse noted that:

"Possibly the most stated and restated theme in Low Carbon Pulse (and sibling publications relating to hydrogen and hydrogen-based fuels) is the need for supply and demand for hydrogen and hydrogen based energy carriers to develop in tandem.

In the announcement of the order for the eight container vessels, Mr Soren Skou noted that: " .. **this is a firm signal to fuel producers that sizeable market demand for the green fuels of the future is emerging at speed**".

It is understood that Maersk will use **carbon neutral e-methanol or sustainable bio-methanol** as soon as possible. **Also it is understood that in the near to medium term, the supply of low carbon methanol is likely to be challenging.** To address this challenge, **it should be expected that A.P. Moller – Maersk will increase demand from corporations with which it has existing supply arrangements, and contract with other corporations for supply.**"

More methanol required: On February 4, 2022, it was reported widely that a consortium, comprising A.P. Moller – Maersk, Copenhagen Airports, DFDS, DSV, Ørsted and SAS, working with Everfuel, Haldor Topsøe and NEL, intends to accelerate the rate of Green Hydrogen production at their Power-to-X project to ensure that 100 MW of electrolyser capacity is installed to ensure that 50,000 metric tonnes of clean / sustainable fuels are produced by 2050, mainly to respond to the coming demand for e-methanol for shipping.

Airports and Aviation:

*This section considers news items that have arisen within the news cycle of this **Edition 34** 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.*

To manage the length of this **Edition 34** of Low Carbon Pulse, **Edition 35** will include a catch up on Airport and Aviation news items.

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
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	<u>Hydrogen in Australian natural gas: occurrences, sources and resources.</u>
Department for Business, Energy & Industrial Strategy	<u>Transport and storage business model: January 2022 update</u>
Department for Business, Energy & Industrial Strategy	<u>Transport and Storage – heads of terms: January 2022 update</u>
Great Plains Institute	<u>An Atlas of Carbon and Hydrogen Hubs for United States Decarbonization</u>
Nature	<u>The global carbon sink potential of terrestrial vegetation can be increased substantially by optimal land management</u>
National Renewable Energy Laboratory (NREL)	<u>Grid Operational Impacts of Widespread Storage Deployment</u>
Science	<u>Global assessment of oil and gas methane ultra-emitters</u>
ScienceDirect	<u>Zero air pollution and zero carbon from all energy at low cost and without blackouts in variable weather throughout the U.S. with 100% wind-water-solar and storage</u>

Key Contacts

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.



Michael Harrison
Senior Partner, Energy, Resources and Infrastructure

M +65 9728 8562 /+61 439 512 384/
+61 414 968 707
michael.x.harrison@ashurst.com



Richard Guit
Global Co-Head, International Projects

T +65 6602 9153
M +65 9728 7943
richard.quit@ashurst.com



Daniel Reinbott
Partner

T +65 6416 9529
M +65 9728 8672
daniel.reinbott@ashurst.com



Andrew Roche
Partner

T +65 64160272
M +65 97287452
andrew.roche@ashurst.com



Eleanor Reeves
Partner

T +44 20 7859 1210
M +44 7823 340 854
eleanor.reeves@ashurst.com



Caroline Lindsey
Partner

T +61 8 9366 8109
M +61 417 788 649
caroline.lindsey@ashurst.com



Dan Brown
Partner

T +61 7 3259 7149
M +61 401 564 654
dan.brown@ashurst.com



Paul Curnow
Partner

T +61 2 9258 5738
M +61 434 074 591
paul.curnow@ashurst.com



Michael Burns
Partner

T +44 20 7859 2089
M +44 7717 840 646
michael.burns@ashurst.com



Anna-Marie Slot
Global Environmental, Social and Governance Partner

T +44 20 7859 3724
M +44 7788 710 892
anna-marie.slot@ashurst.com



Antony Skinner
Partner

T +44 20 7859 1360
M +44 7917 635 974
antony.skinner@ashurst.com



David Wadham
Office Managing Partner, Tokyo

T +81 3 5405 6203
M +81 90 4828 5191
david.wadham@ashurst.com

Keep up to date

Sign up to receive the latest legal developments, insights and news from Ashurst. By signing up, you agree to receive commercial messages from us. You may unsubscribe at any time.

[Sign up here](#)

ashurst

www.ashurst.com



Low Carbon Pulse – Edition 34 – February 8, 2022.

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