

# Low Carbon Pulse - Edition 35

## GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 35** 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 February 7, 2022 to Sunday February 20, 2022 (inclusive of each day). The **November and December Report on Reports** has been included in the [Second Compendium of Low Carbon Pulse](#), which contains **Editions 29 to 34** of Low Carbon Pulse (covering October 6, 2021 to February 6, 2022).

Please click [here](#) for the **First Compendium of Low Carbon Pulse** (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.

### IPCC - busy again:

As noted in recent editions of Low Carbon Pulse, the International Panel on Climate Change (**IPCC**) **Working Group II** (on Impacts, Adaptation and Vulnerability) (**WGII**) is in the process of finalising its findings as part of the Sixth Assessment Report (**AR6**). For some time, the **IPCC** has signalled the release of the **WGII** report during February 2022. It is understood that the **IPCC WGII** report will be released on February 28, 2022. As the author finalises this **Edition 35** of Low Carbon Pulse, the **WGII** is at the half-way point of two weeks' of meeting to finalise the **Summary for Policymakers**.

### Content of this Edition 35:

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

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**Low Carbon Pulse – Edition 35 – February 22, 2022.**

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

## Timeline for 2022:

- **Key conferences and publications:** Editions [33](#) and [34](#) of Low Carbon Pulse identified events that may influence or impact progress to **NZE** (and the editions of Low Carbon Pulse that will cover each event).
- **Edition 36** of Low Carbon Pulse will cover:

- **IPCC WGII:** The **IPCC WGII** report on Impacts, Adaption and Vulnerability (**WGII's** contribution to the **IPCC's Sixth Assessment Report**), the report being titled **Climate Change 2022: Impacts, Adaptation and Vulnerability**.

Starting on Monday February 14, 2022 the **IPCC WGII** has been meeting to finalise its findings ahead of the release of the **IPCC WGII** report. The commencement of the meeting was marked by an opening ceremony, live-streamed on February 14. The virtual meeting will conclude on February 25, 2022.

The meeting is the 12th session of **IPCC WGII** (and the 55th of the **IPCC**). The **IPCC WGII** is considering the **Summary for Policymakers**, to approve it. Once approved by the **IPCC WGII**, the **IPCC** will accept formally the entirety of the **IPCC WGII report - Climate Change 2022: Impacts, Adaptation and Vulnerability**.

As reported by the **IPCC**, 195 countries are meeting with **IPCC WGII** to approve, line-by-line, the **Summary for Policy Makers**. While not on the scale of **COP-26**, the 12th session of **IPCC WGII** (and the 55th of the **IPCC**) represents another critical step in understanding the impacts of climate change on the climate system, and the basis for adaptation to those impacts, and how adaptation will address vulnerability to climate change.

Throughout the first week of the virtual meeting to approve the **Summary for Policy Makers**, the **IPCC** released snippets of information illustrating the extent of the work undertaken by the **IPCC WGII**: the work has involved 270 scientists, with over 34,000 publications assessed, and 62,418 comments reviewed.

The **IPCC** alerted the media to register for embargoed material by the end of Friday **February 18, 2022**, and that from noon CET on Monday **February 28, 2022**, among others, the authors of the **IPCC WGII** report will be available for interviews, confirming that the **IPCC WGII** report will be published by the end of February.

- **IPCC WGIII:** The assessment of **IPCC Working Group III** (Mitigation of Climate Change) on the mitigation of the effects of, and progress to limit emissions causing, climate change is scheduled to be published during April 2022, with an update to be provided in Edition **36** of Low Carbon Pulse.

**IPCC:** 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.

- **Hot on the heels of IPCC WGII:**

Straddling the news cycles of Editions **36** and **37** of Low Carbon Pulse are two key events:

- **Middle East and North Africa Week:** As the authors of the **IPCC WGII** report on Impacts, Adaption and Vulnerability are being interviewed, the inaugural **Middle East and North Africa Week**, organised under the auspices of the United Nations Framework Convention on Climate Change (**UNFCCC**), will commence on **February 28, 2022**, and will continue through **March 3, 2022**.

The **Middle East and North Africa Week** is eagerly anticipated by the author of Low Carbon Pulse, providing an opportunity to place the Middle East and North Africa clearly at the centre of production of renewable electrical energy and clean hydrogen.

- **IUCN Africa Protected Areas Congress (APAC):** Four days after the end of **Middle East and North Africa Week**, **APAC** will commence on **March 7, 2022** in Kigali, Rwanda, and will continue to **March 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 37** of Low Carbon Pulse will report on the **Middle East and North Africa Week** and **APAC** events, including anticipating the emerging agenda that is likely to carry through to **COP-27**.

- **By the end of April 2022:**

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

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

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

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

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

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

## Legal and Regulatory highlights:

*This section considers news items that have arisen within the news cycle of this **Edition 35** of Low Carbon Pulse in respect of laws and regulation, and broader policy settings, in each case describing substance, progress and impact.*

- **Carbon properly priced in Singapore:** On February 18, 2022, as part of the Budget 2022, Singapore [announced](#) that the price on carbon would increase incrementally over time to between S\$50 and S\$ 80 per tonne of **CO<sub>2</sub>-e** by 2030. The increase in the price on carbon is part of an integrated plan to ensure that Singapore reaches **NZE** "by or around mid-century". This aligns with the achievement of the outcomes in the [Glasgow Climate Pact](#).

### SINGAPORE BUDGET 2022

#### Carbon tax increase

Currently	S\$5 per tonne
2024 & 2025	S\$25 per tonne
2026 & 2027	S\$45 per tonne
By 2030	S\$50 to S\$80 per tonne

- Current carbon tax will remain unchanged until 2023
- No additional carbon tax on the use of petrol, diesel and CNG as they already have excise duties
- Households will mainly feel an impact via their utility bills. Support, such as additional GSTV – U-Save rebates, will be announced in 2023



Infographic: Dawn Teo  
Source: Ministry of Finance, Feb 18, 2022



Mr Toh (Director at Energy Market Authority, Singapore), has provided a very helpful summary on Linked-In. A link to Mr Toh's summary is [attached](#).

- **Standalone article about EU Green 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 by the end of June 2022.

## Climate change reported and explained:

*This section considers news items within the news cycle of this **Edition 35** 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.*

- **CH<sub>4</sub> concentration on the rise:** On February 8, 2022, [nature.com](#) reported on increasing levels of methane (**CH<sub>4</sub>**) in the climate system (under **Scientists raise alarm over "dangerously fast" growth in atmospheric methane**). **CH<sub>4</sub>** concentration exceeded 1,900 parts per billion during 2021 – see the piece below on the [NOAA 2022 Sea Level Rise Technical Report](#).

The article in nature is well-worth a read – it hones in on the fact that: "The causes of the methane trends have indeed proved rather enigmatic". Mr Alex Turner (an atmospheric chemist at the University of Washington, Seattle) goes on to observe that he is yet to see any conclusive answer emerge.

The nature article notes that the increase in **CH<sub>4</sub>** is caused by both human activities and naturally: 62% of global **CH<sub>4</sub>** emissions from 2007 to 2016 are estimated to have arisen from human activities – see the bar chart at the end of this section.

As is noted (again) in the nature article, tackling methane is probably the best opportunity to buy some time to allow decarbonisation to progress so as to avoid the worst effects of climate change by limiting the increase in average global temperatures to **1.5°C** above pre-industrial times.

#### By way of reminder:

- **Edition 24** of Low Carbon Pulse noted that the reduction in **CH<sub>4</sub>** emissions is important because the global warming potential of **CH<sub>4</sub>**, as a **GHG**, in terms of potency per tonne, is greater than carbon dioxide (**CO<sub>2</sub>**): a molecule of **CH<sub>4</sub>** has a half-life of 9 years, compared to **CO<sub>2</sub>** with a half-life of 100 years. Over 20 years, **CH<sub>4</sub>** traps up to 84 times as much heat energy as **CO<sub>2</sub>**.
- **Edition 27** of Low Carbon Pulse reported that "Increasing concern about increasing the concentration of **CH<sub>4</sub>** resulted in the announcement on September 17, 2021, by the **EC** and US of the [Global Methane Pledge](#), given jointly, to reduce **CH<sub>4</sub>** emissions by nearly a third within the next decade. At that time Low Carbon Pulse expressed: "The hope, and the objective of the **EC** and US now has to be to ensure that as many countries as possible join with them in this critical initiative".

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

- **Edition 29** of Low Carbon Pulse reported on International Energy Agency (**IEA**) [Curtailling Methane Emissions from Fossil Fuel Operations \(CCH4R\)](#). This headline from the **CCH4R** is that the reduction in methane (**CH<sub>4</sub>**) emissions is "among the most impactful ways to combat near-term climate change".

The **CCH4R** notes that:

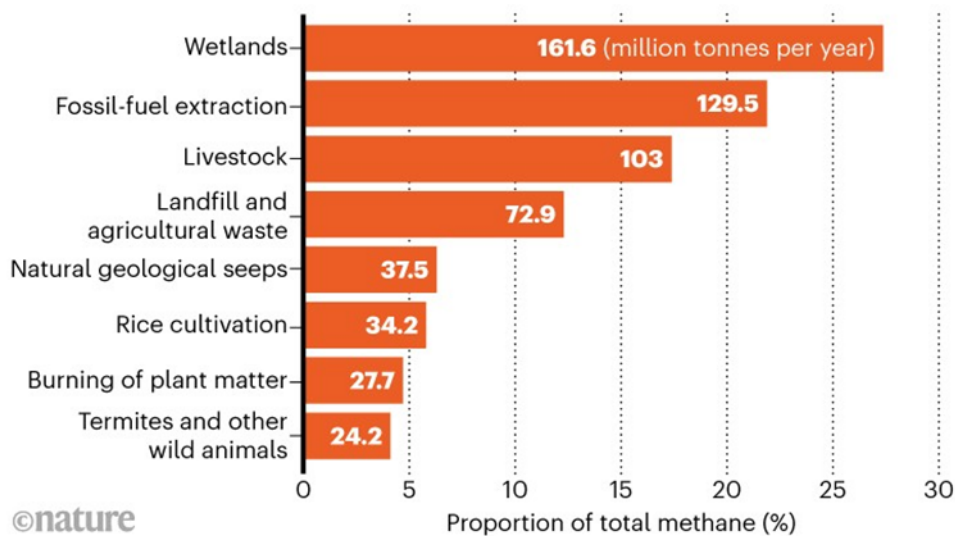
*"Methane has contributed around 30% of the global rise in temperature to date ... Emissions from fossil fuel operations present a major opportunity [to limit global warming in the near term] since the pathways to reduction are both clear and cost-effective".*

**Greater concentration is required to address greater concentration!**

On February 23, 2022, the International Energy Agency (**IEA**) will present is **Global Methane Tracker 2022**. The **January and February Report on Reports** will provide detail from the Tracker.

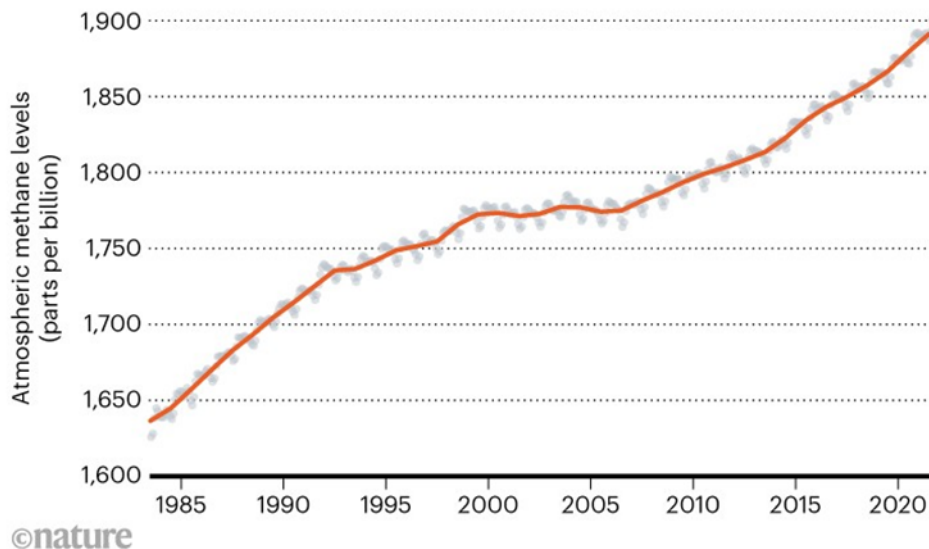
## WHERE IS METHANE COMING FROM?

Studies of the isotopic signature of methane building up in the atmosphere suggest that it has a variety of sources. Most of the increase in emissions seems to be biological in origin, rather than having been released from below Earth's surface during the extraction of fossil fuels.



## A WORRYING TREND

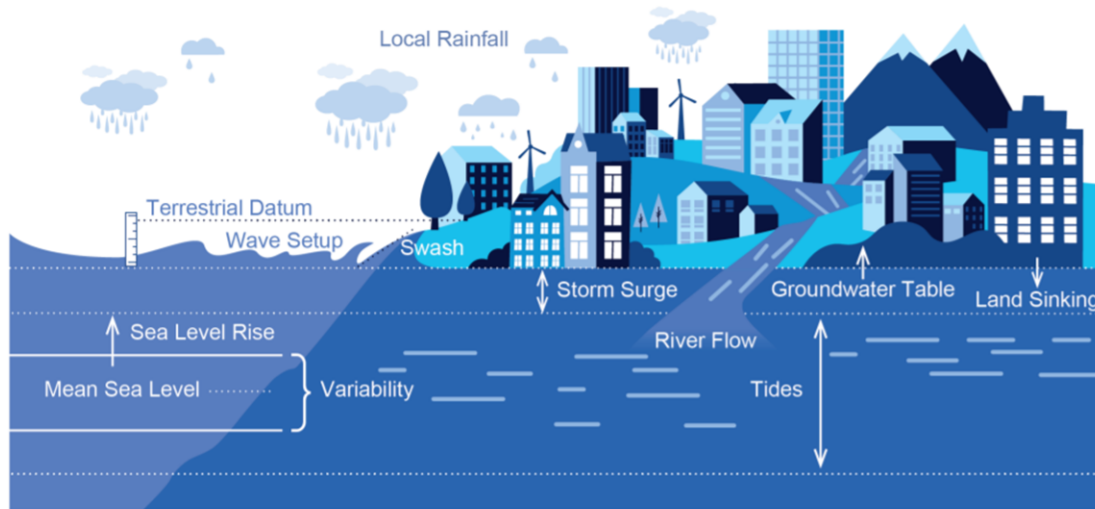
Atmospheric methane levels have been rising since the Industrial Revolution. Growth slowed between 1999 and 2006, but methane levels have increased sharply since 2007. Neither trend is well understood.





- **National Oceanic and Atmospheric Administration (NOAA) releases Sea Level Rise Technical Report:** On February 16, 2022, the **NOAA** published its [2022 Sea Level Rise Technical Report \(2022 SLRR\)](#). The **2022 SLRR** provides absorbing analysis (a little too absorbing for the already challenged sleep patterns of the author). **Attached** is the [link](#) to the conclusion section of the **2022 SLRR**.

### Physical Factors Directly Contributing to Coastal Flood Exposure



**Figure 1.1:** Schematic (not to scale) showing physical factors affecting coastal flood exposure. Due to the clear and strong relative sea level rise signal (i.e., combination of sea level rise and sinking lands), the probability of flooding and impacts are increasing along most U.S. coastlines.

Source: [2022 Sea Level Rise Technical Report](#)

- **World Bank Blog on the Money:**
  - **What is needed is known:** On February 9, 2022, [worldbank.org](#) published [How can developing countries get to net zero in a financeable and affordable way?](#) The blog is excellent. By the use of one example from The Washington Post, the blog illustrates the existential and fundamental dynamics of the need for the more developed countries to work with developing countries to address the competing imperatives of economic development of developing countries and environmental preservation.
  - **One example:** The Democratic Republic of Congo (**DRC**) has peatland covering an area the size of the US State of Iowa, and is estimated to retain as much as three years of **GHG** emissions as is emitted each year globally. If the peatland in the **DRC** were to be drained, as developed countries have drained their peatland in the past, **GHG** emissions would be emitted to the climate system. As reported in recent editions of Low Carbon Pulse, the **DRC** is one of the Least Developed Countries and one of the most vulnerable countries to climate change (see **Editions 33** and **34** of Low Carbon Pulse). The **DRC** is essential to the electric battery market, with around 70% of cobalt sourced the country, and year more than 73% of the Congolese people live below the poverty line. These dynamics are repeated across Africa at **COP27**.
  - **Africa has to be a focus:** This is why the **IUCN Africa Protected Areas Congress (APAC)** scheduled to take place in Kigali, Rwanda from **March 7 to 12 2022**. **APAC** (being 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) is so important. Also, this explains why Egypt, as the host nation for **COP-27**, wants to focus on Africa.
  - **All less developed countries need to be a focus:** The World Bank estimates (see **Beyond the Cap – How Countries Can Afford the Infrastructure They Need while Protecting the Planet**) that developing countries need to invest around 4.5% of GDP to develop infrastructure-related Sustainable Development Goals to avoid more than a **2°C** increase in average global temperatures. This analysis was published in 2019. This analysis is from pre-COVID 19 and a pre-**COP 26** era. A greater proportion of GDP is now required, with targets now tied to avoiding more than a **1.5°C** increase in average global temperatures.
  - **The means to provide what is needed is known:** In this context, the World Bank blog states that it is essential to develop climate-smart and bankable project pipelines, and to mobilize private capital. This is not new. As regular readers of Low Carbon Pulse will know, these objectives were front and centre at **COP-26** as one of the four pillars. As reported in **Edition 30** of Low Carbon Pulse:
    - "**Pillar 3** contemplated:
    - "To deliver on our first two goals, developed countries must make good on their promise to mobilise at least USD 100 billion in climate change funding a year by 2020.
    - International financial institutions must play their parts and we need to work towards unleashing the trillions in private and public sector finance to secure global net zero".

