

# Low Carbon Pulse - Edition 27

## GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 27** of Low Carbon Pulse – sharing significant current news on progress towards net-zero greenhouse gas (**GHGs**) emissions globally. This edition covers the period from Monday September 6, 2021 to Sunday September 19, 2021 (inclusive of each day).

Please click [here](#) for **Edition 26** of Low Carbon Pulse. Please also click [here](#) and [here](#) for the first two articles in the **Shift to Hydrogen Series (S2H2): Elemental Change** series: the **S2H2** series provides a narrative and perspective on hydrogen generally. Please [click here](#) for the first feature in the **Hydrogen for Industry (H24I)**: the **H24I** features provide an industry by industry narrative and perspective.

The third and fourth articles in the **S2H2** series will be published before the end of October 2021. The third article will be on Hydrogen Plans, Roadmaps, and Strategies, and the fourth article will be on CCS / CCUS.

**Edition 27** of Low Carbon Pulse will be posted again on **September 24, 2021** for those reading later in the week, and will include the Report on Report for August 2021.

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### Progress to COP-26:

#### • Trending issues:

- **GHG emissions budget:** As noted in Edition [26](#) of Low Carbon Pulse, there is a real and ready understanding that it is going to be a challenge to peak and then to reduce **GHG** emissions so as to limit global temperature increase to 1.5°C above pre-industrial levels (what Low Carbon Pulse has called the **Stretch Goal**).
- **How long until we reach 1.5°C increase?** Edition [26](#) of Low Carbon Pulse, reported on the best estimates of how much longer we have until the carbon budget is exceeded and we reach a 1.5°C increase is reached (exceeding the **Stretch Goal**) or until we enter the 1.5°C to 2°C range (the **Stabilisation Goal**).

The [Sixth Assessment Report – Climate Change 2021, The Physical Science Basis \(2021 Report\)](#) suggests the **Stretch Goal** will be exceeded by 2040. Chief Economist of BloombergNEF, Mr Seb Henbest, has noted: "As soon as 2028, we will have exhausted the emissions budget to stay within 1.5°C of warming".

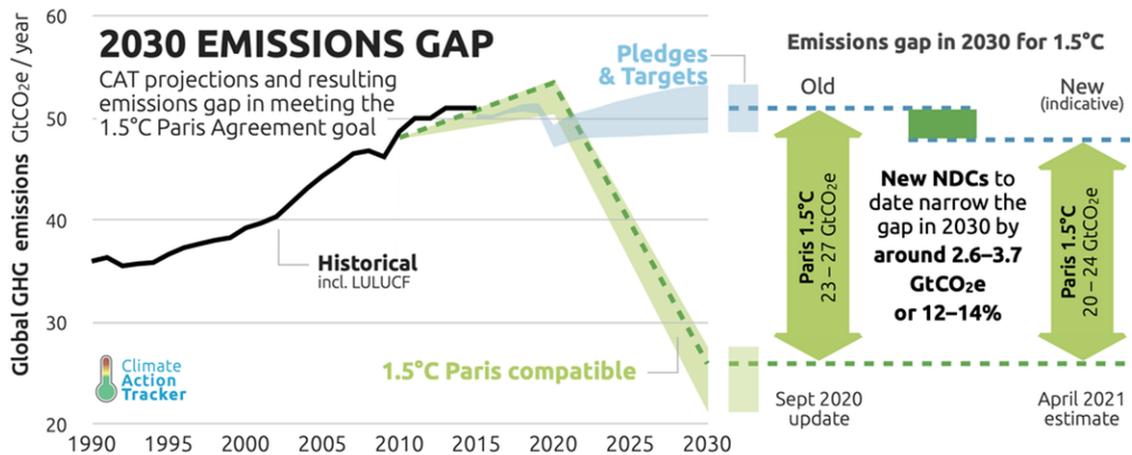
While the papers, reports and studies published tend to emphasise different points, and to focus on either the **Stretch Goal** or the **Stabilisation Goal**, there is a bandwidth of messaging, which is illustrated by two publications the appeared during the week beginning September 13, 2021: the achievement of the **Stretch Goal** is nearly out of reach, and the achievement of the **Stabilisation Goal** is "touch and go" at best.

#### – Climate Action Tracking:

- On September 15, 2021, Climate Action Tracker published a [paper \(CAT Paper\)](#) outlining whether the policy settings of sample countries (activities in those sample countries currently gives rise to 80% of global **GHG** emissions) were aligned with achieving the **Stretch Goal**.

While the sample size is limited to 37 countries, all twenty of the G20 countries were included in the sample.

Based on current policy settings, the **CAT Paper** finds that none of the G20 countries is on track to achieve the **Stretch Goal** (more accurately reductions so as to achieve its proportionate share of the **Stretch Goal** globally). This is not a surprise: even the UK (in many ways leading the way), recognises that more needs to be done, and at an increased rate. The **CAT Paper** supports the argument that the rate of **GHG** emission reductions needs to increase, and those increased reductions need to be acted on in the near term.



- On September 16, 2021, Nature magazine published an article entitled [Wave of net zero emission targets opens window to meeting the Paris Agreement](#). The sample size for the analysis undertaken for the purpose of the article was 131 countries (contrasted with the sample size of 37 for the **CAT Paper**, which countries cover 72% of current global **GHG** emissions). The headline from the article is that based on the implementation, in full, of current commitments to reduce **GHG** emissions, the best estimate of the global average temperature increase is 2°C to 2.4°C by 2100.

The estimates and findings of these recent publications emphasise that acceleration of **GHG** emission reductions is needed, including to lock-in a 45% reduction in GHG emissions by 2030, or even a 50% reduction. This would have a material and significant beneficial effect on the climate system and bring us back within the **Stabilisation Goal**, or, possibly, the **Stretch Goal**.

- Keep Tracking to Stretch Goal?** While not yet a fully-fledged debate, some analysts and commentators have raised whether the **Stretch Goal** should be adjusted on the basis that it may not be achieved, or, to some, cannot be united.

As analysts and commentators have worked out the scale of the task required to achieve the level of **GHG** emission reductions necessary to achieve the **Stretch Goal**, a number have questioned whether or not the scale of the task is achievable. For example, [Rystad Energy](#) has noted that the solar manufacturing industry needs to quadruple in size by 2035, so as to increase annual manufacturing capacity to 1.2 - 1.4 TW from the current manufacturing capacity of 330 GW.

While this is a valid policy debate to have, ultimately it is a debate better had about moving the **Stabilisation Goal** towards the **Stretch Goal** rather than the increasing the **Stretch Goal** to limit the global average temperature increase to say 1.7°C above pre-industrial levels.

The debate around achievability tends to focus on the need to increase the rate of extraction of raw materials to allow the renewable energy manufacturing sector to manufacture for installation the necessary renewable electrical energy equipment. During the week commencing September 13, 2021, a [Venn diagram](#) (see right) came to the attention of the author. It is a helpful reminder of the metals and minerals required.

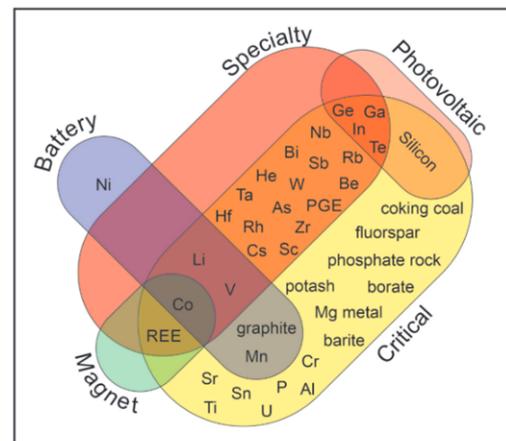


Figure 7. Examples of overlapping material categories. Terms 'battery', 'magnet', and 'photovoltaics' are used here in *sensu lato* (as used by industrial users, exploration companies, banks, and government organizations). For example, cobalt (Co) is currently considered as one of the speciality materials but may be referred to as a 'critical', 'battery', or 'magnet' metal.

Geoscience Canada: Volume 48, 2021, *Economic Geology Models 5. Speciality, Critical, Battery, Magnet and Photovoltaic Materials: Market Facts, Projections and Implications for Exploration and Development*

- Developments in CH<sub>4</sub> policy:**

- Background:** As noted in previous editions of Low Carbon Pulse, the rate at which the **GHG** emissions budget is being spent means that increased reductions in **GHG** emissions are required, promptly.

As noted in Edition 24 of Low Carbon Pulse, 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>**.

- **CH<sub>4</sub> avoidance is key:** As noted in Edition 26 (under **CH<sub>4</sub> fugitive emission avoidance and CO<sub>2</sub> capture key**) avoidance of **CH<sub>4</sub>** emissions is key in particular the avoidance of fugitive emissions:  
*"While there is more than 200 times more CO<sub>2</sub> than CH<sub>4</sub> at large in the climate system, and each CH<sub>4</sub> molecule remains in the climate system for an average of ten years (not hundreds of years), CH<sub>4</sub> molecules absorb and retain more radiative heat, which means that CH<sub>4</sub> can have up to 84 times the global warming potential of CO<sub>2</sub>.*

*This is why in recent Government to Government engagement and reports, there has been a focus on the reduction in CH<sub>4</sub> emissions: it is estimated that up to 57% of CH<sub>4</sub> could be reduced by 2030, reducing the impact on the climate system by 0.25°C by 2050, and 0.5°C by 2100."*

In this regard there was some good news during the week beginning September 13, 2021. The week started with news reports that the European Commission (**EC**) and the US were working to agree to reduce **CH<sub>4</sub>** emissions by 30% within the decade. While reductions in **CO<sub>2</sub>** are the long-game, the short-game of **CH<sub>4</sub>** emission reductions will result in a material and significant reduction in **GHG** emissions by 2030.

On September 17, 2021, the **EC** and US announced a pledge (the **Global Methane Pledge**), given jointly, to reduce **CH<sub>4</sub>** emissions by nearly a third within the next decade. 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.

**See:** [Joint EU-US Press Release on the Global Methane Pledge](#)

- **Good news feed needs to continue:** From all of the papers, reports and studies, one target emerges at the core of policy settings - the need to reduce **GHG** emissions by at least 45% by 2030 if the global climate system is to avoid the ever-increasingly serious impact of increased concentrations of **GHG** emissions. Unfortunately this target sits alongside trends that indicate an increase in **GHG** emissions of 15% by 2030.

This is one of the key policy settings to watch out for ahead of, during, and after, COP-26. The G-7 countries (Canada, France, Germany, Italy, Japan, the UK and the US) need to take a clear lead on this, with the remaining G-20 countries in tandem, both in terms of their own targets and in working with other countries.

World Trade and accompanying agreements globally need to reflect that policy settings that achieve reductions in **GHG** emissions are now key to cooperation, trust and sustainable trade. In the absence of this alignment, more Carbon Border Adjustment Mechanisms (**CBAMs**) are needed, and less state policy avoidance mechanisms (**SPAMs**). More **CBAMs**, less **SPAMs**.

- **High level observations on current high energy prices:** Global prices of natural gas (including LNG) have increased significantly of late, a function of gas markets, including spot prices. For example, Asian spot LNG prices are trading at ten times the prices seen in mid-2020, and Henry Hub gas prices reaching their highest level since 2014, with expectations of still higher prices as the Northern Hemisphere winter in Asia, Europe and the US approaches. The high energy prices (gas prices in particular) in Europe in particular have focussed attention on the need to run economies while at the same time decarbonising the generation of electricity essential for everyday activities.

It is not possible to detail each factor contributing to these high prices, but at its most basic the price of natural gas is a function of supply and demand. Over-time, and having already started, as international and national oil and gas companies respond to policy settings that reduce the benefit to them of exploration and new sources of production of natural gas, the supply side becomes constrained. At the moment more supply, including more reliable supply, is needed.