Progress was made in the sense of a clear acknowledgment (through an expression of "deep regret" - see paragraph 44 of the [Glasgow Climate Pact] that the goal of mobilising USD 100 billion a year by 2020 "had not yet been met". Developed countries are urged to mobilise "fully on the USD 100 billion a year

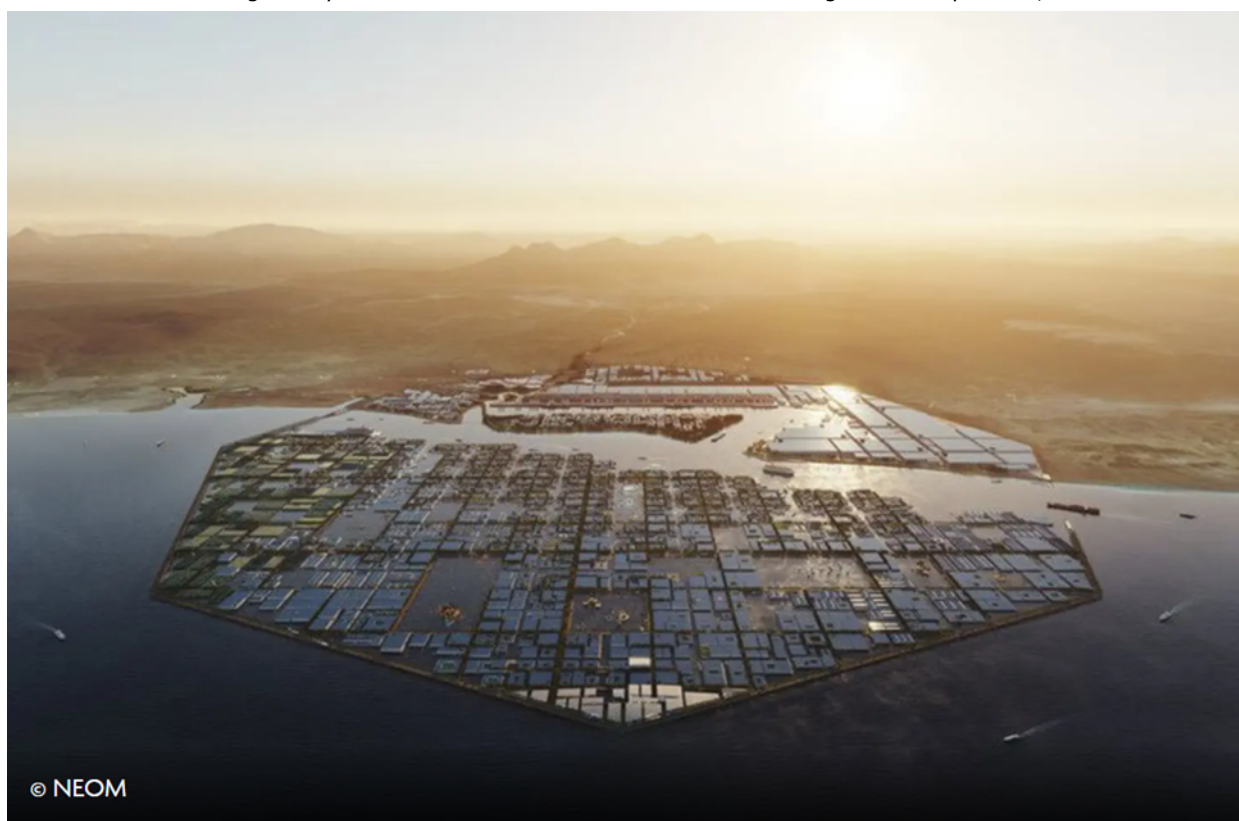
*This section of Low Carbon Pulse considers news items within the news cycle of this **Edition 35** of Low Carbon Pulse relating to the Gulf Cooperation Council (GCC) Countries, being countries that are leading the way in the development of Blue Hydrogen and Green Hydrogen capacity for own use and for export.*

commitment urgently through to 2025" (paragraph 46), and at least to double "their collective provision of climate finance for adaptation to developing countries from 2019 levels by 2025" (paragraph 18)."

What needs to be done is known, the means of achieving what needs to be done is also known.

## GCC Countries:

- **Dubai Carbon Abatement Strategy approved:** On February 6, 2022, [khaleejtimes.com](https://www.khaleejtimes.com) reported that Dubai is to reduce **GHG** emissions by 30% by 2030, providing a progress check on the road to achieving **NZE** by 2050. The **Dubai Carbon Abatement Strategy 2030 (DCAS)** was approved by The Supreme Council of Energy. The **DCAS** is aligned with the **UAE Net Zero Goal by 2050**, as announced on October 21, 2021 (see **Edition 29** of Low Carbon Pulse). The **DCAS** provides the basis for great granularity to develop initiatives and measures to reduce **GHG** emissions.
- **NEOM cellular development:** On February 15, 2022, [h2-view.com](https://h2-view.com) reported that NEOM (see **Editions 29, 31** and **32** of Low Carbon Pulse), is to undertake heavy-duty hydrogen fuel cell stack manufacturing, having contracted with Al Misehal Group for this purpose. Subject to finalisation of contractual arrangements, the heavy-duty hydrogen fuel cell stack manufacturing facility is to be located on NEOM's innovative floating industrial precinct, OXAGON.



- **High-level hydrogen cooperation:** On February 16, 2022, [Masdar](https://www.masdar.ae/en) (Abu Dhabi Future Energy Company) announced that Masdar and the Korean Agency for Infrastructure Technology Advancement (**KAIA**) had signed a memorandum of understanding (**MOU**) providing for them to explore the development of clean technology solutions, with a particular focus on hydrogen and smart cities. The **MOU** continues, and strengthens further, the long and strong partnership between the **UAE** and the **ROK**.

## Africa:

*This section considers news items within the news cycle of this **Edition 35** 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.*

- **South Africa sizing-up Green Hydrogen:** On February 11, 2022, [hydrogen.central.com](https://hydrogen.central.com) reported (under **South Africa Talks with Investors on Green Hydrogen Projects**) that the Government of South Africa is in talks with potential investors to develop Green Hydrogen production projects. The current thinking of the Government of South

Africa is to support the development of a pipeline of Green Hydrogen production projects requiring investment of USD 18 billion over the coming decade.

- **President von der Leyen on song:** In the opening speech at the **EU – African Union Summit** (that commenced on February 17, 2022 and closed on February 18, 2022) President von der Leyen set the scene for the continued development of a Global Gateway:

*"[The] Global Gateway is a strategy of investment in infrastructure and people ... We want investments in quality infrastructure – connecting people and good and services ... [the] Global Gateway will muster Europe's power to unlock unprecedented levels of investment ... We can expect a package of at least EUR 150 billion for Africa in the next seven years. This is the first package under our Global Gateway Strategy ... With this [first] package, we want to catalyse investments in three categories. The first, of course is infrastructure. And there, the top priority is energy. The pathway to renewable energy and, of course, the transition towards renewable energy. Because we all know first-hand that sustained economic development hinges on reliable access to energy. Africa has solar, wind and hydropower in abundance. So let us build on that. Let us invest in Global Gateway projects, for example to build together green hydrogen capacity ... ."*

The speech is worth reading in full, but putting energy front and centre is what was hoped for.

- **Germany to transfer Hydrogen Technology:** On February 17, 2022, [hydrogen-central.com](https://hydrogen-central.com) reported that Germany is to transfer hydrogen production technology to African countries.

The benefits of the transfer of technology will be reciprocal: to decarbonise Germany will need to import between 40% and 60% of its hydrogen demand, and it would be reasonable to expect that technology that is transferred will be used to produce Green Hydrogen for export to Germany. The commitment from Germany was made just before the commencement of the **EU – African Union Summit**, but very much aligned with the investment message conveyed by **EU** President von der Leyen.

## India and Indonesia:

*This section considers news items within the news cycle of **Edition 35** 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.*

- **Green Hydrogen exempt from transmission costs:** On February 16 and 17, 2022 it was reported widely that India is to exempt Green Hydrogen (and Green Ammonia) producers from the cost of transmission. In addition, producers of Green Hydrogen (Green Ammonia) are to have flexibility to purchase renewable electrical energy (without incurring transmission charges) or develop their own renewable electrical sources, or exchange renewable energy.  
The initiative also allows dispatch to a distributor of renewable electrical energy that is not needed to produce Green Hydrogen (or Green Ammonia), and to bank that dispatched renewable electrical energy, and then draw from that bank. The exemption and initiative are available to Green Hydrogen producers that establish Green Hydrogen production facilities before 2025.  
The detail of the exemption and the initiative can be found in the attached [link](#).
- **Pertamina and Marubeni have a plan:** On February 19, 2022, [solarquarter.com](https://solarquarter.com) reported that PT Pertamina and Marubeni Corporation had signed a memorandum of understanding to work together to on CCS / CCUS and BECCS / BECCUS, including at the Marubeni paper mill in Indonesia, with the possible use of biomass, and the creation of carbon credits understood to be being contemplated.
- **India Hydrogen Alliance – January 2022:** Attached is the link to the January edition of [India H2 Monitor – January 2022](#). 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 35** 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.*

- **Teaming with ideas:** On February 7, 2022, it was reported widely that Doosan Fuel Cell had signed a letter of intent to cooperate with Shell (international energy corporation) and Korea Shipbuilding & Offshore Engineering (**KSOE**) (a leading corporation in shipbuilding and the offshore market, with Hyundai Heavy Industries as part of its group).  
The three leading corporations are to develop, and to test the use of, marine fuel cell technology. It is understood that as the development and testing progresses, additional leading corporations (including ship builders and owners) will be involved, as will leading classification societies.  
Doosan Fuel Cell is to develop and to test its low temperature solid oxide fuel cells (**SOFCS**) for the purposes of its work with Shell and **KSOE**, with the **SOFCS** to be certified by 2024. Shell will manage shipping and **KSOE** will install the marine fuel cells.
- **Lotte Ecosystem:** On February 7, 2022, it was reported widely that Lotte Chemical (see **Editions 22, 23, and 34** of Low Carbon Pulse) is to invest up to USD 3.7 billion to develop hydrogen business across the **ROK**. This investment will support the development plans for Lotte Chemical for a hydrogen supply / value chain across the **ROK**. Future editions of Low Carbon Pulse will follow the developments.
- **ROK battery majors sit tight at 30% market share:** On February 8, 2022, [pulsenews.co.kr](https://pulsenews.co.kr) reported that **ROK's** battery majors, LG Energy Solution, SK On, and Samsung SDI has maintained a combined 30% share of the battery market globally. In GWh, this means that batteries from the Big Three were mounted on pure battery electric vehicles

with a capacity of 90.1 GWh, and 296.8 GWh if plug-in-hybrid and hybrid vehicles are added to the 90.1 GWh for pure battery electric vehicles.

The following table provides details of the top 10 battery majors.

### Global electric vehicle battery application

(Unit: GWh, market share)

Company	Capacity Jan.-Dec. 2020	Capacity Jan.-Dec. 2021
(1) CATL	36.2	96.7 (32.6%)
(2) LG Energy Solution	34.3	60.2 (20.3%)
(3) Panasonic	27.0	36.1 (12.2%)
(4) BYD	9.8	26.3 (8.8%)
(5) SK On	8.1	16.7 (5.6%)
(6) Samsung SDI	8.5	13.2 (4.5%)
(7) CALB	3.4	7.9 (2.7%)
(8) Guoxuan	2.4	6.4 (2.1%)
(9) AESC	3.9	4.2 (1.4%)
(10) SVOLT	0.6	3.1 (1.0%)

(Source: SNE Research)

Graphics by Song Ji-yoon



## PRC and Russia:

*This section considers news items that have arisen within the news cycle of this **Edition 35** of Low Carbon Pulse relating to the **PRC** and Russia, being countries that give rise to the most and the fourth most **GHG** emissions.*

- **Gobi Desert Shimmers:** On February 11, 2022, [channelnewsasia.com](https://www.channelnewsasia.com) reported that the **PRC** is to focus on the development of photovoltaic solar and wind power development. This is news is entirely aligned with plans for **PRC** to enhance its HVDC network (see **Edition 32** of Low Carbon Pulse for most recent coverage).

By way of reminder, and for those approaching the following statistic for the first time, hold on to your hat! Or take a seat! The **PRC** intends to have installed 1,200 GW of renewable electrical energy capacity by 2030.

In guidelines published by the National Energy Administration (**NEA**) on February 10, 2022, by 2030 all new energy demand is to be matched by dispatch from non-fossil fuel sources, and the development of renewable electrical energy capacity in the Gobi Desert is key to this. While the **PRC** remains on target to reach peak **GHG** emissions by 2030 (possibly a little sooner), the expectation is that coal-fired power station dispatch will increase until at least 2025, noting that a further 150 GW of coal-fired power generation capacity is expected to come on line within the 2021 to 2025 time frame.

**By way of reminder:** **Edition 34** of Low Carbon Pulse reported that in 2021 the **PRC** connected more off-shore wind than "every other in the world had managed to install in the last five years".

Data from the **NEA** indicate that a little under 17 GW (16.9 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.

- **NEA and WFO reconciled:**

The World Forum Offshore Wind (**WFO**) report for 2021, [Global Offshore Wind Report 2021](#) states that the **PRC** connected 12.7 GW (12.869 GW) of new off-shore wind field capacity during 2021. This is less than reported by the **NEA**. Nothing should be read into the difference, the **WFO** counts off-shore wind field capacity that is in operation with all turbines installed and first electrical energy produced.

The **January and February Report on Reports** will outline the **WFO** report. For the time being, the headlines are that, using the accounting methodology of the **WFO**, in 2021: **1.** 15.7 GW of off-shore wind field capacity was installed; **2.** The **PRC** added 12.7 GW of that capacity; **3.** New and installed capacity now comprises 48.2 GW of installed capacity; and **4.** There is 17 GW of off-shore wind field capacity currently under development and moving to deployment globally.

- **PRC renewables boom in context:** On February 17, 2022, [Wood Mckenzie](#) published an article placing the might of the **PRC's** renewable manufacturing capacity in context. As noted in previous editions of Low Carbon Pulse, the growth of the renewable manufacturing capacity of the **PRC** has assisted the **PRC**, and those trading with the **PRC**, to develop and deploy renewable capacity at a lower cost and at a faster rate than might otherwise have been the case.

**Edition 33** of Low Carbon Pulse noted that the size of the **PRC** renewable manufacturing capacity in 2022 would likely exceed demand, with resulting over-supply capacity.

The Wood Mac article places these dynamics in context (including in a geopolitical context):

"This production [capacity] of epic proportions is enough to meet what China needs to accelerate decarbonisation while supporting the ambitions of much of the rest of the world".

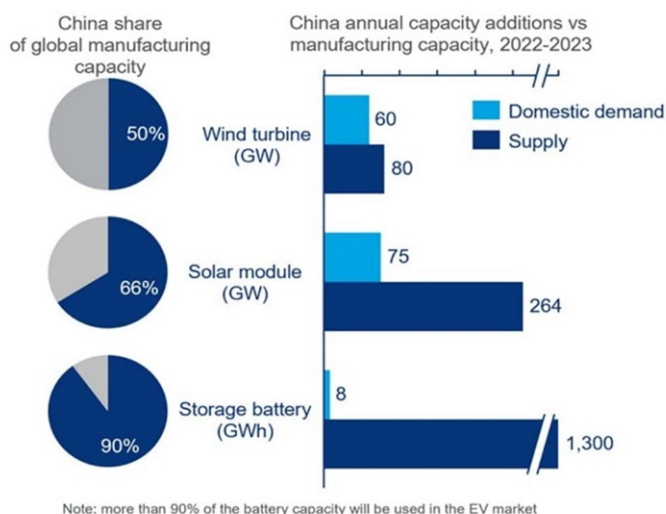
"China's position as the world's dominant supplier of solar modules looks secure with nearly 70% of global manufacturing ... wind turbines ... account for 50% of global manufacturing, mainly of the [**PRC**] domestic market.

The country also accounts for nearly 90% of global manufacturing capacity of lithium-ion batteries."

As ever, the Wood Mac article is well-worth a read. And the article is complemented by Wood Mac's February [Horizons](#) thought leadership, which identifies what has driven growth in the **PRC's** renewable sector, and Wood Mac's view of the sustainability of that growth.



## China's renewables and battery manufacturing dominance



Source: Wood Mackenzie APAC Power & Renewables Service

1

- Russian-German hydrogen study:** On February 16, 2022 a number of sources reported on the first-bilateral study on the potential use of hydrogen across the Russian and German energy systems, and the role of hydrogen in the development of energy markets. The bilateral study is the work of Russian and German teams working in cooperation with each other.  
 The study is available through the AHK Russland [website](#). The **January and February Report on Reports** will provide an outline of the findings from the study.
- IRENA and State Grid:** On February 17, 2022, the International Renewable Energy Agency (**IRENA**) and the State Grid Corporation of China held a virtual event, **Facilitating the Transition Toward Smart Electrification with Renewables in China**. The virtual event complemented the report prepared jointly by **IRENA** and **State Grid Smart Electrification with Renewables: Driving the transformation of energy services**.  
 The **January and February Report on Reports** will outline the findings from **Smart Electrification with Renewables: Driving the transformation of energy services**.

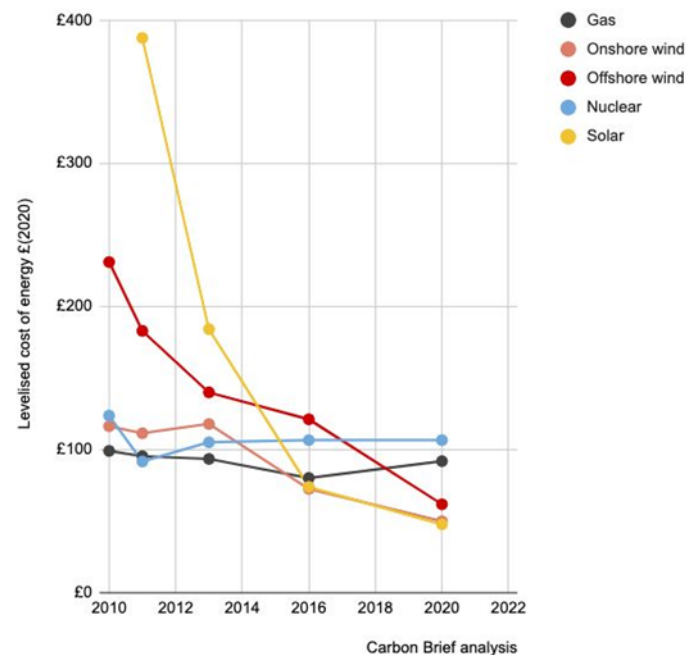
## Europe and UK:

*This section considers news items that have arisen within the news cycle of this **Edition 35** 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.*

- UK Decarbonising Heat in Homes:** On February 3, 2022 the UK Government Department of Business, Energy and Industrial Strategy (**DBEIS**) released its report **Decarbonising heat in homes** (**DH1H** report). The **DH1H** report will be covered in detail in the **January and February Report on Reports**, which will be included in the **Second Compendium of Low Carbon Pulse** during March, 2022.
- CfD Auctions Annual: Edition 34** of Low Carbon Pulse reported that: "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." By way of reminder, **Edition 17** of Low Carbon Pulse outlined changes to the form of CfD in 2021.  
 On February 9, 2022, **DBEIS** announced (under **Government hits accelerator on low-cost renewable power**) that contract for differences auctions will be held annually, rather than every other year as currently, to accelerate adoption of renewable electrical energy and enhance energy security. The next CfD round will open in March 2023.
- Cluster sequencing for carbon capture, usage and storage (CCUS) deployment: Phase 2: Edition 33** of Low Carbon Pulse noted the passing of the deadlines for applications for funding to develop **Phase 2** projects, **Phase 2** projects being **Power**, **Industrial Carbon Capture** and **Hydrogen** production projects. In addition, Greenhouse Gas Removal (**GGR**) projects (**GGR** including **BECCS** and **DACs**) with an interest in requesting access to **Track 1 Clusters** (the Track 1 Clusters being East Coast and HyNet North West, with the Scottish Cluster in reserve) were invited to complete expressions of interest. It has been the intention to include an update on the applications in **Edition 34** or this **Edition 35** of Low Carbon Pulse, but to manage the length of each Edition the author has deferred this idea, rather a future edition of Low Carbon Pulse to cover the successful applicants.
- Photovoltaic Solar cheaper than a decade ago:** It was reported from a number of sources that the levelized cost of energy (**LCOE**) from photovoltaic solar sources is lower in the UK than was the case a decade ago.

Solar is now 88% cheaper than thought a decade ago,  
UK govt says – and half its estimate for gas power

Levelised cost estimates are down 57% for onshore and 73% for offshore wind



Source: [Jan Rosenow LinkedIn](#)

## Americas:

*This section considers news items that have arisen within the news cycle of this **Edition 35** 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.*

- **Canada Hydrogen Alliance (CHA) plans acceleration:** On February 7, 2022, [h2-view.com](https://h2-view.com) (under **Canada Hydrogen Alliance unveils project to accelerate hydrogen innovation**) reported that the Hydrogen Transition Hub is to begin a new project to support acceleration of resolution of challenges associated with the development of the global hydrogen economy – the FUSION-MAP project.
- **Preparing the Californian Grid:** On February 9, 2022, [rechargenews.com](https://rechargenews.com) reported (under **California scopes \$30bn grid plan in face of "unprecedented" green power demand**) that the Californian state grid operator, Caiso, has estimated that up to USD 30 billion may be required to enhance the high-voltage transmission network across the state to ensure the integrity and stability of the grid as it moves to 100% renewable electrical energy and up to 121 GW of BESS across the grid.  
The final version of the **20 Year Transmission Outlook** will be published in March 2022, and will be covered in the **March and April Report on Reports**.
- **US DOE goes live:** Various editions of Low Carbon Pulse reported have reported on the **Infrastructure Investment and Jobs Act (IIAJA)** also known as the **Bipartisan Infrastructure Law (BIL)**, its progress and its passing. The initiatives in the **IIAJA** are now being rolled out.
  - **Clean Hydrogen RDD goes live:** On February 9, 2022, the US Department of Energy (**DOE**), through the Office of Fossil Energy and Carbon Management (**FCEM**), announced formally the roll-out of the USD 24 million in federal funding for research and development and front-end engineering and design that will advance the adoption of clean hydrogen as a carbon free fuel for electrical energy generation, industrial use and transportation. This is the first step in provision of funding for **RDD**.
  - **EV charger funding goes live:** On February 10, 2022, the Biden Administration rolled out its plan to allocate USD 5 billion to fund the development and deployment of electric vehicle chargers over the coming five years. This initiative is part of, which earmarked USD 7.5 billion to roll-out a nationwide electric vehicle charging network of 500,000 electric vehicle chargers. The initiative includes the designation of alternative fuel corridors.
  - **Clean Hydrogen Project Process goes live:** On February 15, 2022, the US **DOE** announced that it requires information on the development of hydrogen hubs across the US, with at least four hydrogen hubs contemplated.

**By way of reminder:** The largest hydrogen program in the **IIAJA** provides the US (**DOE**) with USD 8 billion to provide support for at least four hydrogen hubs that are able to demonstrate that their development and deployment will contribute to production of clean hydrogen (being hydrogen that gives rise to less than 2 kg of **CO<sub>2</sub>** for each 1 kg of hydrogen produced) and to multiple uses of that clean hydrogen. The **IIAJA** prescribes that at least one hydrogen hub will use fossil fuel feedstock to produce hydrogen, one will use renewables and one will use nuclear.

Also there is funding to support lowering the cost of production of Green Hydrogen with the goal of achieving a cost of USD 2 per kg by 2026 and for research, development and demonstration (**RDD**) to develop and deliver clean hydrogen production, delivery, storage and use technologies. Finally, the **IIAJA** contemplates the development of a national hydrogen strategy and roadmap to facilitate large-scale, and wide-spread, production, delivery, storage and use of clean hydrogen.

## France and Germany:

*This section considers news items within the news cycle of this **Edition 35** of Low Carbon Pulse relating to France and Germany.*

- **One Ocean Summit:** On February 9, 2022, the three day **One Ocean Summit** opened in the sea port of Brest, France, on the Brittany Coast. The **One Ocean Summit** was convened by the President of France, Mr Emmanuel Macron, and may be regarded as the centre piece of the six month **EU** presidency of France.

In the lead-up to the **One Ocean Summit** there was considerable coverage of the agenda and the basis for engagement, with identified role of blue diplomacy "in a host of area, from privacy to pollution to overfishing and carbon storage [Blue Carbon]".

In addition to countries attending the **One Ocean Summit** (in person and virtually), the **One Ocean Summit** was attended by leading shipping companies, AP Moller Maersk, CGM and Hapag-Lloyd (each in the vanguard of the decarbonisation of shipping). The **One Ocean Summit** is to be followed by the **UN Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction** to be held in New York in March 7 to 18, 2022.

[Note: At the time of publication of this Edition 35 of Low Carbon Pulse, the UN Intergovernmental Conference of Marine Biodiversity of Areas Beyond National Jurisdiction is under maintenance.]

The key points to take away from the **One Ocean Summit** are:

- **High Seas Agreement on the horizon:** **EU** Member States and 16 other countries agreed to pursue a global agreement by the end of 2022 to regulate the use of sea-waters lying outside the jurisdiction of each country (the **High Seas**). The hope is that agreement can be reached in New York in March 2022.
- **30X30 Coalition:** More than 30 countries committed to the **30x30 Coalition**, the purpose of which is to protect 30% of the world's land and sea by 2030.
- **Banking on clean oceans:** French, German, Italian and Spanish development banks, and the European Bank for Reconstruction and Development and European Investment Bank are aligned around the clean oceans initiative to reduce the mass of plastic at large in oceans by 9 million metric tonnes each year, with financing of €4 billion pledged by 2025.
- **Blue Carbon Coalition:** Columbia and France announced the establishment of a **Blue Carbon Coalition** to provide financial support for the restoration of coastal ecosystems, including mangrove swamps, salt marshes and sea-grass beds.

For all agreements and initiatives click on the following [link](#).

- **France joins the Ocean Panel:** On February 11, 2022, President Macron announced that France would join the High Level Panel for a Sustainable Ocean Economy (**Ocean Panel**). France joins 15 other countries on the **Ocean Panel** (Australia, Canada, Chile, Fiji, Ghana, Indonesia, Jamaica, Japan, Kenya, Mexico, Namibia, Norway, Palau, Portugal, and the US). With France joining, the 16 countries (represented on the **Ocean Panel**) represent globally nearly 46% of exclusive economic zones (comprising areas of sea within the jurisdiction of countries, as opposed to the **High Seas** – see below), 25% of fisheries and 20% of the shipping fleet.

In a busy few days for Norwegian Prime Minister, Mr Jonas Gahr Støre (see below under **Wind round-up, on-shore and off-shore: Norwegian off-shore winding up**), as the co-chair of the **Ocean Panel**, Prime Minister Støre welcomed the announcement:

*"I am delighted to see President Macron and France commit to the ambitious agenda of the Ocean Panel. With a sustainably managed ocean, we will all stand better equipped to meet many of our challenges, such as climate change, plastic pollution and biodiversity loss."*

### THE AIMS OF THE OCEAN PANEL

By enhancing humanity's relationship with the ocean, bridging ocean health and wealth, working with diverse stakeholders and harnessing the latest knowledge, the Ocean Panel aims to facilitate a better, more resilient future for people and the planet.

- **France to increase nuclear capacity and renewable capacity:**

- **Clear on nuclear:** In a busy week for President Macron, on February 10, 2022, President Macron announced that the nuclear industry in France was to undergo a rebirth. The announcement by President Macron has been signalled for a while (see **Editions 29** and **31** of Low Carbon Pulse), and aligns with the **EU Green Taxonomy**.

President Macron announced that six new nuclear reactors would be developed (with options to develop a further eight to make 14) so as to remove the reliance of France on fossil fuels, and to allow France to achieve carbon neutrality by 2050. As noted in previous Ashurst publications, around 70% of the electrical energy generated in France is derived from use of nuclear reactors.

In context, it is important to understand that the rebirth is a matter of renewal – a firm proportion of France's existing nuclear reactor power stations will come to the end of their life-cycle by 2035. It is understood that the six new nuclear reactors will be 1,650 MW EPR2 – being third generation pressurized water reactors.

- **Clear line of sight on renewables:** At the same time as the development of new nuclear reactors was announced, President Macron announced that the development and deployment of photovoltaic solar and off-shore wind field capacity would be accelerated. In this context, President Macron announced that France will have developed 40 GW of off-shore wind field capacity by 2050, on a rough and ready basis, equating to 50 off-shore wind field projects. Currently France has 2 GW of off-shore wind field capacity, and it has plans to procure a further 8.75 GW of off-shore wind field capacity by 2028 (see [Editions 16](#) and [32](#) of Low Carbon Pulse).

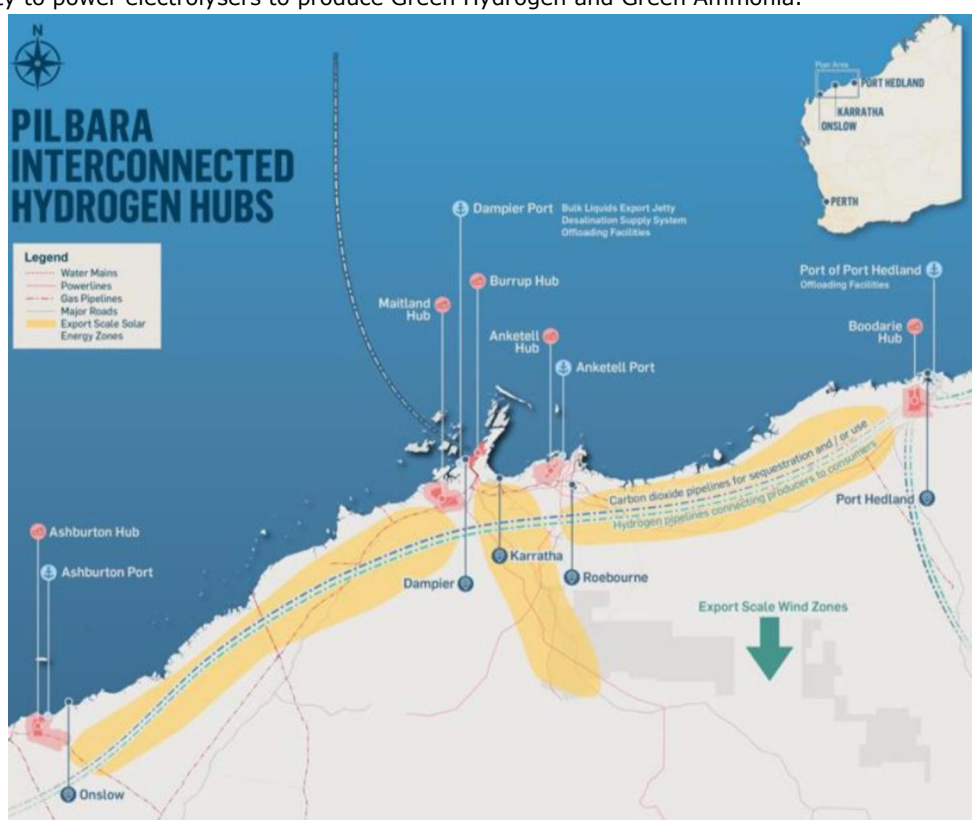
In addition, President Macron said that €1 billion in funding support would be provided to allow the development and deployment of emerging and new technologies, including the development and deployment of floating off-shore wind field capacity.

## Australia:

*This section considers news items that have arisen within the news cycle of this [Edition 35](#) 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.*

- **Western Australia 500 km strip:** On February 8, 2022, [WAtoday](#) (under **Billions to transform the Pilbara: WA's hydrogen hubs plan revealed**) report that the Government of Western Australia intends to develop hydrogen hubs along the coast of Western Australia, making use of 500 km of Pilbara coastline to develop the necessary photovoltaic solar capacity to power electrolyzers to produce Green Hydrogen and Green Ammonia.



The development of the hydrogen hubs and solar strip would further monetise the renewable resources of the Pilbara region – principally its solar resource. The Pilbara region would become a "global centre for hydrogen production, use and export at scale". The development of the Green Hydrogen and Green Ammonia production capacity in the Pilbara, would allow the greening of the iron ore industry.

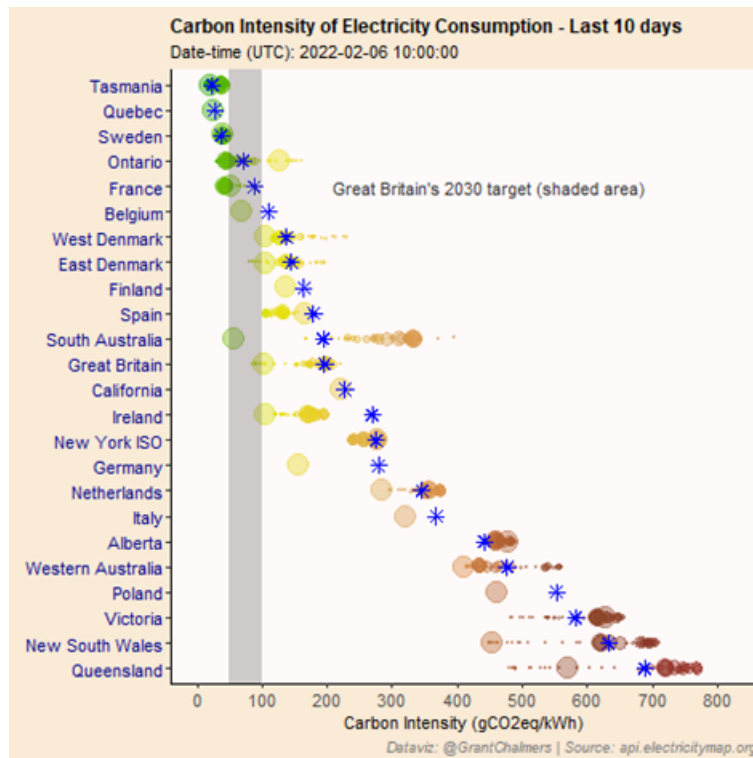
As outlined, there will be five hydrogen hubs producing Green Hydrogen, from Onslow to Port Hedland. Critically, a Green Hydrogen pipeline is planned. The plans have the support of leading international energy corporations and leading iron ore producers, Fortescue Metals Group (and its subsidiary, Fortescue Future Industries), and Rio Tinto.