As noted below (under **We are not there yet ... !**), planning is required. Natural gas is different from coal, and has a role to play in transition. To provide sufficient supply, certainty of demand is required. The more certainty there is around demand, the more certainty there will be around supply, including the development of new sources. This is an area where pragmatism is required in policy settings, including from policy banks.

## • Roles to be played to reduce **GHG** emissions:

As foreshadowed in previous editions of Low Carbon Pulse, ahead of COP-26, current and relevant matters will be considered in Low Carbon Pulse, including the roles of Governments and institutions, and policy settings.

This Edition 27 of Low Carbon Pulse covers the roles of Policy Banks and Carbon Credits / Permits in the context of reductions in **GHG** emissions generally and **NZE** specifically, and the role of Government in the context of the development, in tandem, of supply and demand for hydrogen and hydrogen-based fuels. These are significant matters, which are considered over the next three pages or so, if only to scratch the surface.

### - **A role for Policy Banks:**

- **Background:** Policy Banks are distinct from Central Banks and Commercial Banks. Policy Banks provide funding support to assist the development objectives of areas and countries of the world that need that support, and in the absence of which development would not occur or would occur slowly and less soundly, and more recently in areas and countries to support decarbonisation initiatives.
- **Possible future role for Policy Banks:** Edition 25 of Low Carbon Pulse outlined the "acquire to retire" program proposed by the Asian Development Bank (**ADB**) aimed at acquiring, and then retiring, coal-fired power stations in Asia Pacific to reduce **GHG** emissions, in particular to acquire and to retire less efficient coal-fired power stations. The "acquire to retire" program has received considerable attention, and it is expected that further details of the program will be described and explained at COP-26.

The "acquire to retire" program illustrates an ideal role for a Policy Bank, in particular if accompanied by a staged and realistic program for the development of electrical energy generation to replace the retired coal-fired capacity. If the "acquire to retire" program progresses in this way it will be a good thing.

In terms of the form, substance and timing of any progress of the "acquire to retire" program, it is important to recognise the role that Policy Banks have in supporting renewable energy projects, and that this role needs to increase. Further, in the context of the "acquire to retire" program this may result in bypassing the use of natural gas, and move straight to renewable electrical energy outcomes.

- **Scrutiny and Criticism:** As is the case with Central Banks, narratives have emerged around the role of Policy Banks, including direct and indirect criticism of the role that policy banks have played in funding fossil fuel developments in the past, and are playing, or not playing, currently in the context of progress towards achieving **NZE**.

Clearly, the "acquire to retire" program would be a good thing on the basis that retirement is coordinated with lower, low or no carbon generation capacity, or more likely a mix of all three. For countries with low or lower rates of electrification, there is a balance to be struck between avoiding the development of coal-fired power stations, and yet increasing rates of electrification and electricity system development and integrity and stability as increased renewable energy is connected to the system. Depending on the source used, it is estimated that between 0.8 billion and 1.2 billion people globally do not have access to electricity.

- Policy **Banks have had a role in reduced investment in coal-fired power generation:** It should be noted that while some Policy Banks have continued to provide funding support for coal-fired power generation development, over the last five years or so, since the Paris Agreement, the level of funding support has reduced, contributing, at least in part, to fewer coal-fired power generation developments.

A recent [report](#) from E3G, Global Energy Monitor and Ember published on September 13, 2021, reports that: "*Only five years ago, there were so many new coal power plants planned to be built, but most of these have now been either officially halted, or paused and unlikely ever to be built*".

Consistent with other reporting in Low Carbon Pulse, Associate Director of E3G, Mr Chris Littlecott says: "*increasingly [coal-fired power generation is] uncompetitive in comparison to renewable energy, while the risk of stranded assets has increased*". The risk of stranded assets is already a risk being realised in a number of developed economies.

- **Clear mandates:** While there is a debate around the investment mandate of Policy Banks in facilitating progress towards achieving **NZE**, it is important to understand that the investment mandates of Policy Banks are a function of the policies of the countries that provide funding to the Policy Banks.

- **A role for Carbon Credits / Permits:** Previous editions of Low Carbon Pulse have considered matters relevant to Carbon Credits / Permits; these are not repeated here.

- **Current Framework for Policy Settings:** In some ways what follows is closer to opinion than is typical in Low Carbon Pulse, and reflects the perspective of the author from a policy setting perspective.

The intention of this editorial is to frame thinking around Carbon Credits / Permits in the context of COP-26, critically, to ensure that thinking is focussed on the core of the Paris Agreement objectives and how to achieve them, and over time the removal of obstacles to their achievement:

- the decarbonization of activities giving rise to **GHG** emissions – the means to achieving the **Stabilisation Goal** or the **Stretch Goal** in Article 2; and
- the removal of **GHG** emissions from the climate system (referred to by many as **Carbon Dioxide Removal** or **CDR**), by the use of negative **GHG** emission initiatives (**NGHGs**) – a means to achieving reductions under Article 4.

#### CORE OBJECTIVES OF THE PARIS AGREEMENT

##### Article 2:

(a) Holding the increase in global average temperatures to well below 2°C [**Stabilisation Goal**] above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C [**Stretch Goal**] above pre-industrial levels, recognising that this would significantly reduce the risk and impacts of climate change.

##### Article 4:

In order to achieve the long-term temperature goal set in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, ... and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals to sinks in greenhouse gas in the second half of this century ...

**Note on Article 4:** Article 4 contemplates "*peaking of greenhouse gas emissions as soon as possible and to undertake rapid reductions thereafter*". This should not be read to preclude removal of **CO<sub>2</sub>** (to sinks) to achieve reductions before peaking or before achievement of **NZE**, in particular to preclude use of **NGHGs** at any time.

- **Achievement of these objectives:** If these objectives are to be achieved, value needs to be ascribed to **NGHGs** globally, outside any existing Carbon Credit / Permit regime (through **NGHGs Value Certificates** or **NVCs**). Any **NVC Regime** should be global, placing value on absolute **CDR**, rather than net-**CDR**.

To achieve this, any **NVC Regime** should be "ring-fenced" to ensure that absolute **GHG** emission removal initiatives do give rise to Carbon Credits / Permits that can be used to off-set **CO<sub>2</sub>** emissions arising from activities that continue to be undertaken rather than being decarbonised. This approach will maintain and underpin the integrity of the objective of the Paris Agreement, and accelerate **NGHGs**. Any **NVC Regime** should be funded by G20 countries, and any other country that wants to participate.

In the thinking of some (it has to be said based on the wording of Article 4 of the Paris Agreement to some extent), **NGHGs** are to be undertaken following the achievement of **NZE**. From a policy and scientific perspective, it is not possible to conclude that this is a logical or sustainable position, nor, it has to be said, from an interpretive perspective. While the Paris Agreement calls for the achievement of "*a balance*"

between anthropogenic emissions by sources and removals to sinks in greenhouse gas in the second half of this century" there is a need to "cut-through" this – there is a need for **NGHGs** to commence now, and **NGHGs** should be a top three agenda item at COP-26.

- **Policy Settings need to be brought into absolute alignment:** It is acknowledged that this is easily said, and difficult to do. This is why it should be a top three agenda item at COP-26. While easily said, it is not said often enough. The reason for this may be that thinking has been clouded with the passage of time: the thinking that informed the development and use Carbon Credits / Permits was to put a price on carbon so as to encourage and over time, effectively, to force adoption of lower, low and no carbon.

In a number of countries, policy settings embraced the use of Carbon Credits / Permits to support what may be referred to as notional reductions in **GHG** emissions so as to be able to be counted towards the achievement of **GHG** emission reduction targets through the use of sequestration and sink schemes (**Sink Schemes**).

There is nothing wrong with **Sink Schemes** that are sustainable and that achieve verifiable capture and storage of **GHG** emissions on a "permanent" basis.

The challenge with **Sink Schemes** is that many of them are neither sustainable nor are the reductions in emissions verifiable, and a good number of them are susceptible to climate change itself, most obviously **Sink Schemes** based on the development of forests. More than this, the activities that give rise to **GHG** emissions continue.

**Policy setting to the practical:** Providers of debt and equity in financial markets increasingly expect **NZE** plans and overtime, they will be mandated. It is increasingly likely that the use of Carbon Credits / Permits under **Sink Schemes** will be scrutinised more closely, including whether or not the use of Carbon Credits / Permits from **Sink Schemes** is part of a transition to decarbonisation or a means to avoid or to postpone decarbonisation of activities, and the risks associated with avoidance and postponement strategies. This is why financial markets are looking closely at these Carbon Credits / Permits, and this explains why exchanges (like the global carbon exchange in Singapore, Climate Impact X or CIX) are looking for "high-quality carbon-credits to address hard-to-abate emissions (see Edition [18](#) of Low Carbon Pulse, and Editions [16](#), [19](#) and [20](#)).

- **Sink Schemes become NGHGs:** In any event, from a policy setting perspective **Sink Schemes** should continue, effectively becoming **NGHGs** over time for so long as they remove **CO<sub>2</sub>** from the climate system, but the ability to use Carbon Credits / Permits to off-set mandatory or voluntary **GHG** reduction targets should have a shelf-life, being a shelf-life that is aligned with the adoption of lower, low or no carbon consistent with **NZE** based on activities undertaken that are described as carbon neutral.
- **Application of Article 6 of the Paris Agreement:** On a related issue, there is debate about the application of Article 6 of the Paris Agreement (allowing voluntary cooperation initiatives (**VCIs**)), in particular whether the use of voluntary Carbon Credit / Permits arising under **VCIs** should be counted towards the achievement of the nationally determined contributions (**NDCs**) of the country in which the **GHG** emission reduction arises or the country in which the Carbon Credit / Permit is used to off-set **GHG** emissions, or in both countries.
- As a matter of principle, it is clear that the use of any Carbon Credit / Permit to off-set **GHG** emissions does not result in an absolute reduction in **GHG** emissions, and as such there is a strong argument for not counting it towards the achievement of any **NDC**. If to be counted towards the achievement of any **NDC**, it should be the country in which the **GHG** emission reduction arose, not in the country in which it is used to off-set **GHG** emissions. It will be interesting to see how this debate develops and, ultimately, how it is resolved. Future editions of Low Carbon Pulse will report on this.

#### – **A role for Government in the development of supply and demand for hydrogen:**

- **With NGHGI a top three agenda item:** Edition [26](#) of Low Carbon Pulse reported on an excellent [opinion piece](#) from Wood Mackenzie. The opinion piece noted that COP-26 will be the acid test for the development of hydrogen (and hydrogen-based fuels) as part of the pathway to decarbonisation and progress to achieving **NZE**.

The Wood Mackenzie opinion piece notes that COP-26: "*must go far beyond setting new emissions targets. Ensuring that hydrogen is not just a "fuel for the future", but a fuel that needs to be ... implemented into global society from today [and] should be top of the agenda*".

- **Government needed to guide to achieve timely development:** Edition [26](#) of Low Carbon Pulse noted that it is difficult to overstate the need for Government involvement in the development of renewable electrical energy capacity to allow the development of Green Hydrogen capacity as soon as possible.

At the core of the development of the hydrogen economy in any country is the central (both establishing and sustaining) challenge of the development of supply and demand for Green Hydrogen in tandem.