- **A rush on records:** On February 8, 2022, Rystad Energy reported on the quantity of renewable electrical energy dispatched to match load across Australia during January 2022 – 3,628 GWh, an historical high. This was a result of many factors, but some standouts were that each of the six wind farms in Western Australia, Badgingarra, Emu Downs, Mumbida, Walkaway, Warradarge and Yandin, delivered capacity factors of greater than 50% during January. The two best performing photovoltaic solar farms during January were also in Western Australia – Merredin and Greenough River (the first utility scale solar project in Australia).
- **FMG continues development plan roll-out:** On February 9, 2022, Dr Andrew Forrest, AO (founder of Fortescue Metals Group) announced plans to develop a 5.4 GW, AU\$ 10 billion, photovoltaic solar and wind project to power its iron ore operations in the Pilbara, Western Australia (the **Uaroo Hub**). The **Uaroo Hub** project involves the deployment of around 25 km<sup>2</sup> of photovoltaic solar panels and 340 wind turbines. Coming up for 12 months on since



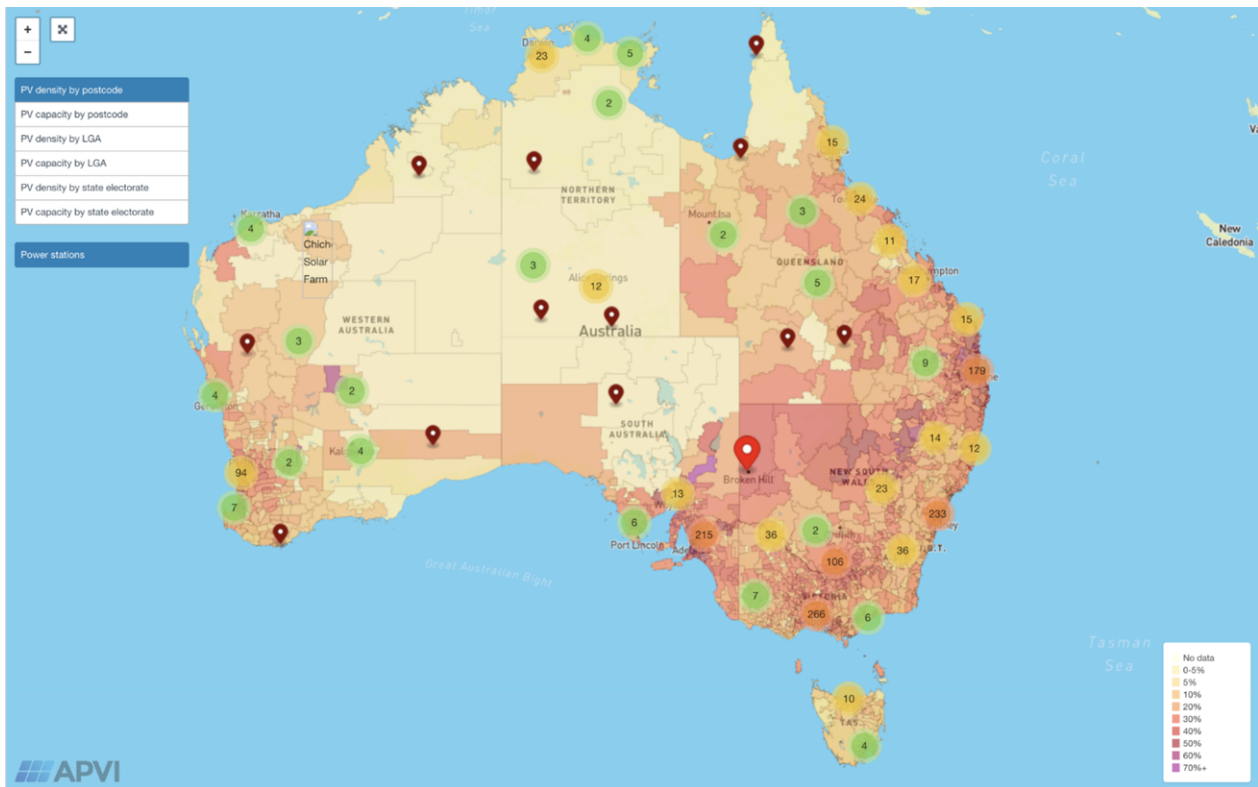
the commitment of FMG to achieve carbon neutrality in its mining operations (in mid-March 2021), the basis of the realisation of that commitment is now becoming apparent.

- **Carbon Intensity:** While renewable electrical energy is being developed at good rate in Australia, the carbon intensity of electrical energy generation is still high – please click to the attached graphic to get a sense of this ([Carbon Intensity Link](#)).



- **Coal fired generation has a glide path** Within the news cycle of this **Edition 35** of Low Carbon Pulse, AGL Energy and Origin Energy (two of the big three integrated energy corporations in Australia, the third being EnergyAustralia) announced plans to shutter the two largest coal-fired power stations in New South Wales, and the largest remaining coal-fired power station in Victoria:
  - On February 10, 2022 AGL Energy announced that its 2,640 MW Bayswater power station, in NSW, would close no later than 2033 and that its 2,210 MW Loy Yang A power station, in Victoria, would close in 2045.
  - On February 16, 2022 Origin Energy announced that its 2,880 MW Eraring power station, in NSW, would close by August 2025 (seven years ahead of previous its planned closure). Eraring is the largest remaining coal-fired power station in Australia. As reported previously in Low Carbon Pulse, Origin Energy intends to install a 700 MW / 1,400 MWh **BESS**, on the site of the decommissioned power station.
- **ANZ for A - Z:** On February 10, 2022, the Australia and New Zealand Bank (**ANZ**) released its **Hydrogen Handbook**. The **Hydrogen Handbook** is a very useful addition to the commonwealth of knowledge available for those active in the Australian market.
- **25 GW of solar, and counting:** On February 15, 2022, [pv-australia.com](http://pv-australia.com) reported that Australia has installed 25 GW of photovoltaic solar capacity – almost 1 kW for each person resident of the Lucky Country. As has been noted in previous editions of Low Carbon Pulse, this progress has been achieved primarily by the forward thinking States and Territories of Australia.

While this places Australia at the forefront of installed photovoltaic solar capacity per capita, as is apparent from the [Carbon Intensity Link](#), Australia still has a ways to go to lead the world in the lowest **GHG** emissions per capita.



## Blue and Green Carbon Initiatives and Biodiversity:

*This section considers news items that have arisen within the news cycle of this **Edition 35** Low Carbon Pulse relating to the Blue Carbon and Green Carbon initiatives and Biodiversity.*

To manage the length of this **Edition 35** of Low Carbon Pulse, and noting the detailed coverage in **Editions 32, 33** and **34**, **Edition 36** of Low Carbon Pulse will include features on Blue and Green Carbon, and Bio-diversity.

## Bioenergy and heat-recovery:

*This section considers news items that have arisen within the news cycle of this **Edition 35** 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.*

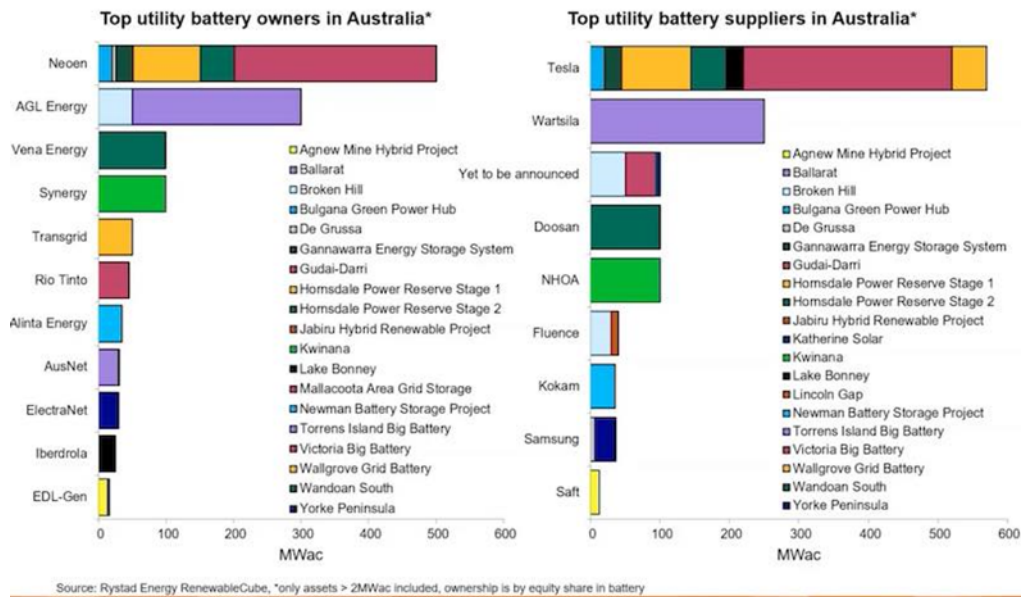
To manage the length of this **Edition 35** of Low Carbon Pulse, and noting the detailed coverage in **Editions 32, 33** and **34**, **Edition 36** of Low Carbon Pulse will include features on bioenergy and heat-recovery.

## BESS and HESS (and energy storage):

*This section considers news items that have arisen within the news cycle of this **Edition 35** of Low Carbon Pulse relating to battery electric storage systems (**BESSs**) and hydrogen energy storage systems (**HESSs**). In addition to **BESSs** and **HESSs**, other forms of energy storage systems are covered, including use of compressed air energy storage (**CAES**) and pumped storage. In this context, long duration energy storage (**LDES**) is considered, being energy technology that is able to allow the off-take electrical energy out of storage for a duration of more than four hours. In the brave new world described in **Edition 13** of Low Carbon Pulse: "**BESS** storage of 10/12/24 hours is being contemplated for business users, and up to 72 hours for telecommunications companies, including to guard against the consequences of land-borne weather events". The **November and December Report on Report** provides a summary of the LDES Council and McKinsey report from November 2021.*

- **Big Battery Flood:** On February 8, 2022, [pv-magazine-australia](https://www.pv-magazine-australia.com) reported that [Rystad Energy](https://www.rystadenergy.com) (see **Edition 27** of Low Carbon Pulse) expected that the BESS capacity of Australia would double during 2022.

## Overview of utility batteries in Australia



### • More news on BESS in CA:

- **Edition 34 of Low Carbon Pulsed** reported that California Utility, Pacific Gas and Electric (**PG&E**), proposed 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.
- **Progress check on IOUs:** On February 11, 2022, [energy-storage.news](https://energy-storage.news) reported that the **CPUC** had authorised San Diego Gas and Electric (**SDG&E**) to develop and to deploy three **BESSs**, together providing 161 MW / 664 MWh.  
Also the **CPUC** made public further details of the Arevon and Tenaska developers 300 MW / 1,200 MWh Nighthawk BESS project, within **PG&E** territory.

## 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 35** 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 **CO<sub>2</sub>** 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 **CO<sub>2</sub>** each year through **CCS**, **CCUS** and **CDR**. **CCS** and **CCUS** (and **BECCS** and **BECCUS**) involve the capture at source of **CO<sub>2</sub>**, preventing release to the climate system. The following provides a helpful overview of carbon capture as things currently stand.*

- **Eni more for eni more?:** On February 9, 2022, [eni.com](https://www.eni.com) announced that Eni UK had signed 19 memorandums of understanding with corporations interested in the provision of carbon transportation and storage services by Eni UK, so as to store permanently **CO<sub>2</sub>** in Eni UK's depleted hydrocarbon reservoirs in Liverpool Bay, as part of the HyNet North West Project.
- **INPEX plans CCS:** On February 12, 2022 (and after), it was reported widely that INPEX is to invest around USD 850 million to develop the world's largest CCS facilities in Australia. The CCS project will capture **CO<sub>2</sub>** arising from the Ichthys Project.
- **Nippon Steel looks to CCS down-under:** On February 14, 2022, [upstreamonline.com](https://upstreamonline.com) reported (under **Decarbonising industry: Nippon Steel looks to DeepC Store's Australian floating CCS hub**) that Nippon Steel Corporation (the largest steel producer in Japan) is exploring the export of **CO<sub>2</sub>** to what has been described at the first off-shore floating CCS hub in the Asia Pacific – off-shore of Australia.

For these purposes, it is reported that DeepC Store had signed a study agreement with Nippon Steel, under which jointly, DeepC Store and Nippon Steel will assess the storage of between 1 to 5 million metric tonnes per annum of liquified **CO<sub>2</sub>** captured by Nippon Steel and transported for storage to the Cstorel project (DeepC Store's flagship multi-user off-shore floating CCS hub).

- **Storegga and Talos Energy triple up:** On February 16, 2022, energy voice.com reported that Storegga and Talos are to work together on a new CCS project in Louisiana, US (**River Bend CCS**). Talos has announced that it is to lease around 26,000 acres. The area under lease is in Iberville, St James, Assumption and Lafourche parishes, with capacity to store up to 500 million metric tonnes of **CO<sub>2</sub>**. As reported, the location of the **River Bend CCS** is ideal with up to 80 million metric tonnes of **CO<sub>2</sub>** arising annually within the region.
- **Aker Carbon Capture and Northern Lights Joint Venture:** On February 17, 2022, Aker Carbon Capture announced progress on carbon capture on the Northern Lights Project, with Aker Carbon Capture and the Northern Light Joint Venture signing a memorandum of understanding to realise carbon capture and storage projects together in Norway, and across Europe. The Northern Lights Project involves the collection of **CO<sub>2</sub>** captured by emitters which is to be transported by **CO<sub>2</sub>** carriers to a receiving terminal in Norway, and then transported by pipeline into storage in a geological sub-surface structure 2,600 metres under the sea-bed of the North Sea.

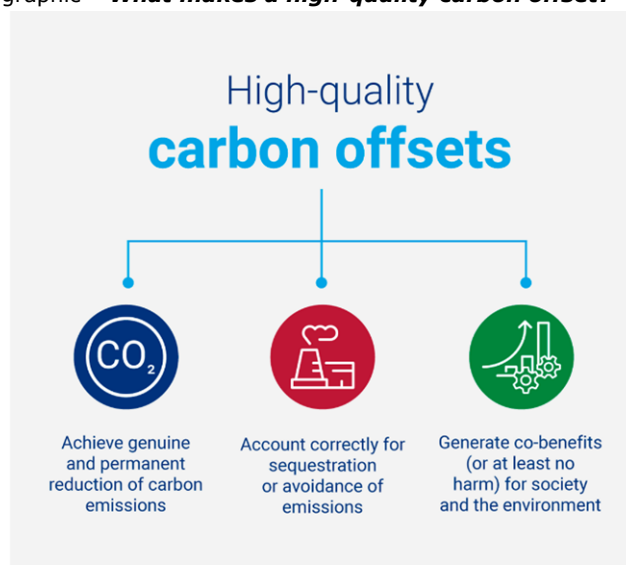
## Carbon Credits and Hydrogen Markets and Trading:

*This section considers news items that have arisen within the news cycle of this **Edition 35** of Low Carbon Pulse relating to the creation of carbon credits, the role of carbon credits, and the trading of them. Also this section covers the development of hydrogen markets and trading (bilateral and likely wholesale).*

- **Wood Mac on Voluntary Markets:** On February 8, 2022, Wood Mackenzie published an article entitled [Voluntary carbon markets: here to stay?](#) The article is stated to be the first in a series of articles. Among other things, the article frames the use of voluntary carbon markets by corporations, outlines the genesis of the market, and notes the varying quality of carbon credits / offsets that may be acquired from the voluntary carbon market. In this context, the authors provide a helpful graphic – **What makes a high-quality carbon offset?**

What makes a  
high-quality  
carbon offset?

Source: Wood Mackenzie



As ever, the Wood Mac article is well-worth a read, especially for those wishing to orientate their thinking clearly.

- **Worth another read:** In the context of work on a standalone article on **Carbon Credits, Article 6 and the Paris Rulebook**, the author re-read the excellent article published in [climatetechv.sustack.com](https://climatetechv.sustack.com) - **Wrangling the wild west of the voluntary carbon offset market**.

As noted in **Edition 35** of Low Carbon Pulse, the article may be considered mandatory market reading for this interested in the **Voluntary Carbon Market / Voluntary Carbon Credit Market**:

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

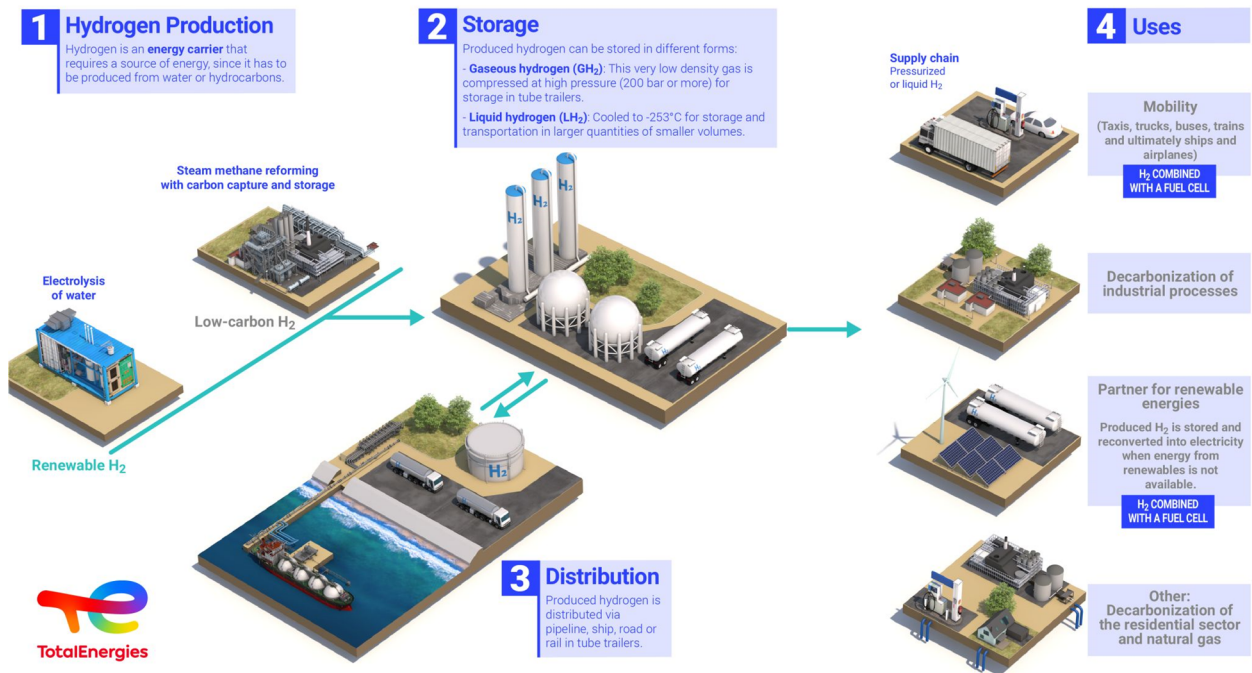
## E-fuels / Future Fuels / Now Fuels:

*This section considers news items that have arisen within the news cycle of this **Edition 35** 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.*

- **Hydrogen Ecosystem: Editions 33 and 34** of Low Carbon Pulse included the TotalEnergies' Aerobic Digestion Ecosystem infographic. TotalEnergies has produced a Hydrogen Production Ecosystem infographic, which is set out below:



# HYDROGEN PRODUCTION ECOSYSTEM



- **Cactus Energie Verde plans GH<sub>2</sub> in Brazil:** On February 9, 2022, it was reported widely that Cactus Energia Verde (**CEV**) plans to invest €5 billion in the development of a Green Hydrogen Project in Ceara, Brazil, to produce 126,000 metric tonnes of hydrogen and 63,000 metric tonnes of oxygen annually.

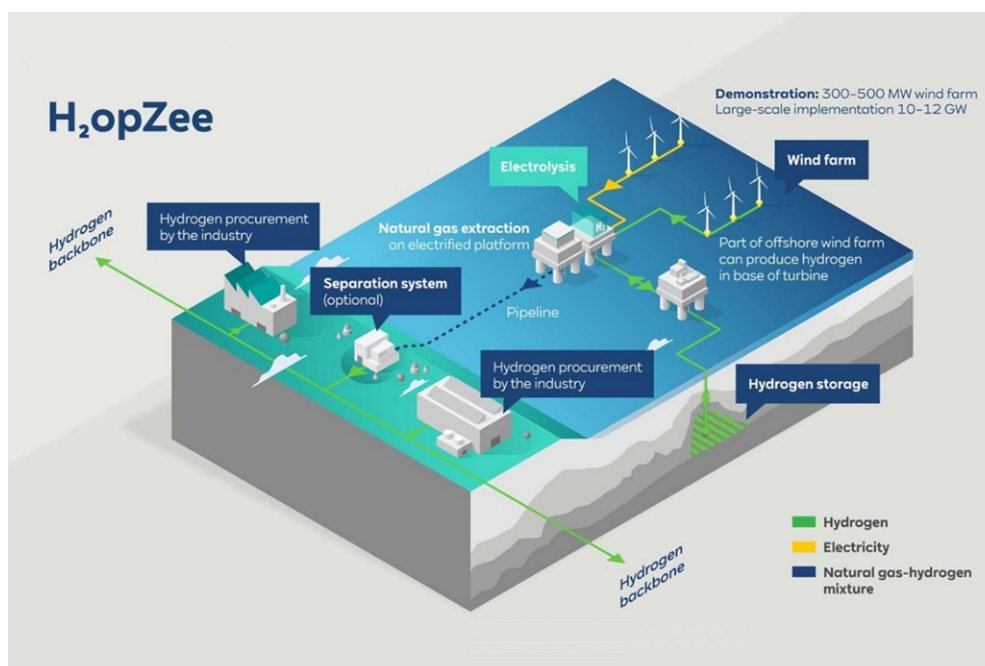
For these purposes, it is reported that **CEV** had signed a memorandum of understanding (**MOU**) with the Government of Ceara (**GOC**) to develop a Green Hydrogen production facility at the Pecém Port Complex. The renewable electrical energy to power the electrolyzers will be sourced from a photovoltaic solar project (the 2.4 GW Uruque Photovoltaic Park) and wind project (a 1.2 GW offshore wind field currently under construction).

The **MOU** with **CEV** is the 15th MOU signed by the Government of Ceara with prospective proponents (see **Editions 10** and **21** of Low Carbon Pulse): AES, Differential, EDP, ENEGIX, ENEVA, ENGIE, FFI, Green Energy Cactus, H2Helium, Hytron, Neoenergy, Qair, Total Eren, Transhydrogen Alliance, and White Martins / Linde have all signed **MOUs** with **GOC**.

- **Essar First:** On February 9, 2022, Essar Oil UK announced plans to develop the first refinery-based hydrogen (powered) furnace at its Stanlow refinery. On the installation of the hydrogen furnace, existing furnaces will be decommissioned.
- **Government Green Lights for Oracle Power and PowerChina International:**
  - **Edition 29** of Low Carbon Pulse (under **PowerChina International and Oracle Power Green Flag**) reported that: "On October 25, 2021, [H2-view.com](https://www.h2-view.com), reported that PowerChina International and Oracle Power had signed a co-operation agreement to develop a 400 MW Green Hydrogen production facility in Pakistan".
  - **Government support:** On February 10, 2022, [H2-view.com](https://www.h2-view.com) reported that the proposed Green Hydrogen production facility, to be located in Jhimpir Ghara or Keti Bandar is targeting a sub-USD 2 per kilogram production cost, and in so doing allowing use of Green Hydrogen and Green Ammonia across a broad range of sectors, including aviation, fertiliser production, and ocean going shipping, and some transport mobility.  
The Green Hydrogen production facility is reported to have the support of the Government of Pakistan, and is progressing to bi-lateral government support, with support expected from the **PRC**.
- **Total Eren in Morocco:** On February 11, 2022, [Total Eren](https://www.total.com) announced plans to develop a 10 GW Green Hydrogen production facility in the Western Sahara. The investment is estimated to be US\$10.6 billion and will be located in Morocco's southern region of Guelmim-Oued Nour.
- **Neptune and RWE team for off-shore green:** On February 15, 2022, it was reported widely that Neptune Energy (leading independent UK oil and gas company) and RWE (German energy giant) are to develop the **H2opZee** project to demonstrate production of Green Hydrogen off-shore. The **H2opZee** is to develop and to deploy 300 to 500 MW of electrolyser capacity in the Dutch Sector of the North Sea to produce Green Hydrogen, using off-shore wind field capacity to power the electrolyzers.

The Green Hydrogen produced by **H2opZee** will be transported to the Netherlands using an existing pipeline, repurposed for this use. It is understood that Neptune Energy and RWE intend H2opZee to be operational before 2030. Ahead of a final investment decision, Neptune Energy will undertake a feasibility study, commencing 2022.

The **H2opZee** project is supported by the Dutch Government under the auspices of TKI Wind op Zee, an initiative to bring tougher financing, knowledge and people to support the development of off-shore energy transition projects.



Source: [RWE website](#)

- **Takasago Hydrogen Park:** On February 16, 2022, it was reported widely that Mitsubishi Heavy Industries (**MHI**) is to establish the **Takasago Hydrogen Park** to produce hydrogen that **MHI** will use to allow it to develop and to commercialise its hydrogen gas turbine technology. **Takasago Hydrogen Park** will use electrolyser technology to produce Green Hydrogen, and it will produce hydrogen from the thermal treatment of methane (Grey without CCS / CCUS, Blue Hydrogen, without CCS / CCUS).

- **Southern Green Hydrogen:** On February 16, 2022, it was reported widely that Fortescue Future Industries and Woodside Energy had been shortlisted as partners to Contact Energy and Meridian Energy for the **Southern Green Hydrogen** project. Other shortlisted potential partners are said to include a consortium comprising ENEOS, Mitsui and BOC Gases.

As understood, the current intention is to develop 600 MW of Green Hydrogen production capacity. The Green Hydrogen produced by the **Southern Green Hydrogen** project would be used domestically within New Zealand and exported.

#### By way of reminder:

- **Edition 22** of Low Carbon Pulse reported that in July 2021 the [Otago Daily Times](#), had outlined plans for the development of renewable electrical energy, and use of that energy at Tiwai Point, Southland. Contact Energy and Meridian Energy (two of New Zealand's electricity generation corporations) are testing the appetite for the development of a world-scale Green Hydrogen production facility (**Southern Green Hydrogen**).

The CEOs of Contact Energy (Mr Mike Fuge) and Meridian Energy (Mr Neal Barclay) regard the development of the **Southern Green Project** as "whole of economy" development, facilitating the development of domestic demand for hydrogen and allowing New Zealand to achieve 100% renewable electrical energy generation country wide.

- **Edition 23** of Low Carbon Pulse Contact Energy and Meridian Energy (two of New Zealand's electricity generation corporations) are testing the appetite for the development of a world-scale Green Hydrogen production facility (**Southern Green Hydrogen**).

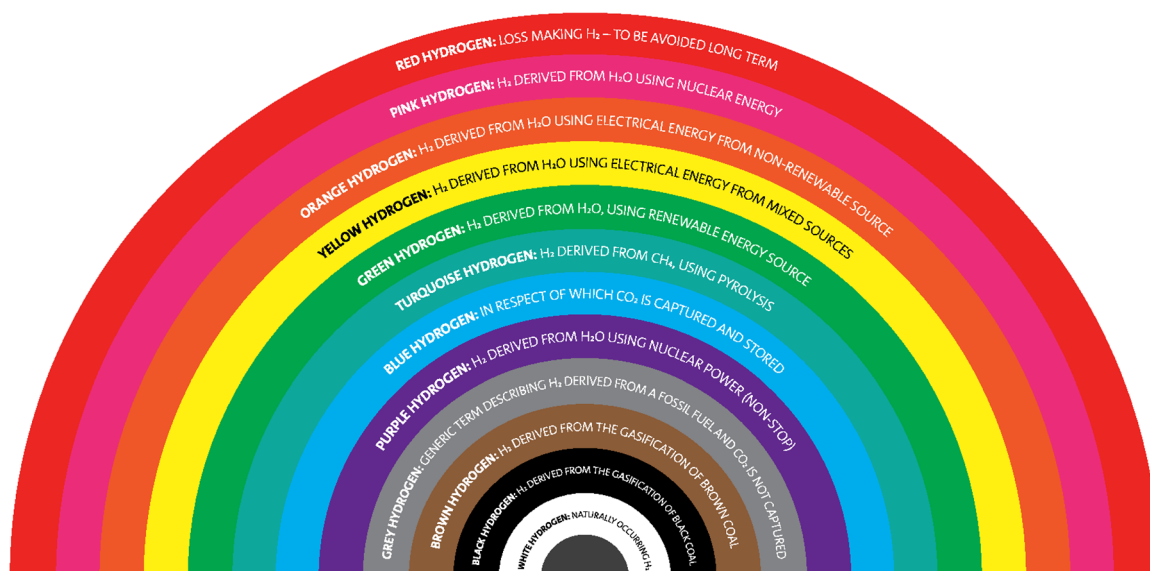
On August 1, 2021, the [Otago Times](#) provided an update on **Southern Green Hydrogen**, noting that production of Green Hydrogen may commence as early as 2023. The update noted the likely involvement of Fortescue Future Industries or **FFI** (a subsidiary of Fortescue Metals Group, founded by Dr Andrew Forrest, AO).

On August 3, 2021, [The West Australian](#) (Western Australia being the home state of Dr Forrest, AO, and **FFI**), picked up on the **FFI** interest in **Southern Green Hydrogen**.

On August 4, 2021, **FFI** announced that it had signed a collaboration agreement with Murihiku Hapu of Ngai Tahu in respect of the potential development of a large scale, Green Hydrogen production project in Southland, New Zealand.

- **Gold Hydrogen for USA:** On February 17, 2022, [h2-view.com](#) reported (under **US-based Gold Hydrogen Programme to extract natural hydrogen from underground**) and **Edition 34** of Low Carbon Pulse reported on the extraction of Gold Hydrogen in Australia, with a particular focus on South Australia.

The Gold Hydrogen Programme comprises key players, including Cemvita Factory, Chart Industries, EXP and Center for Houston's Future.



**Note:** Some authors / commentators use Purple Hydrogen to refer to the production of hydrogen using coal or petcoke gasification using CCS to capture the CO<sub>2</sub> arising.

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

**Green Hydrogen for LA:** On February 18, 2022, [reuters.com](https://www.reuters.com) reported that Southern California Gas Co (the largest gas utility in the US, and division of Sempra Energy) intended to deliver Green Hydrogen to Los Angeles (the **Angeles Link**) to assist in the decarbonisation of the electrical energy, industrial and manufacturing and transportation sectors. SoCalGas announced that the **Angeles Link** could displace up to 3 million gallons of diesel fuel a day and may be used to convert up to four natural gas fired power stations to hydrogen.

The reported scale of the SoCalGas' plans is epic: up to 20 GW of electrolyser capacity sourcing renewable electrical energy from up to 35 GW of installed photovoltaic solar and wind capacity, 2 GW of BESS, and a 200 to 700 mile pipeline to haul Green Hydrogen to the point of use.

- **Green Hydrogen for Belgium:** On February 17, 2022, it was reported widely that a 100 MW Green Hydrogen production facility is to be developed at the Port of Zeebrugge, Belgium. The facility is to be developed by BESIX and John Cockerill, working with Fluxys and Virya Energy.

The Flemish Minister for Economy and Innovation, Ms Hilde Crevits stated: "Hyoffwind is one of the projects that Flanders has submitted in connection with the European call for IPCEIs".

- **Hydrogen from waste:** The derivation and production of hydrogen from waste appears to be gathering momentum. In the first of the Hydrogen for Industry publications (entitled [Feature 1: Hydrogen from Waste](#)), the derivation / production of hydrogen from waste was considered. In a number of recent news items, it is clear that hydrogen from waste, organics and plastics is coming close to breaking through as a viable source of hydrogen. In the standalone article referred to above (under **E-Fuels / Future Fuels**), Michael Harrison and Richard Guit will provide an update.

## 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 35** 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.*

- **Basque Hydrogen Corridor development:** On February 8, 2022 it was reported widely that the [Basque Hydrogen Corridor Association](#) (**BH<sub>2</sub>CA**) has identified investment decisions of over USD 200 million to be made in 2022. (By way of reminder, **Edition 11** of Low Carbon Pulse outlined the establishment of the **BH<sub>2</sub>CA**.) The **BH<sub>2</sub>CA** held a conference on February 7, 2022. Low Carbon Pulse will follow the development of the Basque Hydrogen Corridor as it widens and lengthens.
- **A world first in Levenmouth, Fife:** On February 9, 2022, SGN H100 Fife ([h100fife.co.uk](https://h100fife.co.uk)) provided an outline of **A world-first green hydrogen gas network in the heat of Fife**. The H100 Fife is described as "a first-of-a-kind demonstration project that's leading the way in decarbonising home heating ... [bringing] 100% green hydrogen gas



to customers for the first time". As is the case in a number of northern European countries heating accounts of a material proportion of **GHG** emission, according to SGN in the UK 37% of "all UK carbon emissions".

- **Enapter plans giga-factory at Saerbeck:** On February 11, 2022, cleantech corporation [Enapter](#) announced plans to develop a giga-factory to manufacture up to 2.1 GW of electrolyzers in Saerbeck, a town in North-Rhine-Westphalia, Germany.
- **H2PiyR Corridor:** In February 2022 a hydrogen corridor for the Pyrenees Region was announced. Future editions of Low Carbon Pulse will cover its development.
- **Spanish Hydrogen Hub:** On February 12, 2022 it was reported widely that ArcelorMittal, Enagas, Grupo Fertiberia and DH2 Energy intend to develop "the world's largest renewable and competitive hydrogen hub" (**HyDeal España**) that will result in an additional installed electrolyser capacity of 7.4 GW by 2030, with power to be sourced from 9.5 GW of renewable electrical energy, with the production and supply of Green Hydrogen to increase incrementally, starting in 2025.