The key elements for the development of the supply side for Green Hydrogen are the:

- quantity of renewable electrical energy needed, and, unless off-shore wind field capacity is to be used, the related matter of land and the location of that land;
- mass of water required, and its sources and its storage, and how the sources are best realised, delivered and stored, and how associated infrastructure is best developed and funded;
- use of fresh water sources and the use of osmosis to desalinate saltwater, and the sources are balanced with activities / business as usual for each sector of the economy;
- development of electrolyser technology and transportation technology; and

- o price of Green Hydrogen, including any role for the Government as a wholesale buyer of Green Hydrogen in the near to medium term.
- o **Coordination is needed at country level and globally:** Editions [25](#) and [26](#) of Low Carbon Pulse have outlined the role that the German government is taking in the development of the supply side for Green Hydrogen. The German model is to be commended in the highest terms, and it is likely that globally the benefit of the work being done in Germany will be leveraged with German developed technology playing a key role in the development of the Green Hydrogen economy.

Among other things, Edition 28 of Low Carbon Pulse will cover **trending issues** and consider the role of bioenergy and CCS / CCUS, including the role of Government, critically to facilitate the production of Blue Hydrogen.

## Climate change reported and explained:

- **NOAA news:** Each month the US National Oceanic and Atmospheric Administration (**NOAA**), among other things, reports on findings for the previous month. In the second edition of Low Carbon Pulse each month, we will cover the latest data from the **NOAA** report for the previous month.

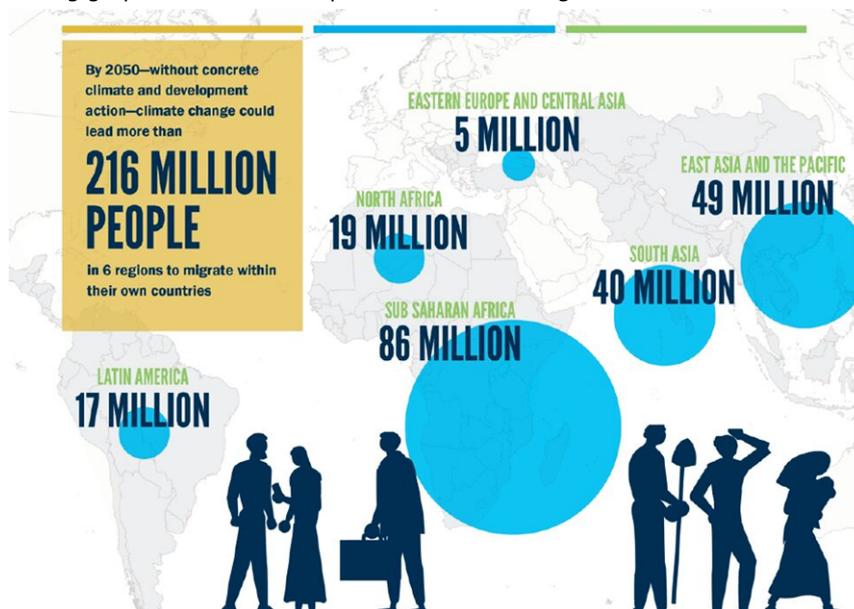
During the metrological summer (June, July and August) of 2021 in the US:

- the temperatures were:
  - o 2.6°F (or 0.8°C) above the average for the 20th century; and
  - o the hottest ever, and as such hotter (by 0.01°F or 0.018 °C) than the Dust Bowl Summer in 1936;
- the rate of temperature increase was greater than had been anticipated in previous modelling;
- 18% of the 48 contiguous States experienced their hottest average summer temperatures; and
- California, Idaho, Nevada, Oregon and Utah experienced their hottest average summer temperatures, and 16 other States experienced temperatures within their top five hottest summer temperatures.

The **NOAA** August [report](#) notes that August 2021: "*brought Hurricane Ida, numerous wildfires and floods, capping off a summer of record heat and rainfall for many states throughout the [US]*". As reported in Edition [25](#) of Low Carbon Pulse, the **NOAA** [report](#) for July 2021, reported that it was the hottest month recorded since records began 142 years ago.

As a straight-talking Texan known to the author said: "*When it rains, it rains too much, when it's hot, it's really hot, too hot. Y'all can deny the reason for it, but not the fact of it*". The reasons are known.

- **World Bank Report:** During the week commencing September 13, 2021, a number of news items reported that by 2050 up to 216 million people may be forced to migrate globally as a result of the effects of climate change. This news items has picked up on the conclusion of the second part of the [Groundswell report](#) from the World Bank. The following graphic illustrates the possible source of migration.



- **Weather Hazards Map:** Space does not permit consideration of all of the Northern Hemisphere summer weather hazards and extreme weather and extreme weather events. To provide a high-level summary, please view this [link](#) for a map indicating weather hazards for the Northern Hemisphere during the summer of 2021.
- **Extreme weather and extreme weather events:** Edition 26 of Low Carbon Pulse reflected on reporting of climate change, in particular the use of "extreme weather event". In the light of recent extreme weather, and extreme weather events, what is clear is that the private and the public sector are having to get to grips with how to adapt to the effects of climate change, however they may be described.

Edition 28 of Low Carbon Pulse will consider the ways in which countries and areas within countries are adapting to the effects of climate change, and the medium to long term consequences of adaptation by reference to the Paris Agreement and the **2021 Report**.

## Visualisation Platforms and Tools:

- **ENTSOG Visualisation Platform:** On September 13, 2021, **ENTSOG** (the **European Network of Transmission System Operators for Gas**) launched its Europe wide visualisation [platform](#) for hydrogen projects along transmission lines, aka value chains. The platform is a great tool, detailing hydrogen projects of all kinds across Europe (greenfield and brownfield), and accompanying data.
- **Dairy and Meat Emissions:** On September 8, 2021, EcoWatch (Ohio, US based, long-time leader in science derived reporting on environmental issues) published a [graphic](#) and [article](#) detailing the **GHG** emissions arising from the activities of the five largest dairy and meat producers globally.
- **Food System gives rise > 30% of anthropogenic GHG emissions:** On September 13, 2021, a [study](#) was released that suggested that the food system (including production, processing transportation and disposal of waste), gives rise to about 35% of global **GHG** emissions. Nine crops provide 75% of the calories consumed by humans, maize, rice and wheat (50%), with the balance from barley, palm oil, potatoes, soy and sugar.  
It will not be a surprise that the study finds the **GHG** emissions arising from animal-based food production is twice that of **GHG** emissions arising from plant-based food production. While not a surprise, what this finding illustrates is that it is necessary to find a solution to **GHG** emissions arising from the food system in its entirety, with the focus on reduction across the food system.
- **Industrial heat close to 30% of final energy demand:** On September 13, 2021, BloombergNEF and the World Business Council for Sustainable Development published a helpful [report](#) outlining the current levels of global energy demand arising from industrial heat use, and which of the G20 countries may be regarded as the leading countries, in the sense of being able best to respond to that demand by deployment of low carbon solutions.

The leading countries for these purposes are listed as the PRC, France, Italy, Germany, South Africa and the UK. There is a helpful [map](#) in the report comparing these leading countries to other G20 countries.

## AFOLU GHG emission reductions and waste to biofuels:

Future editions of Low Carbon Pulse will report on, and consider, **GHG** emissions arising from agriculture, forestry and other land use (**AFOLU**), and the food system generally. The role of **BECCS** and **BECCUS** (bioenergy carbon capture and storage, and bioenergy carbon captured use and storage) will be considered in detail, and how **AFOLU** waste, and waste arising from the food system can be used as a feedstock to produce biofuels.

At the moment, the reduction of the **GHG** emissions arising from **AFOLU** activities and the food system may be regarded as the most difficult to address as a front-end issue, but addressing **GHG** emissions arising from these sectors as a back-end issue (through processing waste) will realise **GHG** emission reduction benefits, because most of the **GHG** emissions from **AFOLU**, and the food system and waste, are **CH<sub>4</sub>**.

This said, it is important to recognise the need to achieve balance in the use of nitrogen in fertiliser (**NH<sub>3</sub>**), with over 100 mtpa of nitrogen applied annually. The dynamics in the application of nitrogen are considered in a recent [study](#) from the International Institute for Applied Systems Analysis, Wageningen University, The Netherlands, and Zhejiang University, China.

(To provide some background, links are attached to publications written by members of the Global Ashurst Towards Zero Emissions team. See: [Aerobic and Anaerobic digestion waste projects](#); [Fuel and Feedstock Resource Recovery – Energy Carrier from Waste](#); [Hydrogen for Industry](#).)

## Global Carbon Levy:

- **Background:** It is estimated that between 2% to 3% of global anthropogenic **GHG** emissions arising annually arise from the activities of the shipping industry (the estimates vary between 1.8% and 3%).  
As reported in Edition [16](#) of Low Carbon Pulse, there is a level of consensus across the shipping industry of the need to decarbonise the shipping industry. The issue is how best to do this.  
Edition [19](#) of Low Carbon Pulse (under **Global Maritime Forum**) reported on the progress of the shipping industry towards decarbonisation, including the aim of "achieving zero-emission vessels as the dominant and competitive choice by the end of the [current] decade", and the initiatives of some countries and economic blocs to achieve this outcome.  
Edition [22](#) of Low Carbon Pulse reported on the proposed extension to the European Union Emission Trading Scheme (**EU ETS**) to cover shipping trade to and from **EU** member states.  
Edition [22](#) noted the reaction of Maersk McKinney Moller Center for Zero Carbon Shipping (the epitome of balance and good sense) to the proposed extension of the **EU ETS**: "The [**EC's**] proposal to accelerate the decarbonisation of shipping is an important first step towards the introduction of Market Based Measures [**MBM**]. As long as global consensus on [**MBM**] is not within reach, the [**EU**] should take the lead. In a parallel track, the **EU** and other maritime stakeholders should continue to encourage IMO regulation on global maritime **MBM**. Shipping is global by nature and needs global regulation to avoid multiple charges".  
On September 13, 2021, the UK Government "nailed its colours to the mast", proposing to "chart a course" to achieve **NZE** across the shipping industry by 2050.  
The introduction of a truly global carbon levy would be significant, and for this reason the next two pages are devoted to it, not least because the devil will be in the detail, critically the price point, and its application.
- **Global Carbon Levy proposed:** On September 13, 2021, the International Chamber of Shipping (**ICS**) proposed the introduction of a global levy on **GHG** emissions from shipping activities (**ICS Proposal**). On September 13, 2021, **ICS** issued [press release](#) in respect of the **ICS Proposal**.

The **ICS** is the representative organisation for the national ship-owning associations (with over 80% of the global merchant shipping fleet members of those associations). The **ICS Proposal** was provided to the International Maritime Organisation (**IMO**) during the week ending September 12, 2021. The **ICS Proposal** would be mandatory in respect of vessels trading globally having gross tonnage exceeding 5,000 tonnes. The amount of the global levy would provide funding for the **IMO Climate Fund**.

It is not difficult to deduce the cause and effect of the proposed extension of the **EU ETS** to the **ICS Proposal**. The **ICS** press release addresses the interface between the two proposed policy settings: "*ICS believes that a mandatory global levy based **MBM** is strongly preferable over any unilateral, regional application of **MBMs** to international shipping, such as that proposed by the European Commissions which wishes to extend the [**EU ETS**] to international shipping*".

The interface between the two proposed policy settings is a matter for discussion (possibly at COP-26).

If the price point for the global carbon levy (**Global Carbon Levy**) proposed by the **ICS** is:

- equal to, or is greater than, the price point achieved by the extension of the **EU ETS**, the **EC** may be regarded as likely to allow the **Global Carbon Levy** to prevail because there will be an alignment on the required outcome from the policy setting; or
- less than the price point achieved by the extension of the **EU ETS**, the **EC** may regard this as likely to result in carbon-leakage, and as such not achieve the broader outcomes that it is seeking to achieve.
- **Book-ending with balance and good sense:** Just as the Maersk McKinney Moller Center for Zero Carbon Shipping welcomed the extension of the **EU ETS** (in the absence of global maritime **MBM** to price carbon), it welcomed the **ICS Proposal**, picking up on the (all-important) price point in the second sentence: "*Global regulation is a critical driver of the transition towards zero carbon shipping and essential to close the price gap between fossil fuels and zero carbon fuels. As a next step, we need a firm carbon price to enable timely transition*".
- **Global bunker build out:** The **IMO Climate Fund** would be used to fund the development and deployment of bunkering equipment and infrastructure for lower, low and no carbon hydrogen and hydrogen-based fuels (including ammonia and methanol). This reflects the desire of the **ICS** to ensure that equipment and infrastructure is developed and deployed as widely as possible.

The **ICS Proposal** is significant because of the:

- acceptance of a new cost, the **Global Carbon Levy**;
- acceptance that the **IMO Climate Fund** is to be used to develop and deploy new bunker equipment and infrastructure; and
- most significantly, acceptance of the need to replace or to refurbish existing fleet so as to switch to lower, low or no carbon fuels.
- **Global fleet replacement / refurbishment:** As noted in Edition 26 of Low Carbon Pulse, as is the case with all sectors of the transport industry, a decision needs to be taken as to when to invest in new fleet, and when to refurbish and retire existing fleet. These decisions may be regarded as pressing for the merchant shipping industry. The **ICS Proposal** will place increased purpose on decisions to replace and to refurbish fleets.
- **Giant signal to lower, low and no carbon supply side:** The **ICS** press release notes the need for the supply side for lower, low and no carbon fuels to develop.

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

- **The form and application of the Global Carbon Levy will shape supply and demand:** As noted by the Maersk McKinney Moller Center for Zero Carbon Shipping, the next step is a "*firm carbon price*".

The key feature of the Global Carbon Levy will be that "*firm carbon price*" and whether it is payable in respect of any fuel that is not a "*zero carbon fuel*". It would seem more likely than not that the **Global Carbon Levy** will recognise fuels in respect of which it is payable, and fuels in respect of which it is not payable, and in respect of which variable rates may be payable.

The sooner the amount of the "*firm carbon price*", and its application, is clear, the better, assuming, of course, that the price point encourages (or the price points encourage) lower, low, and no carbon fuel usage. Also, the form and application may encourage progress overtime to "*zero carbon fuel*". Carbon neutral fuel contains carbon, with any **CO<sub>2</sub>** arising on use being balanced / matched by the growth of renewable resources from which that fuel was derived and produced notionally to absorb the **CO<sub>2</sub>** arising on its use, or **CO<sub>2</sub>** or **N<sub>2</sub>O** is captured.

(While some abatement measures naturally lead to a gross reduction in **GHG** emissions, some do not, for example, the use of organic matter to derive or to produce biofuels and biogases, and the ultimate use of those biofuels or biogases will not. As such, for these reductions to be achieved, any **GHG** emissions arising in deriving or producing biofuels or biogases need to be captured. The capture of the life-cycle of **CH<sub>4</sub>** is achievable, at least in the context of deriving biofuel and biogases from organic matter.)

- **Current spread of lower, low and no carbon / nitrogen fuels:** At the moment ammonia (**NH<sub>3</sub>**) and LNG (predominantly **CH<sub>4</sub>**) are regarded as being the most prospective for the purpose of powering and propelling vessels, noting however that in the absence of matching off-sets, LNG (while a lower carbon fuel than heavy fuel oil) is less likely other fuels to be exempt from the **Global Carbon Levy**.

As noted in Edition 26 of Low Carbon Pulse, methanol (**CO<sub>3</sub>OH**) is a viable lower or low carbon fuel. The decision by AP Moller – Maersk to order eight dual fuel container vessels appears to have increased interest in methanol as a bunker fuel, and the size of the potential demand for methanol is as yet unmatched by supply. On a rough and ready basis, eight container vessels will have an annual demand of between 300,000 and 360,000 metric

tonnes a year. For a "deeper dive" see the S&P Global feature from September 16, 2021 - **Methanol bunkers in the limelight after Maersk's latest ship orders.**

Ammonia and methanol may be regarded as more than likely to be exempt from, or subject to a lower **Global Carbon Levy** rate, than LNG. Also both ammonia and methanol are existing chemical commodities with existing laws and regulations (and standards) covering production, storage and transportation, and proven means of compression / pressurisation and refrigeration (in the case of ammonia).

As will be apparent from the above narrative, biofuels and biogas are often derived and produced from **CH<sub>4</sub>** intensive sources, and on oxidation those biofuels and biogases give rise to **CO<sub>2</sub>** (or **N<sub>2</sub>O** if ammonia).

• **A reminder of the dynamics:**

– **If carbon or nitrogen atoms are present, GHG emissions will arise on oxidation:** It is important to note that on oxidation, neither ammonia nor methanol derived or produced from any source (or whatever the colour code) are **GHG** emission free: ammonia gives rise to **N<sub>2</sub>O** and methanol gives rise to **CO<sub>2</sub>** on oxidation.

– **Green Hydrogen is a no GHG emissions fuel:** Green Hydrogen is the only fuel that does not give rise to **GHG** emissions on production or oxidation (it contains no carbon atoms). As such, Green Hydrogen may be regarded as an ideal fuel, but its energy density is lower than both ammonia and methanol.

As noted in [How Hydrogen Can Help Decarbonise the Maritime Sector \(HE FF Paper\)](#) from Hydrogen Europe, one of the three factors around the choice of fuel is energy density. The other two factors (in the **HE FF Paper**) are: availability and security of supply and **GHG** emission neutrality "from well to wake". "From well to wake" describes the source of the feedstock for the production of that applicable fuel (well) to the result of the use of that fuel (the wake of the vessel).

(For completeness, Green Ammonia does not give rise to **GHG** emissions on production, but does give rise to **N<sub>2</sub>O** on oxidation (see Edition 25 of Low Carbon Pulse).)

– **Lower, Low and No GHG emission fuels:** By way of a reminder, the following table describes each relevant hydrogen and hydrogen-based fuel.

BIOENERGY / HYDROGEN-BASED FUEL TERMINOLOGY	
<b>Bioenergy:</b> energy derived or produced from biogas or biomass, whether in gaseous, liquid or solid form	<b>Biofuel:</b> a subset of Bioenergy, being any energy carrier that is derived or produced from biogas or biomass for use as a fuel
<b>Biogas:</b> a mixture of <b>CH<sub>4</sub></b> and <b>CO<sub>2</sub></b> (and trace elements of other gases), arising from the decomposition of organic matter, including derived or produced from anaerobic digestion	<b>Biomethane</b> (or Renewable Natural Gas ( <b>RNG</b> )): <b>CH<sub>4</sub></b> in near pure form, derived or produced from upgrading <b>Biogas</b> or gasification of biomass. Biogas and Biomethane are Biogases
<b>E-Fuel</b> (or electro-fuels): any energy carrier that is derived or produced using renewable electrical energy, incl. energy carriers derived and produced from renewable and non-renewable sources, including each of the <b>E-Fuels</b>	<b>E-Fuels:</b> include <b>E-diesel</b> , <b>E-kerosene</b> , <b>E-LNG</b> , <b>E-methanol</b> the derivation or production of each of which requires the synthesis of <b>H<sub>2</sub></b> with <b>CO<sub>2</sub></b> (hence synthetic fuel). <b>E-Ammonia</b> requires the synthesis of <b>H<sub>2</sub></b> with <b>N</b>
<b>Ammonia</b> compound of <b>H<sub>2</sub></b> with <b>N</b> ( <b>NH<sub>3</sub></b> ) that can be used in direct combustion, in fuel cells to derive electrical energy, or as a medium to carry hydrogen	<b>Methanol</b> (methyl alcohol) is a compound of carbon, hydrogen and oxygen ( <b>CH<sub>3</sub>OH</b> ) that can be used in direct combustion to power and to propel vehicles and vessels

**GCC counties update:**

• **ADNOC Group, bp and Masdar align:** On September 16, 2021, it was reported widely that ADNOC Group (leading national oil company), BP (leading international energy corporation) and Masdar (Abu Dhabi Future Energy Company) entered into framework agreements. It is understood that the framework agreements provide the basis for the development of two clean hydrogen hubs, each of 1 GW, one in the UAE, the other in the UK.

The framework agreements reflect the clear commitment of ADNOC Group and Masdar to the "[Principles of the 50](#)" and the commitment of BP to progress to **NZE** and the achievement of its objectives in respect of the Net-Zero Teesside project (see Edition 23 of Low Carbon Pulse). The development of the 1 GW Blue Hydrogen facility on Teesside (**H<sub>2</sub> Teesside**) will be facilitated by the investment of ADNOC Group and Masdar.

**See:** [bp, ADNOC and Masdar to form strategic partnership to provide clean energy solutions for UK and UAE; ADNOC, bp and Masdar agree to expand UAE-UK new energy partnership; ADNOC, bp and Masdar agree to expand UAE-UK new energy partnership](#)

• **ENI and Mubadala Petroleum align:** On September 8, 2021, it was reported widely that Eni (leading international energy corporation) and Mubadala Petroleum (a wholly-owned subsidiary of Mubadala Investment Company) signed a memorandum of understanding (**MoU**) outlining the basis for cooperation in respect of potential opportunities in the Middle East, North Africa, and South East Asia, and Europe, and other regions of mutual interest.

The **MoU** is intended to identify opportunities in respect of energy transition, including CCS / CCUS, hydrogen production projects and REDD + initiatives (**REDD** being an acronym **Reducing Emissions from Deforestation and Forest Degradation**), and as those opportunities are developed to allow each of Eni and Mubadala Petroleum to achieve their respective **NZE** targets. By way of remainder, for Eni this means **NZE** for Scope 1 and Scope 2 from upstream **GHG** emissions by 2030, and all activities by 2040, and **NZE** across **GHG** life-cycle emissions for Scopes 1, 2 and 3 by 2050.

**See:** Eni [press release](#); Mubadala Petroleum [press release](#)

## India: up-beat tempo continues:

- **State of Kerala's ambitions:** Edition [25](#) of Low Carbon Pulse reported on the Independence Day speech of Indian Prime Minister, Mr Narendra Modi, in particular the announcement by Mr Modi of the National Hydrogen Mission (**NHM**). It understood that details of the **NHM** are being developed.

During the week beginning September 13, 2021, a number of reports appeared to the effect that the State of Kerala is "getting ahead of the curve", and is developing its own strategy.

For these purposes it is being reported that Kerala has started to engagement with energy giants, BPCL (Bharat Petroleum Corporation Limited), GAIL Limited (Government of India owned natural gas corporation), IOC (India Oil Corporation Ltd) and NTPC Limited (India's largest integrated energy corporation), and others, including for the development of a Green Hydrogen facility within the vicinity of the Cochin Airport.

- **Reliance Industries' ambitions:**
  - Chair of Reliance Industries, Mr Mukesh Ambani, has devised the "1-1-1" plan to achieve a price point of USD 1 per kg of hydrogen by 2030 (or soon after).  
**See:** Reliance [website](#)
  - Reliance and BP have combined to establish BluSmart, the first and largest electric (including **BEV** and **FCEV**) ride-hailing platform, as part of plans to invest USD 10 billion over the next three years on clean energy. BluSmart will provide a platform for the use of all clean energy forms.

- **Tata Steel achieving ambitions:**

On September 15, 2021:

- Tata Steel announced that it had commissioned its carbon capture facility at its Jamshedpur steelworks. The carbon capture technology captures directly **CO<sub>2</sub>** arising from the blast furnace high-temperature heat processes required to produce pig iron.

The **CO<sub>2</sub>** is captured using an amine-based technology, and is then used on-site, and as such is not stored permanently. It is understood the Carbon Clean is providing technological support. Initially the five tonnes of **CO<sub>2</sub>** will be captured each day. This is a first for iron and steel production in India.