The Green Hydrogen produced by **HyDeal España** will be supplied to industrial users located in Asturias, Spain. It has been reported that those industrial users will commit to offtake for 20 years, thereby matching supply with sufficient demand to allow the **HyDeal España** to proceed.

The headline grabbing fact that has emerged from the news items around **HyDeal España** is that:

"HyDeal Spain is the first concrete implementation of the green hydrogen model with a cost of €1.5 / kg [of hydrogen] announced .."

The installation of the 7.4 GW of Green Hydrogen production capacity contemplated **HyDeal España**, the 2 GW of Green Hydrogen production capacity contemplated by **Project Catalina**, and 2 GW of Green Hydrogen production capacity contemplated by **SHYNE**, means that these projects will match the Spanish Government's target and will then exceed (by nearly 8 GW) 4 GW of installed capacity by 2030. With other projects announced and planned, Spain appears well set to lead Europe in Green Hydrogen production.

**By way of reminder**, since the start of 2022, **Editions 33** and **34** have reported as follows:

- **SHYNE project:** **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)".
- **Project Catalina fully sized:** **Edition 34** of Low Carbon Pulse reported as follows: "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 Ammonia and fertiliser".

**By way of summary:** To reflect the momentum around hydrogen production development in Spain, the following infographic is helpful. In summary, all targets in the road to 2030 are going to be in the rear-view mirror:





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

*This section considers news items that have arisen within the news cycle of this **Edition 35** of Low Carbon Pulse relating to the development of wind power generation capacity, on-shore and off-shore (fixed bottom and floating).*

- **Norwegian off-shore winding up:** On February 7, 2022, [www.the-eic.com](http://www.the-eic.com) (under **Adger Energi, GIG to bid for floating wind project in Norway**) reported that Norwegian power utility, Adger Energi had partnered with Macquarie-owned Green Investment Group (**GIG**) to bid for floating off-shore wind field site within the **Utsira Nord** zone (covering 1,010 km<sup>2</sup> and having an average depth of 267 metres).

The 1.5 GW **Utsira Nord** (North Utsira) zone is one of the two zones for which the Norwegian Government is seeking licensing applications, the other zone being **Sørilige Nordsjø II** (South Utsira). **GIG** regards Utsira Nord as suitable for the development of floating off-shore wind field capacity because of its deep waters strong wind conditions/resources, and relatively close proximity to industrial off-takers of renewable electrical energy.

- **Auction Process:** The Norwegian Government intends to auction the 3 GW **Sørilige Nordsjø II** in two phases. The auction model is under-development, with legislation required to support the off-shore wind development. It was reported widely that the [Norwegian Offshore Wind Cluster](#), met to debate the off-shore auction model with the Norwegian Prime Minister, Mr Jonas Gahr Støre.

On February 10, 2022, Prime Minister Støre outlined first phase (comprising 1.5 GW) of the **Sørilige Nordsjø II** off-shore wind field development: the first phase was to be completed in the second half of the current decade, providing up to 7 TWh per annum of renewable electrical energy.

Prime Minister Støre did not rule out the provision of government funding support (through subsidies of the electrical energy price). In respect of the second phase of the development of **Sørilige Nordsjø II** project the Prime Minister contemplated that 1.5 GW of renewable electrical energy from this off-shore wind field development may find a market in northern Europe, rather than Norway.

Regular readers of Low Carbon Pulse will recall earlier coverage of both **Utsira Nord** and **Sørilige Nordsjø II**. For ease of reference, that earlier coverage is included below.

- **Edition 18** of Low Carbon Pulse reported as follows:

- **"Equinor, Norsk and RWE cooperate to bid for Southern North Sea 2:** Oil major (**Equinor**), aluminium giant (**Norsk**) and giant utility (**RWE**) are reported to have signed a cooperation agreement to inform the basis of a joint bid for the fixed bottom off-shore wind field auction in respect of **Sørilige Nordsjø II**, in the Norwegian sector of the North Sea.

**Sørilige Nordsjø II** is one of two areas that the Norwegian Government has opened up for development, the other being **Utsira Nord**, which is to be developed as a floating offshore wind field development. In respect of **Utsira Nord**, **Equinor** is cooperating with Eni SPA and HitecVision.

- **A fair wind:** On May 25, 2021, Norseman Wind Consortium (**NWC**) announced that it has applied for a licence to develop a €3 billion, 1.4 GW off-shore wind field project off Norway, in respect of the **Sørilige Nordsjø II** area. The **NWC** comprises ASKO Fornybar, EnBW, NorgesGruppen, and Norseman Wind. The **NWC** business model is reported as meaning that its proposed off-shore wind field project will be developed without the need for government support of any kind: "Our business model means that we do not need government subsidies. Thus the state's green money can rather be spent on floating offshore wind at Utsira Nord as well as on hydrogen and carbon capture".

- **Edition 20** of Low Carbon Pulse reported as follows:

**"North and South Utsira bottom or floating forecast news:**

- **"Status check: Edition 18** of Low Carbon Pulse reported on the **Utsira Nord** and **Sørilige Nordsjø II** areas (known on UK shipping forecasts, as North Utsira and South Utsira) in the Norwegian sector of the North Sea. Together, **Utsira Nord** and **Sørilige Nordsjø II** have wind resource potential of up to 4.5 GW of installed capacity. The Norwegian Government (Ministry of Petroleum and Energy) has indicated that **Utsira Nord** is suitable for floating off-shore wind and that **Sørilige Nordsjø II** must be developed without any state-aid.

- **BP and Aker Offshore Wind and Statkraft:** On June 14, 2021, it was announced that BP is partnering with Aker Offshore Wind and Statkraft in a consortium to apply to develop a fixed bottom off-shore wind field in the **Sørilige Nordsjø II** area.

- **Shell and BKK and Lyse bottom out and float:** On June 17, 2021, it was announced that Shell intends to partner with Norwegian hydro-electric companies, BKK and Lyse, to apply to develop off-shore wind field projects in both the **Utsira Nord** and **Sørilige Nordsjø II** areas. It is understood that the partners are contemplating the development of floating off-shore wind field capacity in the **Utsira Nord** area, and each partner has a clear view about the quality of the wind resources in the North Sea.

Also BBK, CEO, Ms Jannicke Hilland provided an interesting perspective on the interface between hydro-electric and wind: "[When these off-shore wind fields produce electrical energy], we can hold back the water in our reservoirs, we can cover the demand for power by phasing in hydro-production".

- **Poland off-shore wind capacity progressing:** On February 8, 2022, [offshoreWIND.biz](http://offshoreWIND.biz) (under **Race for New Mega Offshore Wind Acreage Starts in Poland**) reported that **PKN Orlen** (a Polish based oil refiner and petroleum retailer, see Editions 20 and 34 of Low Carbon Pulse) and Polska Grupa Energetyczna (**PGE**) has submitted multiple applications for permits to develop off-shore wind field capacity in areas recently designated for development in the Polish sector of the Baltic Sea.

It is reported that there are 11 areas for which applications may be submitted to build and to operate off-shore wind fields and energy islands. **PKN Orlen** has submitted applications for seven areas, covering around 3 GW of installed capacity. **PGE** has submitted applications for six areas, with two applications submitted jointly with Enea and one jointly with Tauron.

## WHY IS THE BALTIC SEA IS HIGHLY PROSPECTIVE?

WindEurope estimates that the Baltic Sea will allow the development of up to 80 GW of off-shore wind capacity

Strong and stable winds, particularly the case across the Polish sector

The Polish sector of the Baltic Sea has relatively shallow waters suitable for fixed bottom off-shore wind fields

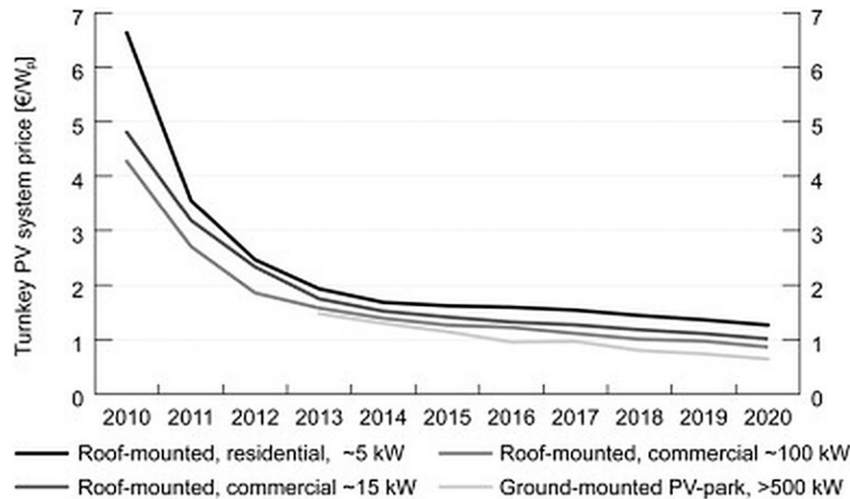
The Polish sector of the Baltic Sea will allow the development of up to 28 GW of off-shore wind capacity

- **Norfolk Vanguard approved:** On February 11, 2022, it was reported widely that the Vattenfall (Swedish state owned energy corporation) 1.8 GW Norfolk Vanguard off-shore wind field project had been approved by the UK Secretary of State for Business, Energy and Industrial Strategy, Mr Kwais Kwarteng.  
The Norfolk Vanguard off-shore wind field development is within the Norfolk Offshore Wind Zone, covering an area of 1,3067 km<sup>2</sup>, located 47 km of the coast of Norfolk, England. The Norfolk Vanguard is in addition to the 1.8 GW Norfolk Boreas, in respect of which approval has already been given.
- **Swedish Government in search of wind:** On February 15, 2022, [offshoreWIND.biz](https://www.offshorewind.biz) reported that the Swedish Government is to identify suitable areas to develop off-shore wind fields for the purposes of generating 120 TWh annually from sources of renewable electrical energy (noting that the electrical energy consumption of Sweden is 140 TWh annually).  
It is understood that the Swedish Energy Agency (**SEA**) has identified, and reported on, three areas – located in the Baltic Sea, the Gulf of Bothnia and the North Sea having wind resources of between 20 to 30 TWh annually. The **SEA** will work with the Swedish Maritime Administration (**SMA**) to identify areas from which 90 TWh annually can be generated. The **SEA** is to report on progress by no later than March 2023, the SMA no later than December 2024.

## Solar and Sustainability (including NZE Waste):

*This section considers news items that have arisen within the news cycle of this **Edition 35** 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**.*

- **Egypt leading into COP-27:** On February 8, 2022, [energy-utilities.com](https://www.energy-utilities.com) (under **Egypt reviews offers of green hydrogen projects in Suez ahead of COP 27**) reported that the Government of Egypt and the Suez Canal Economic Zoen (**SCZone**) had met to discuss offers received for the development of Green Hydrogen projects in the **SCZone**. Future editions of Low Carbon Pulse will report on developments.
- **Singapore – lofty mandate:** On February 7, 2022, [jtc.gov.sg](https://www.jtc.gov.sg) announced that JTC Corporation (a Singapore government agency championing sustainable industrial development in Singapore) intends to mandate the installation of roof-top photovoltaic solar panels on new land and land-based allocation, lease renewals, and land launches. This initiative extends the mandate that already existed in respect of some, but not all, property. JTC Corporation anticipates that this initiative will result in the installation of 82 MW at peak (82 MWp). In context, by 2030, Singapore anticipates that it will have installed 2 GWp, sufficient for around 350,000 households a year, and comprising around 3% of electrical energy load of Singapore in 2030.
- **Iberdrola pumps-up scale:** On February 8, 2022, it was reported widely that Spanish renewable energy giant, Iberdrola is developing a MW hydro-electric power complex in northern Portugal, using water from three reservoirs: Alto Tâmega, Daivões and Gouvães.  
The hydro-electric power complex will deploy a 880 MW reversible storage facility (pumped-storage), which is able to store water from the Daivões reservoir delivered into the Gouvães reservoir. There is a 650 metre differential between the two reservoirs, use of the differential will generate renewable electrical energy, with the water in the Gouvães reservoir pumped into the Alto Tâmega reservoir. The pumped storage is being described as the "Alto Tâmega giga battery": on operation the energy storage of Portugal will increase by 30%.
- **Canal plus:** On February 11, 2022, it was reported widely that the State of California, US, is to cover canals with photovoltaic solar "canopies", with the expectation being that the use of photovoltaic solar "canopies" will realise multiple GW of renewable electrical energy.
- **Hydroelectric plus:** On February 15, 2022, [h2-view.com](https://www.h2-view.com) reported that "the worlds' second largest hydroelectric facility" in Paraguay (having peak capacity of 14 GW) is considering the development of a pilot project to produce Green Hydrogen using 50% of the capacity of the hydroelectric facility. It is reported that NeoGreen Hydrogen (comprising an experienced team of developers and financiers) will undertake a feasibility and scoping study for these purposes.
- **LCOE reaches €0.02737 kWh in Sweden:** On February 15, 2022, [pv-magazine.com](https://www.pv-magazine.com) reported that [new research](#) indicated that choice of location and financing conditions are key in reducing the levelized cost of energy (**LCOE**), allowing the development of utility-scale photovoltaic solar facilities in Sweden without the need for financial support from Government. The researchers found that the lowest **LCOE** was **€0.02737 kWh**.



Source: [Economic analysis of the early market of centralized photovoltaic parks in Sweden](#)

- **Electricity Market Report from IEA:** On February 16, 2022, **IEA** published its [Electricity Market Report – January 2022](#). The **January and February Report on Reports** will outline the finding from the **Electricity Market Report – January 2022**.
- **Octopus Outback:** On February 18, 2022 it was reported widely that the UK Octopus Group intends to partner with First Nation communities to develop renewable electrical energy projects in Australia's Northern Territory. It was reported that Octopus Group has teamed up with the Northern Territory Indigenous Business Network (**NTIBN**) to establish Desert Springs Octopus (**DCO**). Low Carbon Pulse will follow the development of this initiative.

## Land Mobility / Transport:

*This section considers news items that have arisen within the news cycle of this **Edition 35** 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:**
  - **Daimler all electric:** On February 9, 2022, [daimlertruck.com](#) announced that it had completed the first trial of its 10 metre electric eCitaro articulated bus on the in schedule service route at Seiser Alm in South Tyrol.
- **Cars (including taxis); Fuel Cell and Battery Technology; Industrial Vehicles and Trucks; Recharging and refuelling infrastructure**

To manage the length of this **Edition 35** of Low Carbon Pulse, news items have been included on trains only. **Edition 36** of Low Carbon Pulse will "catch-up" on other Land mobility news items.
- **Trains:**
  - **Berlin and Brandenburg aligned:** On February 2, 2022, [railjournal.com](#) reported that the German States of Berlin and Brandenburg, and train operator and infrastructure manager Niederbarnimer Railway (**NEB**) had reached agreement to procure and to deploy hydrogen fuel cell technology on trains in the German Capital region, and the development of infrastructure.

The deployment will commence on the Berlin-Wilhelmsruh-Basdorf line. The initial procurement is reported to be for seven hydrogen fuel cell technology powered and propelled units. The procurement and deployment is proceeding with the benefit of €25 million of grant support from the German Federal Ministry of Finance.
  - **CAF AND Iberdrola lining up:** On February 9, 2022, railway-news.com (under [CAF and Iberdrola Partner on Hydrogen-Powered Train Project](#)) reported that CAF (Spanish rail vehicle and equipment manufacturer) and Iberdrola (Spanish integrated energy giant) had signed a framework agreement to promote the use of Green Hydrogen in the rail and passenger.

The signing of the framework agreement comes ahead of the testing of the hybrid electric battery and hydrogen-powered and propelled train developed by CAF at its Zaragoza plant as part of the **FCH2RAIL project** (see **Edition 26** of Low Carbon Pulse). The tests are to commence in April 2022, and hydrogen supplied by Iberdrola will be used.
  - **Porterbrook and Rolls Royce on track:** Both [Porterbrook](#) (the UK's largest rolling stock owner) and [Rolls Royce](#) have announced that they were working together to pioneer the advancement of rail decarbonisation.

To date, Porterbrook and Rolls Royce have worked together on the **HybridFLEX** (combining power and propulsion using diesel and battery) for Chiltern Railways (dear to the heart of the author). The **HybridFLEX** has been developed further so that it can use hydrogen too - making it the world's "first tri-mode" train.

Moving forward, Porterbrook and Rolls Royce intend to work together to develop the use of sustainable / synthetic fuel and net-zero fuels, including hydrogen using both fuel cell technology and internal combustion engine technology.
  - **JR East Hybrid running:** On February 19, 2022, [asia.nikkei.com](#) reported that East Japan Railway (**JR East**) had unveiled Japan's first hydrogen-powered hybrid train (**Hybari**) on February 18, 2022, using technologies developed by Hitachi Corporation and Toyota Motor Corporation – hydrogen fuel cells and electric battery technologies. **JR East** is to commence testing of the **Hybari** in March 2022.