**See:** [Tata Steel commissions India's first plant for CO<sub>2</sub> capture from Blast Furnace gas at Jamshedpur](#)

- Tata Steel announced that it had committed to the introduction of direct reduced iron (**DRI**) technology in one or more electric arc furnaces at its Ijmuiden steelworks. This initiative is part of the plan to reduce **CO<sub>2</sub>** emissions at Ijmuiden by 5 mpta by 2030. This will be achieved by the use of hydrogen, rather than fossil fuels to produce **DRI** / sponge iron.

**See:** [Tata Steel, the leading international steelmaker, has announced plans to pursue a fully sustainable future for its steelworks in IJmuiden, the Netherlands, by adopting a hydrogen route](#)

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

- Tata Steel's ammonia cracker at Ijmuiden was in the news as being integral to plans to import Green Ammonia projects in Latin America, and through use of Tata Steel's cracker to [dehydrogenate] the ammonia to derive Green Hydrogen.

**See:** Tata Steel [website](#)

- **Clean energy car incentives:** On September 16, 2021, [Energyworld](#) reported that India is to introduce USD 3 billion in funding support: "to leapfrog to environmentally cleaner, electric vehicles and hydrogen fuel cell vehicles. It will herald a new age in higher technology, more efficient and green automotive manufacturing". The funding support is to be provided to automobile and drone manufacturers over a five year period. Further detail is expected to follow within the next quarter.

## Japan and Australia – continued cooperation at corporate and G-to-G level:

On September 15, 2021, Stanwell Corporation (a Queensland State government-owned corporation with a power generation business) with APA Group (leading natural gas pipeline network owner and operator in Australia) announced that a feasibility study was to be undertaken for the purposes of assessing plans to develop a large-scale Green Hydrogen Hub in Queensland.

The feasibility study will be undertaken by Stanwell Corporation, and APA Group and a number of leading Japanese corporations, including Iwatani Corporation (see Edition [5](#) of Low Carbon Pulse), Kansai Electric Power Corporation, Kawasaki Heavy Industries and Marubeni Corporation.

The feasibility study has the backing of the Queensland State Government and the Australian Federal Government (through the Australian Renewable Energy Agency (**ARENA**)) and the Japanese Government, through funding provided by the Ministry of Economy, Trade and Industry (**METI**).

## German progress continues, home, on the seas and overseas:

- **Germany is role model:** Edition [25](#) of Low Carbon Pulse (under **Germany flagship projects – progress check**) and Edition [26](#) of Low Carbon Pulse (under **German progress continues, home, and on the seas and overseas**) has reported on the initiatives in Germany, and that Germany and the UK are leading way in terms of policy settings.

In another material and significant development, on September 8, 2021, the German Transport Ministry announced the development and deployment of overhead electric contact lines along the A5 and A9 motorways to allow the use of electrical energy to power and to propel vehicles (and to allow recharging of vehicles) transporting freight. In addition to the deployment of overhead electric contact lines, battery recharging infrastructure will be developed and deployed.

- **Role model remodelled:**

As noted in previous editions of Low Carbon Pulse, the perspective taken in Low Carbon Pulse is forward looking and positive – no policy setting or resulting outcome is perfect, and there will be continuous improvement in progress towards **NZE**. This is why negative news items are not included in Low Carbon Pulse.

In the recent past, there has been some negative comment around the ability of Germany to achieve **NZE** by 2045. More often than not, negative comments are not accompanied by other means of achieving progress towards **NZE**.

On September 10, 2021, there was positive comment and a clear means of achieving progress. McKinsey & Company published a [report](#) (**McKinsey Report**) that outlines how Germany "can become carbon neutral by 2045 – at net-zero costs".

The **McKinsey Report** notes that: "To master decarbonisation we need to accelerate at least at a factor of 3 ... using a fact-based plan and 10 major initiatives - among the rapid build-up the hydrogen infrastructure 10 - 15 mt of clean hydrogen will be needed".

In recent times there have been cautionary narratives around the increased production of hydrogen other than Green Hydrogen, and the importance of the use of Green Hydrogen as efficiently as possible, for example. Further, the focus should be on the electrification of the building and transport sectors in the long term.

Please see a [report](#) from Earthjustice for more details. There is considerable cross-over with the [findings](#) of Professor Ronnie Belmans and Pieter Vingerhoets: in short, hydrogen is not used efficiently in buildings or cars or for short distance transport.

- **The Flagship Program sound, McKinsey Report accelerates:** The **McKinsey Report** builds in the framework of the Flagship Program already underway. While included in Editions [25](#) and [26](#) of Low Carbon Pulse, for ease of reference, by way of a quick reminder, the three Flagship Projects in the Flagship Program are:
  - **H2Giga:** dedicated to the development of large-scale use of electrolyzers (using serial construction of standardised electrolyser technology) to electrolyse water using renewable electrical energy to produce Green Hydrogen. Thyssenkrupp is responsible for the coordination of **H2Giga**;
  - **H2Mare:** dedicated to investigating the use of use off-shore / off-grid renewable wind electrical energy to produce hydrogen and hydrogen-based fuels: effectively, a dedicated, integrated, closed electrical energy to the Green Hydrogen production energy loop. **H2Mare** comprises four joint projects: **1.** OffgridWind, **2.** H2Wind, **3.** PtX-Wind, and **4.** TransferWind. Siemens Energy is responsible for the coordination of **H2Mare**.
  - **TransHyDe:** dedicated to reaching transportation of hydrogen over short, medium and long distances, and comprising four demonstration projects: **1.** Hydrogen Transport in High Pressure Vessels, **2.** Hydrogen-Liquid Transport, **3.** Hydrogen Transport in Existing and New Gas Pipelines, and **4.** Transport of Hydrogen Bound in Ammonia or liquid organic hydrogen carrier (**LOHC**), a carrier medium.
- **We are not there yet ... !**

- **Background:** During the week beginning September 13, 2021, it was reported widely that during the first six months of calendar year 2021, coal-fired electrical energy generation in Germany exceeded that of electrical energy sourced from wind. The increased use of coal has not been restricted to Germany, it has been experienced in other countries in Europe too, along with increased energy prices.

- **Reversion to fossil fuel:** The reversion to coal-fired power generation is a result of a number of factors, including the price of energy, including to respond to weather events consistent with climate change. The recent reversion to coal is not an argument for near, medium and long term reliance on coal, rather it is an argument for increasing the rate of development of renewable energy capacity, and energy storage solutions.

- **Pragmatic planning is required:** As importantly, the experience in Germany indicates the level of planning that is required to retire coal-fired (and other fossil fuel) generation capacity while developing renewable energy capacity: Germany has a well-developed and world leading reverse auction process to retire coal-fired power generation capacity, and yet circumstances have conspired to result in the need to continue to use coal-fired power generation capacity.

The application of the reverse auction process in Germany has been well-planned and executed. This serves to emphasise the need for planning to ensure coordination between the development of renewable energy and transmission system augmentation and enhancement and expansion to ensure system integrity and stability, in tandem with (and as such a little ahead of) the retirement of coal-fired power generation.

The experience in Germany provides a good case study for "acquire to retire" policy settings and "reverse auction to retire" schemes, and, given recent experience, the need to ensure that there is sufficient lower or low carbon fuel available as energy transition is achieved over time.

- **Natural Gas as a transition fuel:** There is a saying in the fossil fuel industry (in particular the natural gas industry), that the "best cure for high prices is high prices": a competitive market that sees high prices, responds by developing new energy sources to take advantage of those high-prices.

In the context of progress towards the achievement of **NZE**, international energy companies and national oil companies may be regarded as less likely to respond in this way, because in the medium to long term there is a risk of not achieving the required return of, and on, capital. As a result, higher to high prices will continue.

## PRC continues to lead the way:

- **PRC leads in off-shore wind installation:** On 9 September, 2021, the Global Wind Energy Council (**GWEC**) released the [Global Offshore Wind Report 2021](#) (**GWEC 2021 Report**).

Of the 6.1 GW of offshore wind capacity installed in 2020 (slightly down on the 6.24 GW off-shore wind capacity installed in 2019), PRC led the way with more than 3 GW. The **GWEC 2021 Report** anticipates that 7.5 GW of off-shore wind capacity will be installed during 2021, again with PRC leading the way (driven in part by installing capacity to get the benefit of the current feed-in-tariffs).

Other key findings from the **GWEC 2021 Report** are contained in the **Wind Round-up** below, critically, that more off-shore wind capacity needs to be installed, up to 2,000 GW of off-shore wind capacity needs to be installed by 2050 if global average temperatures are not to exceed 1.5°C. This level of installed capacity is consistent with the models used by the International Energy Agency (**IEA**) under its [Net Zero by 2050 – A Roadmap for Global Energy Sector](#) and the International Renewable Energy Agency (**IRENA**) under its [World Energy Transitions Outlook](#).

- **PRC leads in production and export of solar panels:** Previous editions of Low Carbon Pulse have noted the importance of the PRC to the solar panel industry. On September 8, 2021, [pv magazine](#) reported that in the first five months of 2021, the PRC had exported more than 37 GW of solar panels, based on reports from the China Photovoltaic Industry Association (**CPIA**).  
**See:** [China exported 37 GW of panels in five months](#).
- **PRC leads in installation of solar photovoltaic:** The National Energy Administration in the PRC has reported that during the first eight months of calendar year 2021, 9.52 GW of solar photovoltaic capacity was installed in the PRC (including 1.85 GW installed in August).
- **Golmud City leading on hybrid solar project:** On September 17, 2021, [pv magazine](#) reported that the Government of the City of Golmud, Qinghai province has announced that state-owned China Green Development Group has commenced the development of a 3.3 GW hybrid solar photovoltaic and concentrated solar power (**CSP**) project: 3 GW of solar photovoltaic, 300 MW of **CSP**, and 520 MW of energy storage (in the form a BESS).

## Republic of Korea (ROK) News:

- **Port of Townsville and Korea Zinc ink MoU:** On September 7, 2021, it was reported widely that the Port of Townsville (being a port in Queensland, Australia) had signed a memorandum of understanding (**MoU**) with Sun Metals owned by Korea Zinc (Sun Metals being a sibling of Ark Energy, and the owner of the Sun Metals zinc refinery in Townsville). It is reported that the **MoU** will allow for the export of Green Hydrogen, with it being anticipated that ultimately up to 200,000 metric tonnes of hydrogen may be exported annually.
- **Korean H<sub>2</sub> Business Summit:** Edition 2 of Low Carbon Pulse reported that a number of leading corporations and organisations in the Republic of Korea intended to establish the Green Ammonia Alliance (**GAA**). On September 8, 2021, the establishment of the **Korean H<sub>2</sub> Business Summit** was reported. The members of the **Korean H<sub>2</sub> Business Summit** are understood to include: Doosan, E1, GS, Hanwha, Hyosung, Hyundai Heavy Industries, Hyundai Motor Company, IL Jin, Isu, Lotte, KOLON, Korea Zinc, POSCO and SK Energy. It is understood that the members of the **Korean H<sub>2</sub> Business Summit** will meet regularly to develop detailed implementation plans, and that the members will come together every September for an annual conference. In the week before the first **Korean H<sub>2</sub> Business Summit**, four ROK corporations joined the [RE100](#) (see Edition 18 of Low Carbon Pulse for background): KB Financial Group (the leading financial services provided in the ROK), Korea Zinc, Mirae Assets Securities and SK (in respect of technology). There is increasingly broad and dedicated commitment across corporations in ROK to clean power, and **GHG** emission reductions generally. The commitment of the Government to achieve **NZE** by 2050, and its Green New Deal.
- **HyStation on station:** On September 10, 2021, it was reported widely that a new corporation had been established in the ROK to construct and to operate a hydrogen refuelling infrastructure (**HRI**) across ROK to provide hydrogen for public bus fleets. HyStation is the name of the new corporation. It is understood that the first **HRI** will be operational by the end of 2022.  
HyStation is a joint venture among Hydrogenic Energy Fund, Hyundai Rotem, Industrial Bank of Korea, KOGAS, Samsung C&T and Woodside Energy Limited. The Korean Development Bank has agreed to provide debt funding for HyStation.  
**See:** Hyundai Rotem [website](#); Industrial Bank of Korea [website](#); KOGAS [website](#); Samsung C&T [website](#); Woodside Energy [website](#)
- **Siemens Energy and KOGAS tee up Green:** On September 14, 2021, Siemens Energy AG (a leading international energy company) announced that it had signed a memorandum of understanding with Korea Gas Corporation (**KOGAS**) to work together in the production of Green Hydrogen for use in hydrogen fuelled turbine power generation.  
**See:** [Siemens Energy and KOGAS sign MoU to collaborate on green hydrogen projects](#)
- **Hydrogen Port Ecosystem on the hydro-carbon coast:** On September 14, 2021, the ROK Ministry of Oceans and Fisheries and SK Group announced plans to develop a hydrogen port ecosystem (**HPE**) in the Yeosu

Gwangyang Port on South Korea's southern coast (deep in the heart of oil refining and petrochemical, and own-use LNG importation territory). The heart of the **HPE** is a 200,000 to 300,000 metric tonnes per year Blue Hydrogen production facility. The Blue Hydrogen produced will be used for port mobility / transportation and shipping.

As is the case with Germany and Japan, the private sector in the ROK continues to work closely with Government in achieving progress to reduction in **GHG** emissions, and **NZE** by 2050. Minister of Oceans and Fisheries, Mr Moon Seong-hyeok summed up the approach perfectly: the Government will "spare no effort in administrative and policy support" so that "corporate investment on hydrogen ports" is achieved.

**See:** SK Group [website](#)

## Finland Has a New Improved Hydrogen Plan:

- Edition [26](#) of Low Carbon Pulse reported on the plans of Nepal to achieve **NZE**, in particular that it is developing a strategy for the production and use of hydrogen to displace the use of fossil fuels.
- As noted in Edition [26](#), the purpose of including Nepal was to illustrate that a number of countries are progressing towards the achievement of **NZE** even though not one of the countries required to do the heavy lifting in terms of reducing **GHG** emissions.
- In a [report](#) issued on September 15, 2021, by Hydrogen Cluster Finland (**HCF**), **HCF** suggests the creation of a hydrogen production and export industry. The report, and the plan contained in it, would allow Finland to achieve **NZE** by 2030, and, through the export of hydrogen, Finland would help other countries achieve **GHG** emission reductions.

## Update on the US in Edition 28:

Edition 28 of Low Carbon Pulse will include a summary of the policy settings, and state of play, in the US.

## Bio-energy (including BECCS and BECCUS) update:

- **Background:** As noted in Edition [26](#) of Low Carbon Pulse, **bio-energy** is energy derived or produced from biogas or biomass, whether in gaseous, liquid or solid form. Bio-energy is derived from organic matter, but not fossilised organic matter. Organic matter contains carbon, and as such bio-energy is not a zero emission energy.  
**Note:** Carbon Dioxide Removal (**CDR**) is not an instant solution in global terms (as outlined in Edition [24](#) of Low Carbon Pulse, it takes time), nor is **BECCS**. For **BECCS** to make a contribution to a reduction in **GHG** emissions, it must displace another electrical energy source or energy carrier source, and, in any event, it must result in a carbon neutral outcome (rather than a carbon removal outcome) so as not to give rise to an increase in **GHG** emissions. The effectiveness of **BECCS** at a global level is more likely than not to achieve carbon neutrality rather than to remove carbon.

- **Bio-energy projects:**

**Maersk invests in WasteFuel:** On September 8, 2021, CNBC reported, that Maersk had invested in WasteFuel (a start-up backed in part by Mr Warren Buffett through Berkshire Hathaway subsidiary NetJets). It is understood that WasteFuel processes agricultural and municipal solid waste to provide synthetic biofuel, bio-methanol for sale into the Americas and into Asia.

Edition [26](#) of Low Carbon Pulse reported on the decision of AP Moller Maersk to order eight dual fuel container vessels, capable of being power and propelled by methanol. In reporting on this decision it was noted that AP Moller – Maersk was aware of the need to continue to procure supplies of methanol.

**See:** [Maersk invests in WasteFuel to develop green bio-methanol production in the Americas and Asia](#)

## Blue Carbon and Ocean update:

**Ocean absorption:** On September 13, 2021, Nature, published an article entitled [Projected ocean warming constrained by observation record](#). The key finding of the article is that: "*The ocean absorbs most of the excess heat from anthropogenic climate change, causing global ocean warming and sea-level rise ... By 2081-2100, under [a high emission scenario], the upper 2,000 m of the ocean is likely to (>66% probability) to warm by 1,546-2,170 J relative to 2005-2019, corresponding to a 17-26 cm sea-level rise from thermal expansion.*"

- **Alignment with 2021 Report:** This finding builds on the findings in the *2021 Report* in respect of the warming of the oceans (and in the realm of Blue Carbon): "It is *virtually certain* that the global upper ocean (0-700 metres) has warmed since the 1970s and *extremely likely* that human influence is the main driver. It is virtually certain that human-caused  $CO_2$  emissions are the main driver of current global acidification of the surface of open ocean. There is *high confidence* that oxygen levels have dropped in many upper ocean regions since the mid-20th century ..."

## CCS / CCUS round-up:

- **World scale DACS matched to World Scale Insurer:** Editions [25](#) and [26](#) of Low Carbon Pulse reported that the Orca project, a new direct air capture and storage (**DACS**) facility, owned by Climeworks (a Swiss corporation), that will capture up to 4,000 **tpa** of  $CO_2$  from the atmosphere (storing the captured  $CO_2$  underground), and Climeworks had signed a 10 year carbon dioxide removal purchase agreement with Swiss Re worth USD 10 million to Climeworks.

On September 8, 2021, to considerable news coverage, Orca commenced operations.

**See:** [Climeworks begins operations of Orca, the world's largest direct air capture and storage plant](#)

- **Aramis CCC Project:** On September 8, 2021, Energie Beheer Nederland BV (a leading natural gas corporation), Gasunie (energy network operator in the Netherlands and northern Germany), Shell Nederland and TotalEnergies announced that they have concluded a joint venture arrangement to develop transport infrastructure to allow the storage of  $CO_2$  captured in carbon industrial clusters.

See: [TotalEnergies, Shell Netherlands, EBN and Gasunie form partnership to develop an offshore CCS-project: Aramis](#)

- **Bifrost CCS Project:** On September 10, 2021, Noreco (Norway-based oil and gas company) announced that it had entered into a joint venture arrangement to develop the **Bifrost CCS Project** involving the proposed use of the depleted Harald off-shore gas field located in the Danish sector of the North Sea. It is estimated the **Bifrost CCS Project** has storage capacity of up to 3 **mtpa** of **CO<sub>2</sub>**.

The joint venture arrangement is with Ørsted, the Technical University of Denmark and the Danish Underground Consortium (**DUC**). **DUC** comprises TotalEnergies (as operator), Noreco and Nordsøfonden. It is understood that the joint venture is seeking funding support from the Energy Technology Development Demonstration Program (**EUDP**), and that the funding support sought includes funding to assess the possible use of additional depleted fields in the North Sea. The work undertaken under the **EUDP** would include assessment of the use of existing pipeline infrastructure haul **CO<sub>2</sub>** from Denmark, and in so doing establish Denmark as a consolidate hub for CCS Hub.

See: [Noreco announces the CCS partnership Project Bifrost](#)

- **Interest in Norwegian Continental shelf:** On September 10, 2021, the Ministry of Petroleum and Energy in Norway announced that application should be made for two areas for injection and storage of **CO<sub>2</sub>** on the Norwegian continental, under the **CO<sub>2</sub> Storage Regulations (CO<sub>2</sub> SRs)**. The **CO<sub>2</sub> SRs** provide a process to allow the development of **CO<sub>2</sub>** storage facilities to allow the storage of **CO<sub>2</sub>** in sub-ocean floor geological structures. The deadline for the applications is stated as noon on December 9, 2021.

On September 13, 2021, Horisont Energi announced that it had made an application for a licence to establish the Polaris **CO<sub>2</sub>** storage facility of the coast of Finnmark. The Horisont Energi application is intended to store the **CO<sub>2</sub>** arising from the production of Blue Hydrogen at the Barents Blue facility (to produce Blue Hydrogen and Blue Ammonia) (**Barents Blue**) reported in Edition 23 of Low Carbon Pulse - Horisont Energi, Equinor and Vår Energy have entered into a cooperation agreement to develop **Barents Blue**, and the Polaris **CO<sub>2</sub>** project has long been an integral part of the thinking around the development of **Barents Blue**.

See: [Announcement of areas related to CO2 storage and Horisont Energi website](#)

- **Acceleration of CCS roll-out required:** On September 10, 2021, Professor Jon Gibbins commented on a paper from Messrs. Welsby, Price, Pye and Ekins entitled [Unextractable fossil fuels in a 1.5°C world](#). Both the paper and the commentary from Professor Gibbins are telling, and both make it clear that CCS / CCUS requires planning and development by Governments globally to ensure that sufficient CCS / CCUS is available, and being available, Governments can mandate its use. As noted above, Edition 28 of Low Carbon Pulse will consider this in more detail.
- **Bayu-Undan CCS project takes next step:** On September 14, 2021, Santos announced that it had signed, as the operator of the Bayu-Undan Joint Venture, a memorandum of understanding (**MoU**) with the Timor-Leste regulator Autoridade Nacional do Petroleo e Minerals (**ANPM**) as the next step in the development of a CCS project to store **CO<sub>2</sub>** arising from the development of the Caldita Barossa field in the depleted Bayu-Undan reservoir in the Timor Sea. This is a significant development in this key CCS project.

See: [MOU signed on Bayu-Undan carbon capture and storage](#)

## CO<sub>2</sub> storage and use:

- **A circular and interconnected world:**

- **CO<sub>2</sub> absorbed from Australia bush fires absorbed by algae:** On September 15, 2021, the New Scientist published an article titled [Most CO<sub>2</sub> from Australia's megafires has been offset by algal blooms](#). As with all articles in the New Scientist related to climate and the environment, the article is well-worth a read. The article reports on a [study](#) from CSIRO (Commonwealth Scientific and Industrial Research Organisation).

The article notes that over the Southern Hemisphere summer of 2019 and 2020, over 70,000 square kilometres of Australian bush and scrub land was burned (an area the size of the Republic of Ireland). As a result, approximately 715 million tonnes of **CO<sub>2</sub>** were released to the climate system (a mass of **CO<sub>2</sub>** equivalent to the **GHG** emissions arising from anthropogenic activities in Germany each year). The article suggests that up to 80% of that mass of **CO<sub>2</sub>** has been absorbed by ocean algal blooms (principally two blooms in the Pacific Ocean and Southern Oceans, covering an area twice the size of Australia).

- **Shortage of manufactured CO<sub>2</sub>:** One of the impacts of the high natural gas prices (see **High Level observations on current high energy prices** above) is that facilities producing fertiliser (the primary feedstock for which is natural gas (predominantly **CH<sub>4</sub>**)). As readers of Low Carbon Pulse (and sibling publications) will know, one of the by-products of the production of hydrogen from natural gas (then combined with nitrogen to produce ammonia) is **CO<sub>2</sub>**.