## Ports Progress and Shipping Forecast:

*This section considers news items that have arisen within the news cycle of this **Edition 35** 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:**

Within the news cycle covered by this **Edition 35** of Low Carbon Pulse, no news items have come to light on Ferries that may be regarded as significant for the purposes of Low Carbon Pulse.

- **Green Shipping:**

- **Energy Observer well and truly observed:** For some time, the Energy Observer 2 has received considerable news coverage across many industry and main stream and network news outlines.

The reason for this are that the Energy Observer is powered and propelled by liquid hydrogen using fuel cell technology and by Oceanwings®, and is a multipurpose cargo ship that would result in zero emission sea borne transportation of cargo. The **Energy Observer 2** was presented at the **One Ocean Summit** in Brest, France (see France and Germany: [One Ocean Summit](#) above).

The **Energy Observer 2** has been developed by Energy Observer (and its industrial subsidiary, EODev), and its technology and operational partners, Air Liquide, Ayro (the developer of Oceanwings®) CMA CGM Group (global leader in maritime transport and logistics), LMG Marin (naval architecture corporation, and developer of the world's first liquid hydrogen powered and propelled ferry, the **MV Hydra** – see **Editions 23** and **34** of Low Carbon Pulse). Bureau Veritas has been providing ongoing input as the design of the Energy Observer has developed.



Source: [Energy Observer](#)

- **Shell accelerating with GTT:** As noted above (under [Teaming with ideas](#)), Shell is working with Doosan and **KSOE** to develop fuel cell technology to power and to propel vessels using liquid hydrogen (**LH<sub>2</sub>O**). On February 8, 2022 it was reported widely that Shell International Trading and Shipping is working with GTT to accelerate technology development to allow the carriage of **LH<sub>2</sub>O** as an energy carrier: GTT is a proven technology developer and provider of cryogenic technologies. GTT and Shell are going to work together to design containment systems to allow the storage and transportation of **LH<sub>2</sub>O**. As readers of Low Carbon Pulse and sibling publications will know, the development of containment systems and scaling up the capacity of **LH<sub>2</sub>O** is key to the development of the world trade in hydrogen.
- **Aker Clean Hydrogen and Kuehne+Nagel clean above and below decks:** On February 11, 2022, [h2-view.com](#) reported that Aker Clean Hydrogen (a corporation within the Aker ASA Group) and Kuehne+Nagel (leading logistics solutions corporation) are combining to continue progress in decarbonising the shipping industry in Norway. Aker Clean Hydrogen is to supply green fuels to Kuehne+Nagel (including Green Hydrogen, Green Ammonia and Green Methanol) for the purposes of its maritime logistics business so as to power and to propel vessels with engines converted to use or the green fuels, including dual fuel engines.
- **Zero carbon shipping:**
  - **World Shipping Council (WSC) plan for zero carbon shipping:** On February 10, 2022, [gcaptain.com](#) reported that the **WSC** has identified six pathways (economic and regulatory) that it regards as key for nations within the UN International Maritime Organisation (**IMO**) to address to achieve a successful transition to zero carbon shipping. The **WSC** made a [formal submission](#) to the **IMO** dated February 9, 2022. For those that have been following the **WSC**, the pathways will not be a surprise: **1.** Applied R&D for ship-board to shoreside systems, to allow use of zero-carbon fuels; **2.** Global application of a carbon price (**GHG Price**) (see **Edition 27** of Low Carbon Pulse); **3.** Life-cycle fuel accounting with appropriate regulatory mechanisms for first movers, critically, transparent well-to-wake life-cycle analysis of fuels, distinguishing well-to-tank and tank-to-wake emissions, coupled with incentives to encourage use of zero carbon fuels; **4.** Integrated development of global production and supply of zero carbon fuels; **5.** The Green Corridors as an enabler of the fuel / technology transition (see below for **Green Shipping Corridors in practice**); **6.** New build standards that support energy transition by requiring energy transition to zero carbon.



As has been the case before, the author looks for the Maersk McKinney Moller Center for Carbon Shipping perspective, which is fully supportive of the approach of the **WSC**. The perspective of the [Maersk McKinney Moller Center](#) for each pathway is worth a read.

- **Green Shipping Corridors in practice:**

**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.

- **Green Free Ports:** On February 13, 2022, it was reported widely that two Green Freeports are to be established in Scotland. Each Green Freeport will offer incentives to investors (including tax incentives). Low Carbon Pulse will cover the process and outcome of the tendering and bidding process as it develops.
- **LCO<sub>2</sub> and LHOC carrier development continues apace:** 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 and **CO<sub>2</sub>** from the point of production to the market in which they are to be used or stored.

As noted in **Edition 34** of Low Carbon Pulse, progress is being made in respect of the **MV Suiso Frontier**, but the technology used for the **MV Suiso Frontier** is being scaled up by **KHI**, with containment tanks of 40,000 m<sup>3</sup> having already been 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.

**Edition 34** of Low Carbon Pulse reported that Mitsubishi Heavy Industries (**MHI**) Group unit, Mitsubishi Shipbuilding, entered into a contract with Sanyu Kisen, based in Kobe, Japan, to build a demonstration test vessel to carry liquified carbon dioxide (**LCO<sub>2</sub>**). The **LCO<sub>2</sub>** carrier is to be built at the **MHI** Enoura Plant, at **MHI's** Shimonoseki Shipyard Machinery Works.

- **On February 7, 2022**, [akercarboncapture.com](#) reported that Aker Carbon Capture (of Norway, the world's first carbon capture and storage-specific shipping entity, having been established by Evergas and Navigator Gas) and Dan-Unity CO<sub>2</sub> (of Denmark) had signed a collaboration agreement to develop flexible **CO<sub>2</sub>** transport solutions, with the aim of establishing a full carbon capture, utilisation and storage value chain.

The focus of Dan-Unity **CO<sub>2</sub>** is: "Transporting **CO<sub>2</sub>** by sea allows for maximum flexibility and multiple sourcing points, thus unlocking economies of scale for many CCS projects, often delivering a lower cost per tonnes with other transport solutions".

- **On February 8, 2022**, Mitsui O.S.K Lines (**MOL**) and Petronas signed a memorandum of understanding to study the transportation of liquified **CO<sub>2</sub>** (**LCO<sub>2</sub>**) for the purposes of facilitating carbon capture, utilisation and storage within the Asia Pacific and Oceania region. Larvik Shipping will work with MOL and Petronas given its experience in managing **LCO<sub>2</sub>** carriers, contributing know-how, in particular
- **LHOC now available:** On February 10, 2022, it was reported widely, and announced by [Chiyoda Corporation](#), that a world first had been achieved with the transportation of hydrogen in the form methylcyclohexane (**MCH**) by chemical tanker from Brunei Darussalam to an ENEOS refinery in Japan.

This world first has been achieved under the auspices, and support, of the Advanced Hydrogen Energy Chain Association (**AHEAD**). Liquid Hydrogen having been recently transported from Australia to Japan as the final piece in the jigsaw puzzle to complete the Hydrogen Energy Supply Chain (most recently, see **Editions 32, 33 and 34** of Low Carbon Pulse).

ENEOS uses **MCH** as feedstock for its demonstration project, under the auspices, and support, of the Consortium for Resilient Oil Supply System (**CROS**). The **MCH** is subject to dehydrogenation at the ENEOS refinery in Japan.

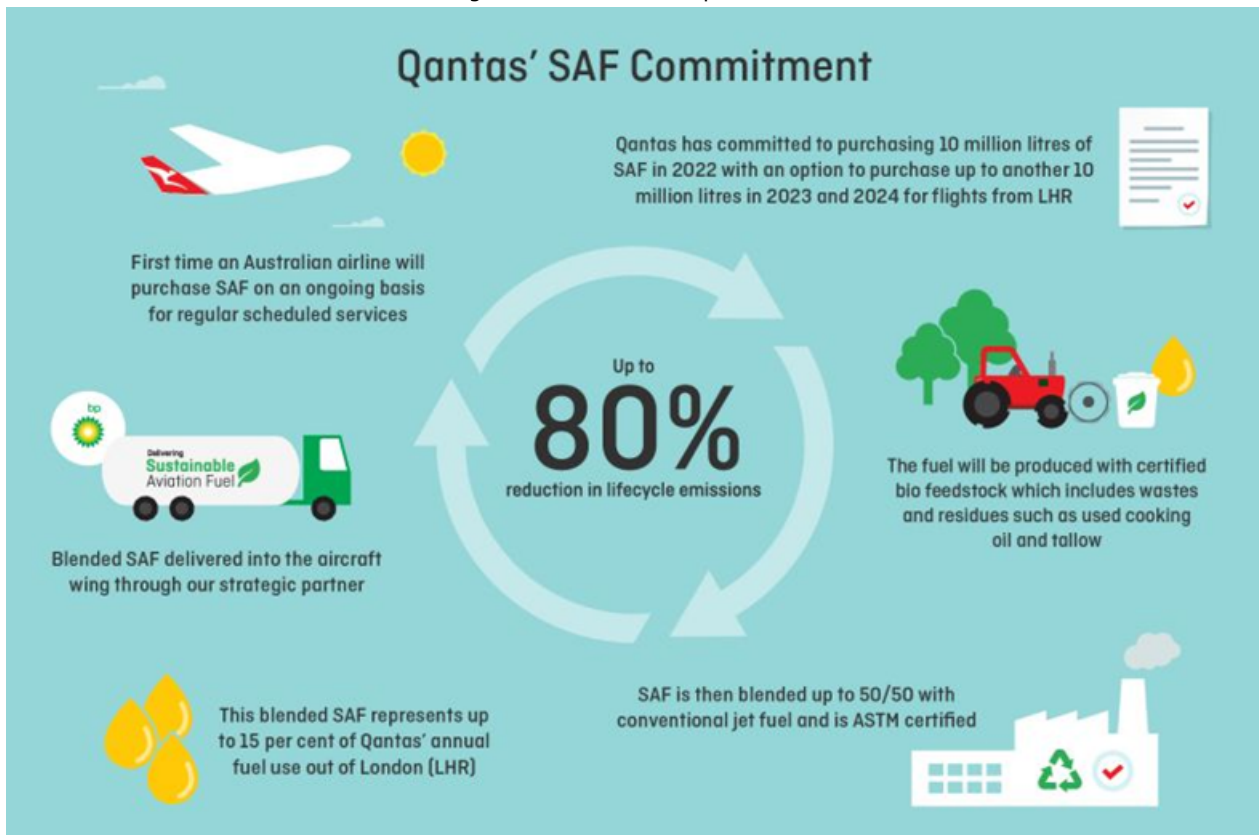
As reported recently (in **Editions 32, 33 and 34** of Low Carbon Pulse), Japanese corporations have been key to the development of the Hydrogen Energy Supply Chain, including the use of the MV Suiso Frontier LH<sub>2</sub> carrier to transport liquid hydrogen from Victoria Australia, to Kobe, Japan.

## Airports and Aviation:

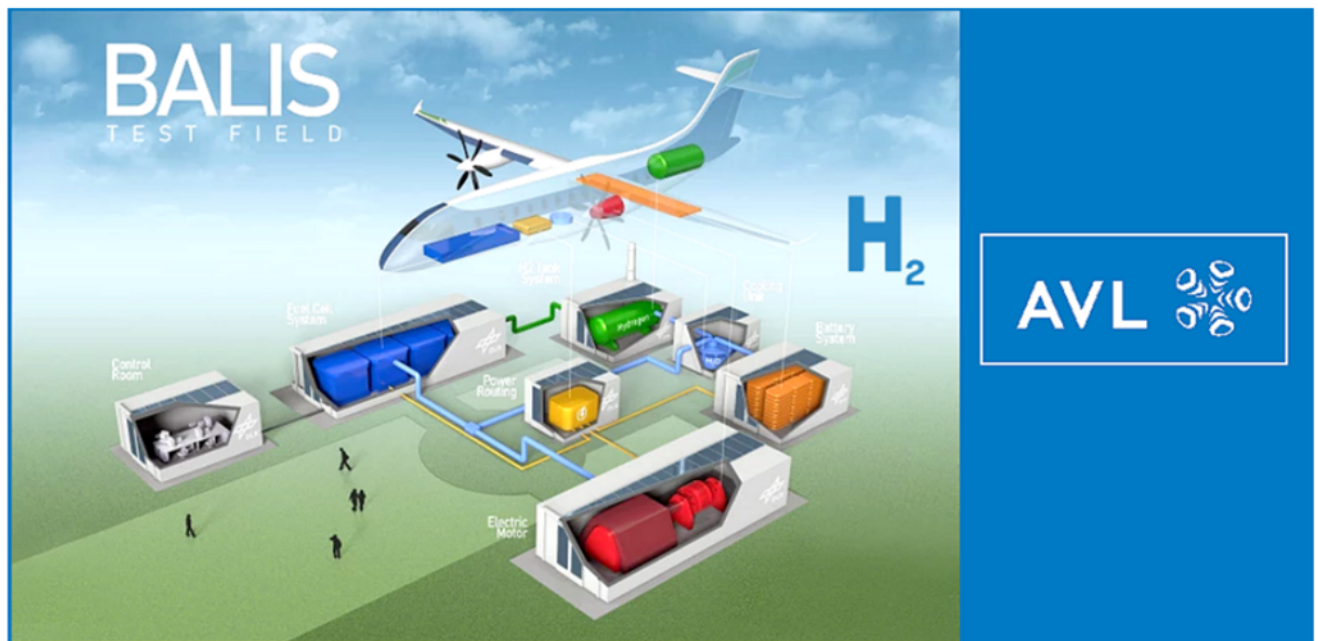
*This section considers news items that have arisen within the news cycle of this **Edition 35** of Low Carbon Pulse relating to the development and deployment of technology at airports and in the aviation sector to decarbonise the airports and the aviation industry.*

- **Airbus moves to H<sub>2</sub> engines:** On February 7, 2022, it was reported widely that Airbus Industries may manufacture engines powered by hydrogen. **Edition 32** of Low Carbon Pulse reported that Airbus Industries intends to develop a zero-emission hydrogen powered and propelled commercial aircraft by 2035.

- **ATR, BRA and Neste firm SAF:** Editions [30](#) and [33](#) of Low Carbon Pulse reported on the testing of engines using sustainable / synthetic aviation fuel (**SAF**). ATR (joint partnership between major European players Airbus and Leonardo), Braethens Regional Airlines and Neste (World's largest producer of renewable diesel and sustainable aviation fuel refined from waste and residues) are to test the use of 100% **SAF** for one engine to achieve 100% **SAF** certification.
- **QF using SAF:** On January 27, 2022, Qantas Airlines (the Australian Flag Carrier) announced that it had been using blended biofuel on its flights from London to Australia, in partnership with bp. QF has been using **SAF** provided by bp as certified bio-feedstock from used cooking oil and other waste products.



- **German Aerospace Centre (GAC) to develop FC:** On February 9, 2022 the BALIS Project was reported widely. The BALIS Project is an initiative of the **GAC** to develop fuel cell technology to provide up to 1.5 MW for the propulsion of aircraft. In this context, the MW scale of the BALIS Project makes it a world first. The BALIS Project includes the development of a 2,000 m<sup>2</sup> test field.



- **Air borne:** On February 9, 2022, [Air Liquide](#) announced that Air Liquide, Airbus, Korean Air and Incheon International Airport Corporation has signed a memorandum of understanding (**MOU**) to explore the use of hydrogen at Incheon International Airport (**IIA**), **ROK**. In addition, it is understood that the **MOU** contemplates the study of **ROK** airport infrastructure to support the development of hydrogen-powered and propelled commercial aircraft.

For the purpose of the **MOU**, first, a hydrogen use roadmap will be developed, identifying the uses for hydrogen air and land side, and within the vicinity of, **IIA**, and secondly, studies will be undertaken to define the infrastructure that will be required at **IIA** to allow hydrogen-powered and propelled aircraft to use **IIA**.

- **Topsoe SAF View:** On February 10, 2022, [topsoe.com](#) published an article entitled **What does it take to decarbonize aviation?** the author of which is Mr Ulrik Frehike. The article is well-worth a read (and can be accessed through the attached link above).

Mr Frehike provides a perspective on why there is not greater uptake, and faster progress in the use of **SAF**:

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

2. the process to produce **SAF** – there is only one commercially scalable production progress – the use of fatty acids and hydrogenated acids as feedstock to produce synthetic paraffinic kerosene (to be covered in greater detail in an upcoming stand alone E-Fuels and Future Fuel article from Michael Harrison and Richard Guit). As such, while there are seven approved means of production of **SAF**, only one means is currently commercially scalable; and

3. there is limited available feedstock (i.e., fatty and hydrogenated acids) from which to produce **SAF**. The primary sources of feedstock are animal fats and used cooking oils. As a result, current supply (200,000 metric tonnes of **SAF** annually) is a drop in the ocean of demand for aviation fuel (300 million metric tonnes annually). There is a market for **SAF**, not least because the aviation industry gives rise to around 1 billion metric tonnes of **CO<sub>2</sub>-e** each year.

- **SIA and Scott SAF:** On February 11, 2022, [channelnewsasia.com](#) reported that Singapore Airlines (**SIA**) and budget carrier, Scoot, are to begin using **SAF** in Q3 of 2022. The Civil Aviation Authority of Singapore (**CCAS**) having approved the use of **SAF** as part of a 12 month pilot program involving **SIA**, Scoot and Temasek that will comprise the use of 1.25 million litres of **SAF**.