Among other uses (in addition to beer and fizzy drinks), one of the uses for manufactured **CO<sub>2</sub>** is to stun animals in abattoirs. This is the second time in three years in which the UK (and Europe) have experienced shortages of manufactured **CO<sub>2</sub>**. As a result of the shortage of manufactured **CO<sub>2</sub>**, news items have focussed in on the causes of increased natural gas prices, and the knock-on effect on energy prices and broader implications.

- **In a world of connected carbon:** The two news items above illustrate the circular and interconnectedness of how nature can respond to the consequences of bush / scrub fires (forest fires in most parts of the world) and the impact that higher energy prices can have on other activities in an economy.

There is not much we can do about nature, but the impact of the shortage of manufacture **CO<sub>2</sub>** on food security is something to which policy settings can respond, including to provide further impetus to Government funding support for CCUS.

## Spotlight on CVX:

- **CVX New Energies ACES it:** Edition [19](#) of Low Carbon Pulse mentioned in passing the development of the Advanced Clean Energy Storage (**ACES**) project in Delta, Utah, developed by Mitsubishi Power Americas and Magnum Development. The project contemplated will comprise a 1 GW electrolyser facility, producing 450 metric tonnes per day of clean hydrogen, with salt-caverns to store hydrogen. On September 10, 2021, Chevron New Energies (**CNE**) announced that it intends to acquire an equity interest in **ACES**.

**See:** Chevron [press release](#)

- **CVX tracks Caterpillar:** On September 8, 2021, Chevron Corporation (global leading international energy corporation) and Caterpillar (global leading heavy equipment manufacturer) inked an agreement under which they will work together to develop hydrogen demonstration projects to enable participation in the mobility / transportation markets (including the use of hydrogen in the rail freight and shipping), and in the stationary power sector (in both instances for primary power). It is understood that Chevron and Caterpillar are to commence work to demonstrate hydrogen powered and propelled locomotives and hydrogen refuelling infrastructure (**HRI**).

Edition [26](#) of Low Carbon Pulse reported that on September 1, 2021, Caterpillar announced that it was on target to deliver electrical energy generation solutions using 100% hydrogen by the end of 2021. At the moment, Caterpillar generation solutions allow for the use of 25% hydrogen and 75% natural gas blended fuels.

**See:** Chevron [press release](#)

- **CVX on the move:** On September 14, 2021, it was reported widely that Chevron Corporation (**CVX**), leading international energy corporation (and one of the super-majors), is committed to the development of 150,000 tonnes per year of hydrogen production by 2030. Consistent with other announcements of late, **CVX** is targeting the supply of hydrogen to the mobility / transportation sector, and power.

As noted in previous editions of Low Carbon Pulse (for example, Edition [26](#) of Low Carbon Pulse), **CVX** is increasing its production of renewable natural gas (**RNG**) and renewable fuels (principally in the form of biofuels), and has a CCS / CCUS and carbon offset trading business.

For these purposes, CVX has ear-marked USD 10 billion in capital expenditure by 2028. For the time being, however, **CVX** has indicated that it does not intend to apply any of this capital expenditure to the development of renewable electrical energy capacity.

**See:** [Chevron Accelerates Lower Carbon Ambitions](#)

## E-Fuels / Future Fuels:

- **For richer, for PORA, green inked in:** On September 6, 2021, Port of Rotterdam Authority (**PORA**) and Uniper (leading global energy company head-quartered in Germany) announced that they had entered into an agreement to develop a 100 MW electrolyser facility (**Maasvlakte Facility**) to be located at Maasvlakte (a site occupied by Uniper), with aspirations to expand to a 500 MW electrolyser. It is understood that the electrolyser will source renewable electrical energy generated from off-shore wind fields.

The **Maasvlakte Facility** will connect to the **HyT Pipeline**. Edition [20](#) of Low Carbon Pulse reported on the background to the development of the HyTransport RTM pipeline (**HyT Pipeline**).

**See:** [Cooperation Uniper and Port of Rotterdam Authority in production green hydrogen](#)

- **BP weighing up Kwinana Energy Hub:** On September 7, 2021, it was reported widely that BP Australia is undertaking a feasibility study to produce Green Hydrogen at the site of its Kwinana refinery, working with leading renewables energy and hydrogen adviser and participant Macquarie Group. While this may be regarded as early days, the repurposing of the Kwinana site, and the supportive policies of the Western Australian Government, may be regarded positively, including the possibility of the development of Kwinana as a hydrogen hub and carbon cluster.

**See:** [bp Australia is undertaking a feasibility study into the production of green hydrogen at its Kwinana site in Western Australia, in partnership with Macquarie Capital and with funding from the Western Australian Government](#)

- **JERA commences hydrogen firing:** Previous editions of Low Carbon Pulse have reported on the plans of JERA Co., Inc. (**JERA**) to test the use of hydrogen combined with natural gas to generate electrical energy.

On September 7, 2021, it was reported widely that, from October 2021, **JERA** (leading Japan based energy company) intends to commence testing the use of hydrogen at power plants currently fired by natural gas sourced from the import of liquid natural gas (**LNG**). The testing and evaluation of the use of hydrogen will continue from October 2021 to March 2026.

On the basis of the results of testing and evaluation, **JERA** will make a decision as to the development of facilities to allow co-firing of hydrogen and natural gas (30% to 70%) by 2025.

- **Danish Green Island Green Light:** Edition [9](#) of Low Carbon Pulse reported on the development of a Green (Power) Island (**Green Island**) in the Danish sector of the North Sea. In early September 2021, it was reported that the Danish Parliament had agreed upon the way forward for the development of the **Green Island**.

Under the final agreement, the Danish State is to retain a 50.1% interest in the **Green Island**, and the criteria for the development are clear, including that the terms of development must provide the lowest prices to Energinet (the Danish national energy system operator). It is understood that this agreement will pave the way for the release in 2022 of a tender to develop the **Green Island**.

Following the announcement of the agreement of the Danish Parliament, prospective tenderers are emerging, including Ørsted and ATP.

- **Porsche on the road:** Edition [21](#) of Low Carbon Pulse reported on the development of the Haru Oni project at Punta Arenas, Chile (**Hari Oni Project**), to produce synthetic methanol (E-Methanol in this instance) from Green Hydrogen, called Green Methanol (as an E-Fuel). On September 10, 2021, Porsche AG announced that construction of the **Hari Oni Project** has commenced with a ground breaking ceremony at site.

**See:** [Construction begins on world's first integrated commercial plant for producing nearly CO2-neutral fuel in Chile](#)

- **Ukraine route to new markets:** On September 8, 2021, it was reported widely that Eustream (Slovakian based natural gas pipeline network owner and operator) has joined a joint venture to develop a supply chain from Green Hydrogen production facilities in Ukraine to Austria and Germany, and other central European markets (**H2EU+Store**). **H2EU+Store** comprises key players, including Bayerngas GmbH, Bayernets GmbH, Eco-Optima LLC, Open Grid Europe GmbH and RAG Austria AG.
- **Giants aligned:** On September 8, 2021, it was reported widely that Mitsubishi Corporation (leading Japanese engineering, manufacturing, and infrastructure and trading corporation) and Shell Canada signed a memorandum of understanding to produce low-carbon hydrogen.

**See:** [Mitsubishi Corporation and Shell sign MoU to collaborate on hydrogen plans in Alberta](#)

- **Two more Giants aligned:** On September 10, 2021, ENEOS Corporation (leading hydrocarbon importer into, and refiner in, Japan) and Petronas (the national oil company of Malaysia) signed a memorandum of understanding (**MoU**) for the development, jointly, of a competitive clean hydrogen supply chain between Malaysia and Japan.

The [press release](#) from Petronas states: "The MoU will see both parties embark on a technical -commercial joint-study of hydrogen production and transportation of methylcyclohexane [(**MCH**)] form, where hydrogen is converted from its original gaseous state into a liquid form to enable large volume deliveries".

Edition [26](#) of Low Carbon Pulse reported that ENEOS Corporation and Origin Energy had agreed to undertake jointly a study to develop a hydrogen and hydrogen-based energy carrier supply chain from Origin Energy's Green Hydrogen facility at Gladstone, Queensland, Australia and terminating at ENEOS Corporation refineries in Japan. Part of the study includes the use of Green Hydrogen to produce **MCH**.

**See:** [PETRONAS and ENEOS Expand Energy Partnership To Include Hydrogen Business; ENEOS Begins Collaborative Studies and Researches with PETRONAS Group toward the Development of a CO2-Free Hydrogen Supply Chain](#)

- **Low Carbon Hydrogen Hub Plans accelerate:** On September 13, 2021, it was announced that plans of Essar Oil UK to derive increased quantities of hydrogen from its Stanlow Manufacturing and Refining Complex at Ellesmere Port, Cheshire, England, were progressing with a planning application lodged which if granted (as expected) will allow the introduction of natural gas and oxygen to derive 3 TWh of clean hydrogen from 2025. This level of production is planned to increase to 9 TWh by 2030, equivalent to 80% of the UK Government [target](#) of 5 GW of low carbon hydrogen production capacity by 2030. Essar Oil is working with Progressive Energy Limited, which is leading the HyNet North West project (see Edition [25](#) of Low Carbon Pulse for details).

**See:** Essar Oil [website](#); Progressive Energy [website](#); HyNet North West [website](#)

- **Shelling out:** On September 16, 2021, Royal Dutch Shell announced plans to develop a 820,000 metric tonne per year biofuels plant in Rotterdam, The Netherlands, as part of its commitment to progress to achieving **NZE** by 2050. The biofuels plant is scheduled to commence production in 2024.

It understood that the biofuel plant will produce sustainable aviation fuel (**SAF**), accounting for around 50% of its production capacity, with the balance being renewable diesel. It is intended that the feedstock for the production of the bio-fuels will be waste vegetable fuels, waste animal fats, and other residual waste materials, with feedstock derived from fuel crops (including rapeseed) to be used to supplement feedstock derived from waste.

**See:** [Shell to build one of Europe's biggest biofuels facilities](#)

## Green Metals and Minerals, the Mining Industry and Difficult to Decarbonise industries:

In addition to the news item above about **CVX** and Caterpillar, **Giants aligned:** On September 14, 2021, Engie (leading international energy corporation) and Liebherr (leading high value engineering and manufacturing corporation) announced that they are partnering to offer carbon neutral solutions to the mining industry, based on the deployment of hydrogen use.

The two corporations bring distinct and market leading strengths, in particular in the remote mine site sector of the industry: Engie brings remote renewable electrical energy expertise and hydrogen and hydrogen-based supply chain know-how, and Liebherr brings its market leading reputation of heavy-duty mining equipment supply.

**See:** [Liebherr and ENGIE partner to offer carbon-neutral solutions for the mining industry](#)

## Hydrogen Cities, Councils, Cluster and Hubs, Infrastructure and Valleys:

- **Green Hydrogen Valley:** On September 15, 2021, it was announced that three new hydrogen production facilities were to be developed, with a combined capacity of 220 MW, as part of broader plans to develop a Green Hydrogen Valley in the Foggia area of the Puglia region of Italy (**Puglia Green Hydrogen Valley**). Each of Brindisi (60 MW), Cerignola (80 MW), and Taranto (80 MW) to site one of the hydrogen production facilities.

Leading Italian corporations, Alboran Hydrogen with 30%, Edison with 30%, Saipam with 10%, and Snam with 30%, have combined resources to establish a single purpose vehicle (**GHSPV**). The **GHSPV** will develop the Green Hydrogen production facilities, with the hydrogen to be used in the local mobility / transport market, by local industry, and to for blending with natural gas into the Snam natural gas pipeline network.

See: [Edison and Snam alongside Saipem and Alboran for the green hydrogen valley project in Puglia region](#); Alboran Hydrogen [website](#); Edison International [website](#); Snam [press release](#)

- **Giga-factory update:** It has been the plan for a while to include a feature on giga-factories in an edition of Low Carbon Pulse. Given the space and word count taken by outlining trends and matters of policy ahead of COP-26, Editions [25](#) and [26](#), and this Edition 27 have been weighty. A future edition of Low Carbon Pulse will include a feature on both giga factories and charging and refuelling infrastructure.

## Wind round-up:

- **Iberdrola positions for Taiwan 6 GW off-shore wind pipeline:** On September 9, 2021, Iberdrola (leading global energy company) announced that it was establishing itself formally in Taiwan to facilitate its participation in "the Zonal Development offshore wind procurement". Iberdrola has invested in work ahead of the "Zonal Development" auction rounds under which offshore wind procurement will be undertaken. For these purposes, Iberdrola has undertaken work in respect of the Da-Chung By, Guo-Feng and Ju-Dao off-shore wind field areas. It is understood that the water depths will allow a choice of fixed-bottom or floating off-shore wind technologies.

See: [Iberdrola expands in Asia-Pacific with development of 6GW pipeline in Taiwan](#)

- **GWEC 2021 Report:** As noted above, the Global Wind Energy Council has released the **GWEC 2021 Report**. The highlights of **GWEC 2021 Report** are as follows: **1.** 2020 was a good year for the installation off-shore wind installation despite COVID-19, with the second highest level of installations, following the record high of 2019; **2.** Off-shore wind is regarded as having the greatest growth potential, and that to realise this potential, new and improved policy settings are needed; **3.** Currently installed off-shore wind capacity is 2% of the level required for there to be assurance of achieving **NZE** by 2050; and **4.** Currently is it possible to project the installation of a further 235 GW of off-shore wind capacity by the end of the current decade.
- **UK provides basis for "biggest ever" auction::** On September 13, 2021, the UK Government [announced](#) details in respect of the [fourth round](#) of its award of **contracts for differences** or **CfDs** (see Edition [17](#) of Low Carbon Pulse for an explanation of **CfDs**). Of particular interest in the announced from the Department of Business, Energy & Industrial Strategy is the backing for off-shore wind field development, both fixed-bottom and floating.

As reported in Editions [9](#) and [13](#) of Low Carbon Pulse in respect of third round for the award of **CfDs**, this resulted in the successful auction of areas for off-shore wind field development around the coast of England and Wales. The use of **CfDs** as a policy setting has been the key factor in the development of renewable electrical energy capacity within the UK.

- **Ocean Winds (OW) and Aker Offshore Wind (AOW):** On September 14, 2021, [energyvoice](#), reported that **OW** and **AOW** had shared details of their planned development of a 6 GW floating off-shore wind field in the Outer Moray Firth, off the east coast of Scotland. It is understood that the details shared reflect the terms of the **OW** and **AOW** response to the ScotWind Leasing Scheme. The scale of the planned development would revolutionise the floating off-shore wind industry.

## Land Transport (automobiles, buses, trains and trucks) round-up:

### • Automobiles:

- **NY zeros in:** On September 8 2021, New York Governor, Ms Kathy Hochul signed legislation requiring cars and light duty trucks / vans to be zero-emission from 2035, and medium and heavy trucks to be zero-emission by 2045. As such New York becomes the second state to commit in these terms, after California. Earlier in September 2021, Los Angeles City committed on similar terms.
- **Mercedes-Benz and Volkswagen decision:** Both Mercedes-Benz and Volkswagen have indicated that they do not intend to develop fuel cell electrical vehicles (**FCEVs**). This reflects the view that **FCEVs** do not achieve the required level of efficiency when used to power and to propel cars.

- **Buses:** As reported in Edition [22](#) of Low Carbon Pulse, Lord Mayor of London, Mr Sadiq Khan, announced the commencement of the use of fuel cell technology (**FCT**) buses in London. On September 18, 2021, it was reported widely that Mr Khan announced that all buses procured for use in London would be zero-emission vehicles.

### • Keeping track of rolling stock:

- **France deploys hydrogen passenger train:** Edition [26](#) of Low Carbon Pulse reported that on August 25, 2021, an Alstom Coradia iLint passenger train had been deployed in Östersund, Sweden. The Alstom Coradia iLint passenger train is powered and propelled using **FCT** (that oxidises hydrogen to generate electrical energy). Alstom Coradia iLint trains have been deployed in Austria, Germany and the Netherlands, and are to be deployed in Italy.

On September 6, 2021, the Alstom Coradia iLint passenger train debuted on French railways. Some of the coverage of the debut was interesting, allowing the casual reader to assume that this was the second coming of the steam engine.

See: [Alstom's Coradia iLint hydrogen train runs for the first time in France](#)

### • Hyundai on the road:

- **To being carbon-neutral road for 2045:** On September 6, 2021, Hyundai Motor Company (**HMC**) announced that it planned to become carbon-neutral by 2045. For these purposes, **HMC** noted its intention to place emphasis on the hydrogen value chain and the scaling up of **FCEV** technology and production.

As noted in previous editions of Low Carbon Pulse, **HMC** is at the forefront of the development and deployment of **FCEV**, and as such this announcement may be regarded as a natural next step.

In addition to progressing to carbon-neutrality, **HMC** has announced its Vision 2040 to popularise the use of hydrogen for "Everyone, Everything and Everywhere".

As noted above, **HMC** is one of the founding member of the KHA.

**See:** [Hyundai Motor Presents Carbon Neutral Commitment at IAA Mobility 2021](#)

- **And ports side with a drone:** On September 9, 2021, HMC unveiled the [e-bogie](#). The e-bogie is a hydrogen powered and propelled container transportation system with the ability to steer front and back, and to move sideways. The e-bogie is intended for use port side and in confined urban environments. The e-bogie is able to transport alone or in a cluster with other e-bogies.

**See:** [Hyundai Motor Group Presents Its Vision to Popularize Hydrogen by 2040 at Hydrogen Wave Forum](#)

- **Hyzon busy sales continue, and listing achieved:**

- **500 FCEV sold to Shanghai:** On September 9, 2021, Hyzon Motors Inc. announced that it had signed a memorandum of understanding (**MoU**) for the supply of 500 hydrogen powered fuel cell technology trucks to Shanghai Hydrogen HongYun Automotive. It is understood that the **MoU** contemplates firm orders by the end of 2021 for the delivery of 100 **FCEVs**, and orders in 2022 for a further 400 **FCEVs**.

**See:** [Hyzon Motors to supply up to 500 hydrogen fuel cell electric vehicles to Shanghai logistics company](#)

- **HoA to VSA:** Edition 22 of Low Carbon Pulse reported on a heads of agreement between Ark Energy Corporation (a subsidiary of Korea Zinc) for the supply of five 154 tonne **FCT** trucks. On September 14, 2021, Ark Energy Corporation announced that it had entered into a vehicle supply agreement with Hyzon Motors, Inc. for the supply of five 140 tonne **FCT** trucks by the end of 2022 to haul to and from the Sun Metals Corporation zinc refinery.

- **IVECO and Nikola:** Previous editions of Low Carbon Pulse reported that IVECO was committed to the development of **FCT** trucks. On September 16, 2021, IVECO and Nikola (leading fuel cell technology corporation) announced the development of a new **FCT** truck manufacturing facility in Ulm, Germany. The first **FCT** truck to be manufactured at the Ulm facility will be the Nikola Tre battery-electric and **FCT** powered and propelled truck, based on the IVECO S-Way track and incorporating Bosch-designed components. Earlier in September, Nikola agreed a licencing agreement with Bosch.

- **KIA to provide Military Hydrogen Fuelled Electric Vehicle:** On September 14, 2021, it was announced that Kia Motors (Korean vehicle manufacturer) had developed military **FCEV**, and that it is to launch non-military **FCEVs** in 2028.

## Port News and Shipping Forecast:

- **Windship head of wind:** Edition 21 of Low Carbon Pulse reported on the development of the windship. On September 6, 2021, it was reported widely that Windship Technology had received Approval in Principle (**AIP**) from international shipping classification society, **DNV**. An **AIP** provides an expert assessment of the basis for development of a vessel.

- **BP and NYK Line align on F/Fuels:** On September 15, 2015, it was reported widely that BP (leading international energy company) and NKY Line (leading global shipping company), had agreed to cooperate in relation to the development of future fuels, including hydrogen and hydrogen-based fuels. It is understood that LNG and biofuels are being considered, and potentially ammonia and methanol.

**See:** [bp and NYK Line join forces to help decarbonise hard-to-abate sectors](#); NYK Line [press release](#)

- **Hydrogen and hydrogen based fuels from Tromsø:** On September 16, 2021, H2view, reported that Magnora ASA, Prime Capital and Troms Kraft are to develop a large-scale Green Hydrogen production facility in Tromsø. As might be expected, the Green Hydrogen produced at the facility will be used as a feedstock for the production of Green Ammonia, and possibly other hydrogen-based fuels, to be used as bunkers.

## Aviation and Airports:

The purpose of this section of Edition 27 of Low Carbon Pulse is to provide an update of news items within the last two weeks (**Recent News**) and from the start of July (**Past News**). Given the word count and length of this Edition 27, **Recent News** is outlined. Edition 28 of Low Carbon Pulse will include **Past News**.

- **Recent News:**

- **100% Sustainable Aviation Fuel by 2050:** On September 9, 2021, the Biden Administration announced [plans](#) to achieve "a fully zero-carbon aviation sector by 2050". This will be achieved incrementally, with the production of at least 3 billion gallons of sustainable fuel that will enable aviation emissions to drop 20% by 2030, when compared to business as usual. The key policy settings to support these targets include the new and ongoing funding opportunities to support sustainable aviation fuel projects and fuel production of up to USD 4.3 billion;
- **Continuous Lower Energy and Noise Program:** On September 10, 2021, it was reported widely that the Federal Aviation Administration (**FAA**) has committed to grants worth more than USD 100 million for the purposes of making aviation more environmentally sustainable (through the reduction of **GHG** emissions) and less noisy;
- **Hyzon Motors Inc. flying:** On September 10, 2021, it was reported widely that ZeroAvia has contracted with Hyzon Motors Inc. for the supply of fuel cell stack systems for trucks to allow assessment of their use as part of its zero-emission aircraft development program. The attraction of the Hyzon full cell stack system is its energy / power density by volume of 6.0 kW per litre of hydrogen; and

- **Stuttgart, Germany, to Melbourne, Australia on 18 tonnes of fuel:** On September 15, 2021, it was reported widely that, based on modelling by easy-jet and the German Aerospace Centre, an Airbus A320 could fly from Stuttgart to Melbourne on 18 tonnes of liquid hydrogen.

## NZE reports:

As noted above, at the end of future editions of Low Carbon Pulse, reports that have been reviewed for the purpose of that edition of Low Carbon Pulse will be listed, by organisation, title / subject matter, and link.

ORGANISATION	TITLE / SUBJECT MATTER
BloombergNEF and wbcscd	<a href="#">Hot Spots for Renewable Heat: Decarbonising Low-to-Medium Temperature Industrial Heat Across the G-20</a>
Climate Action Tracker	<a href="#">Climate target updates slow as science ramps up need for action</a>
E3G	<a href="#">No New Coal by 2021: The Collapse of the Global Coal Pipeline</a>
Global Wind Energy Council	<a href="#">Global Offshore Wind Report 2021</a>
H2 Cluster Finland	<a href="#">A systemic view on the Finnish hydrogen economy today and in 2030 – Our common playbook for the way forward</a>
Intergovernmental Panel on Climate Change	<a href="#">Sixth Assessment Report – Climate Change 2021, The Physical Science Basis</a>
Lancaster University	<a href="#">The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations</a>
National Centers for Environmental Information	<a href="#">Global Climate Report – August 2021</a>
World Bank	<a href="#">Groundswell Part 2: Acting on Internal Climate Migration</a>

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

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



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