The **SAF** (as noted above produced from feedstocks animal fats and used cooking oil) is to be supplied by Neste and will be blended with fossil fuel sourced aviation fuel from ExxonMobil refining facilities in Singapore, with the blended fuel then purchased from ExxonMobil, and delivered to Changi Airport using the existing fuel hydrant system.

[Neste](#) (see previous editions of Low Carbon Pulse, most recently **Edition 34** under **Work commences on Neste sustainable fuels production facility**) announced that it was working with ExxonMobil on the pilot program, noting the use of its Neste MY Sustainable Aviation Fuel. With the expansion of its Singapore refinery, by early 2023 the refinery will be able to produce and supply up to 1 million metric tonnes of **SAF** a year. In global terms, this is a significant increase in **SAF** supply capacity.

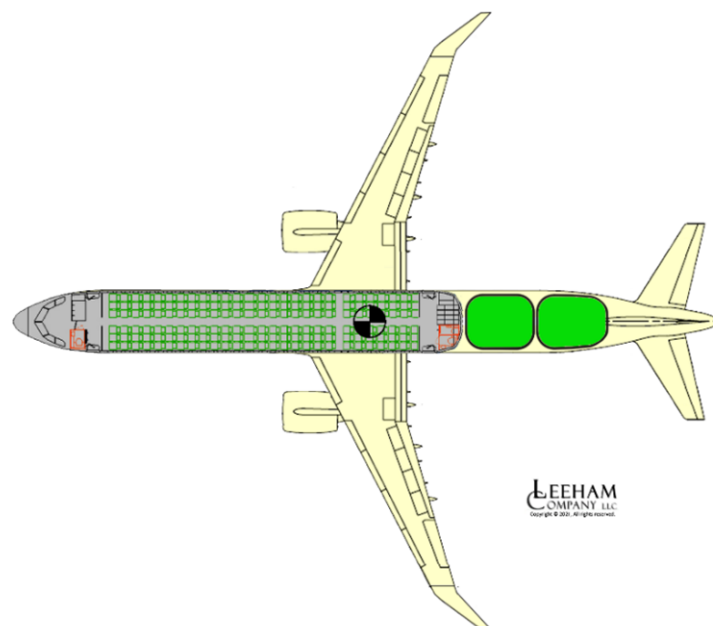
- **Neste flying high:**

- On February 11, 2022, [edie-net](#) reported that Virgin Atlantic had signed a supply arrangement with Neste and ExxonMobil for the supply of 2.5 million litres of **SAF**. The **SAF** is to be supplied during the first half of 2022.

- On February 16, 2022, [Neste](#) announced that Neste and Itochu Corporation had expanded their partnership to increase the availability of **SAF** in Japan. The expansion referred to in the announcement reflects that Neste, Itochu and All Nippon Airways established a **SAF** supply chain in 2020.

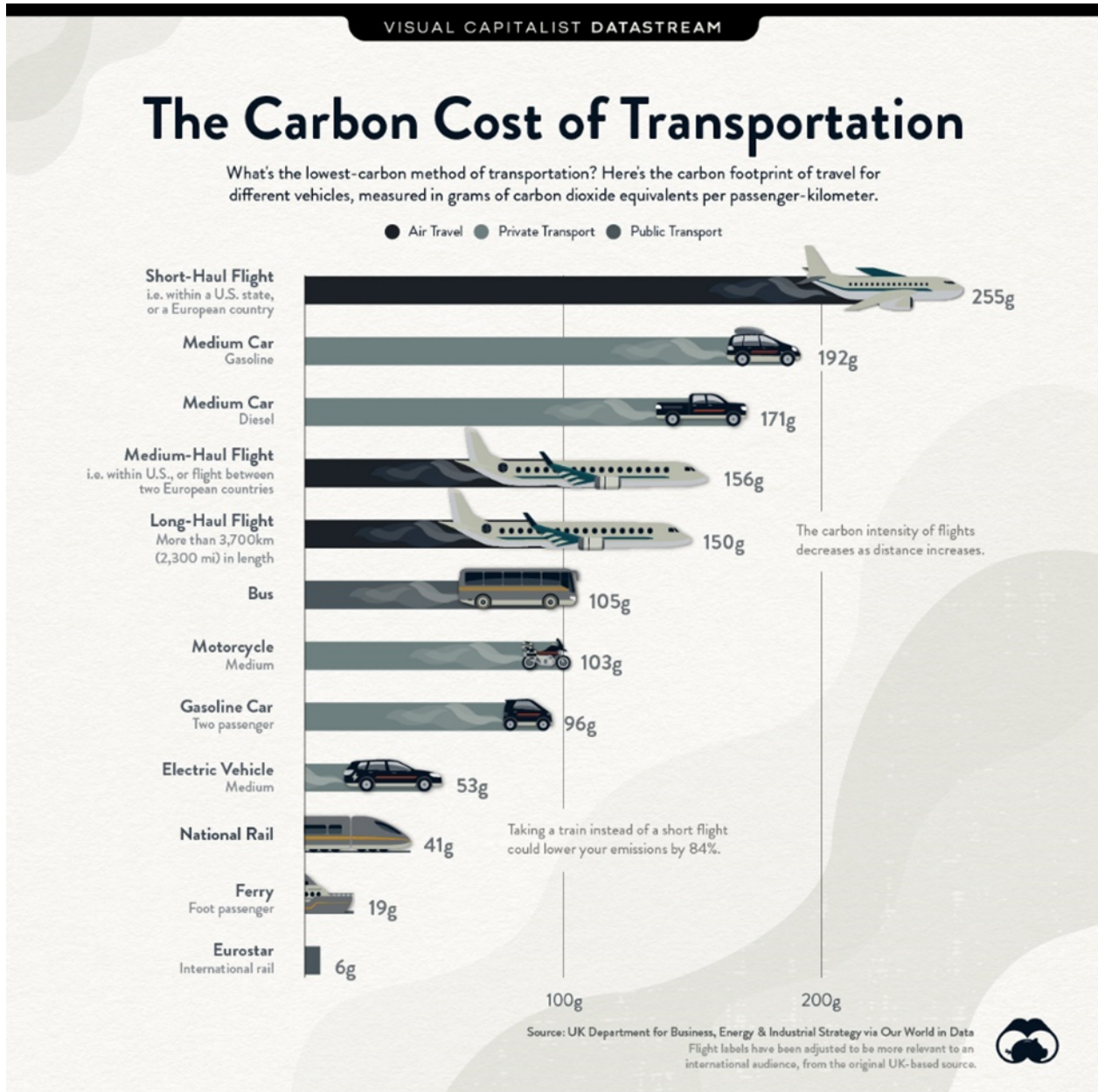
The announcement from Neste notes that by the end of 2023 it will have 1.5 million metric tonnes of production capacity by the end of 2023, including 1 million metric tonnes of capacity at its Singapore refinery.

- **Airbus moves Zero-e demonstrator:** On February 8, 2022, it was reported widely that Airbus plans to fly a hydrogen fuelled **Zero-e demonstrator** aircraft soon, possibly within February 2022.





- **Airbus moves again:** On February 15, 2022, it was reported widely that Airbus, Snam (Italian gas and infrastructure company) and SAVE (the group that manages Venice Airport) had signed memorandum of understanding for the purposes of promoting the use of hydrogen in the airport and aviation sector. Each of Airbus, Snam and SAVE have aligned aims in the reduction of **GHG** emissions arising from activities undertaken at airports. The promotion of the use of hydrogen is to commence at the Marco Polo Airport, Venice (managed by SAVE). It is expected that there will be particular focus on the design and engineering of infrastructure to store fuel and to fuel aircraft.
- **Shell SAF fast:** On February 17, 2022, [channelnewsasia.com](https://www.channelnewsasia.com) reported that Shell had supplied the first **SAF** to Singapore customers. Shell announced that it had: "... delivered [**SAF**] to ... customers as SIA Engineering Company and the Republic of Singapore Airforce".
- **The Carbon Cost of Transportation:** As regular readers of Low Carbon Pulse will know the author is a devotee of the work of the folks at the VisualCapitalist. The folk at the VisualCapitalist have produced another excellent infographic, this time on the Carbon Cost of Transportation.

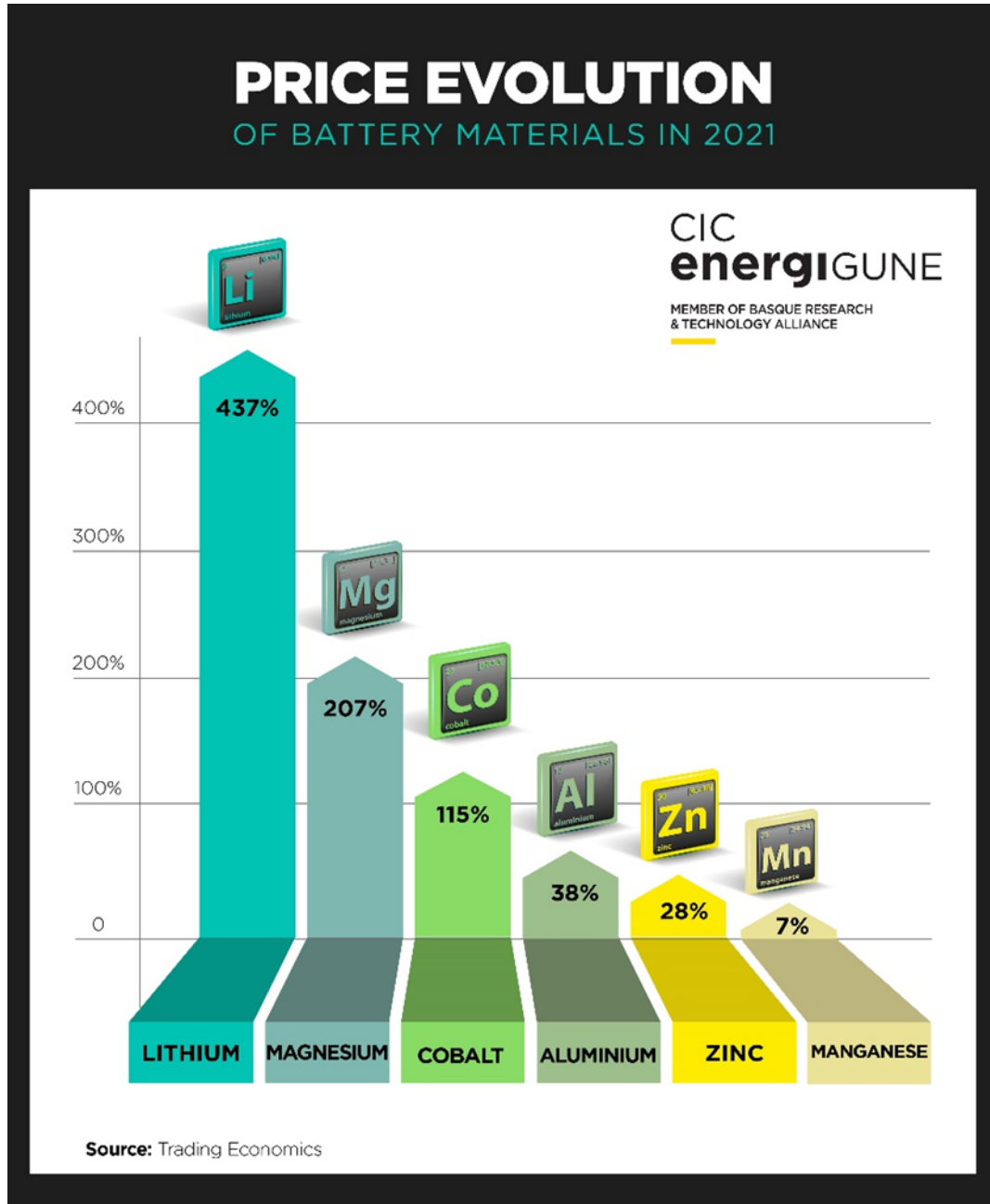




## Green Metals / Minerals, Mining and Difficult to Decarbonise Industries:

This section considers news items that have arisen within the news cycle of this **Edition 35** 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.

- **Metals and Minerals:** On February 8, 2022, or thereabouts, CICenergigune published an infographic headed Price Evolution, representing the shift in the price of metals and minerals key to the battery industry during 2021.



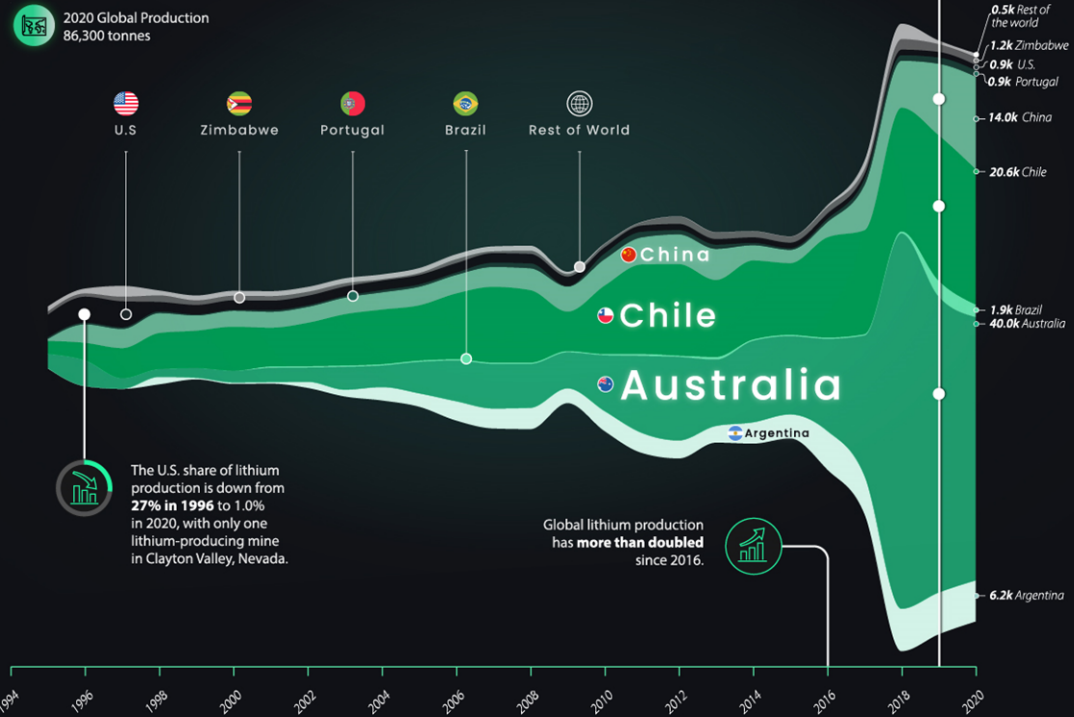
- **Lithium from the perspective of the VisualCapitalist:** On February 13, 2022, the author came across the following infographic conveying the proportion of world lithium production, by country.

# LITHIUM PRODUCTION BY COUNTRY 1995-2020

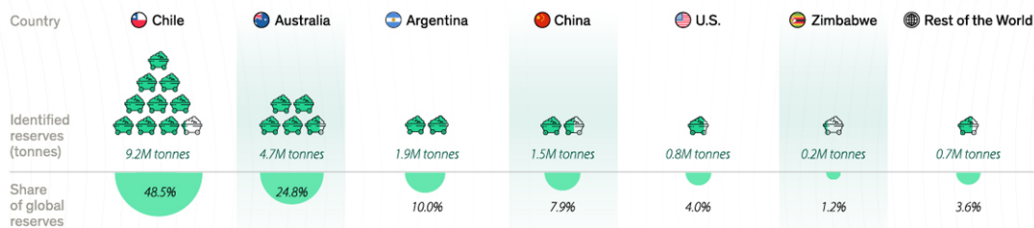
Increasing adoption of electric vehicles (EVs) and energy storage technologies has fueled a global boom in lithium production.

Here's a historical look at lithium production by country.

## Mine Production of Lithium (tonnes of lithium content)



## Distribution of Lithium Reserves



Countries like the U.S. need to ramp up domestic lithium production to support EV adoption, especially as demand increases.

Scotch Creek Ventures is developing two lithium mining projects in Clayton Valley, Nevada, to supply lithium for the green future.

SCOTCH CREEK  
VENTURES INC.  
LITHIUM EXPLORATION IN THE CLAYTON VALLEY

Click here to learn more about Scotch Creek Ventures

SCOTCH-CREEK.COM

CSE:SCV | FSE:7S2 | OTC:SCVFF



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## 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
IEA	<a href="#"><u>Electricity Market Report – January 2022</u></a>
IRENA and State Grid Corporation of China	<a href="#"><u>Smart Electrification with Renewables: Driving the transformation of energy services.</u></a>
National Oceanic and Atmospheric Administration (NOAA)	<a href="#"><u>2022 Sea Level Rise Technical Report</u></a>
One Ocean Summit	<a href="#"><u>Brest Commitments for the Oceans</u></a>
ScienceDirect	<a href="#"><u>Economic analysis of the early market of centralized photovoltaic parks in Sweden</u></a>
UK Government Department of Business, Energy and Industrial Strategy (DBEIS)	<a href="#"><u>Decarbonising heat in homes</u></a>
World Forum Offshore Wind (WFO)	<a href="#"><u>Global Offshore Wind Report 2021</u></a>

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