

Low Carbon Pulse - Edition 30

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS



Welcome to **Edition 30** of Low Carbon Pulse – sharing significant current and recent news on progress towards net-zero greenhouse gas (**GHG**) emissions (**NZE**) for the period from Monday November 1, 2021 to Sunday November 14, 2021 (inclusive of each day).

For those reading later in the week, this **Edition 30** of Low Carbon Pulse will be posted again on Friday November 19, 2021, with the Appendix to comprise the Report on Reports for September and October 2021.

Please click [here](#) for **Edition 29** of Low Carbon Pulse, and click [here](#) for the **Low Carbon Pulse Compendium**, which comprises **Editions 1 to 28** of Low Carbon Pulse (covering the 12 month period from October 6, 2021 to October 5, 2021). Click [here](#) and [here](#) for the sibling publications of Low Carbon Pulse, the **Shift to Hydrogen (S2H2): Elemental Change** series and [here](#) for the first feature in the **Hydrogen for Industry (H24I)** features.

Edition 31 of Low Carbon Pulse will be published in the usual two week cycle on November 30, 2021. **Edition 32** (*The Magic Johnson Edition*) will be published on Friday December 17, 2021 and **Edition 33** (*The Larry Bird Edition*) on Friday January 14, 2021, after the Christmas and western New Year holiday season. The Appendix to **Edition 33** will comprise the Report on Reports for November and December.

Progress at COP-26:

- **Down to earth:**

Edition [29](#) of Low Carbon Pulse, suggested that expectations for the 26th session of the Conference of Parties (**COP-26**) of the United Nations Framework Convention on Climate Change were somewhere between heightened and sky high.

As US Special Climate Change Envoy, Mr John Kerry, said in Milan: "*The bottom line is, folks, as we stand here today, we believe we can make enormous progress in Glasgow, moving rapidly towards new goals that science is telling us we can achieve*". Progress was made in Glasgow, but not, as yet, sufficient progress to avoid the worst consequences of climate change. To achieve this, we need to hold the increase in average temperature to **1.5°C**. This is clear.

- **Down and out in Rome, Up and about in Glasgow:**

Before **COP-26** President of **COP-26**, Mr Alok Sharma, set out the four UK Government Goals for **COP-26** (**Four Pillars**). The next page or so outlines progress made in respect of the **Four Pillars**.

Four Pillars: In the working week before **COP-26**, 2021, Low Carbon Pulse published five [COP-26 Countdown features](#) describing each of the **Four Pillars**.

In short hand, the **Four Pillars** were as follows:

1. Secure global net zero by mid-century and keep 1.5 degrees within reach;
2. Adapt to protect communities and natural habitats;
3. Mobilise finance; and
4. Work together to deliver (including the finalisation of the **Paris Rulebook**).

- **In summary:**

On the evening of November 13, 2021, **COP-26** ended with the agreement of the **Glasgow Climate Pact (GPC)**. In terms of future action, the **GPC** variously encourages, requests and urges increased levels of action on climate change and resolves a limited number of matters. One of the resolutions is, "to move swiftly to the full implementation of the Paris Agreement", in light of the agreement on the **Paris Rulebook**.

- **GPC** was agreed to by 197 countries. This is real progress.

Some headlines may read "climb down" in "phasing down of unabated coal-fired power generation" and increased **GHG** emission reductions (**NDCs**) deferred to COP-27. All progress is incremental.

To the author of Low Carbon Pulse, the agreement of the **Paris Rulebook** as always going to the mark of success of **COP-26** (see Edition 29 of Low Carbon Pulse). The **Paris Rulebook** was agreed.

- In the context of **Pillar 1**, the **GPC**:

- kept "1.5 degrees within reach .. But, its pulse is weak" with countries responsible for between 85% and 90% (depending on which data source is used) of **GHG** emissions now committed to achieving **NZE** and revised and strengthened **NDCs** to be finalised during 2022; and

- reflects agreement to phase-down of unabated coal-fired power generation capacity.

- In the context of **Pillars 2** and **3**, the **GPC** provides for increased financial support through the Adaptation Fund, with developed countries urged to double, at least, their support to developing countries by 2025.

- In the context of **Pillar 4**, the Paris Rulebook agreed:

Before **COP-26**, Mr Sharma had been quoted as saying that reaching agreement of the **Paris Rulebook** will be more difficult than achieving agreement of the Paris Agreement. While it took an extra day, the **Paris Rulebook** was agreed, critically on Article 6, Common Timeframes and transparency. The **Paris Rulebook** is not watertight, but it will float.

Edition 27 of Low Carbon Pulse noted that the compromise was likely, and it was. The **Paris Rulebook** in respect of Article 6 of the **Paris Agreement** reflects that compromise, but it is enough for countries to commence exchange of carbon credits, but with the market to distinguish the high-quality carbon credits.

Early in the western New Year, the author of Low Carbon Pulse will publish a standalone piece on the implications of Article 6 of the **Paris Agreement**, and carbon credits. The *November and December Report on Reports*, to be published as the Appendix to Edition 33 of Low Carbon Pulse, will cover the **Paris Rulebook** in detail.

- **Quotes of COP-26:**

"Two degrees is a death sentence [for small island states]".

Prime Minister of Barbados, Ms Mia Mottley (watch Ms Mottley's speech [here](#))

"What is stopping any other heavy, hard to abate industries from doing the same [i.e., doing what FMG is doing]?"

Nothing. Just the will to make it happen!

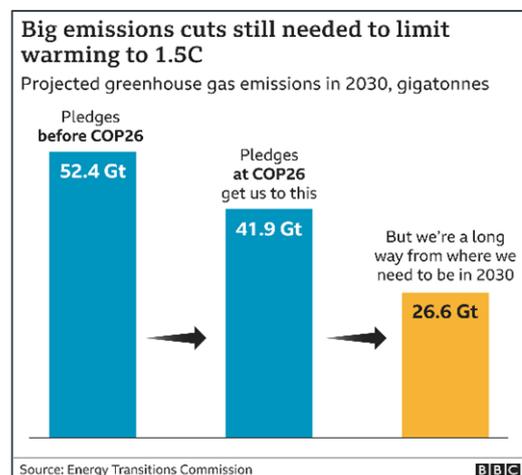
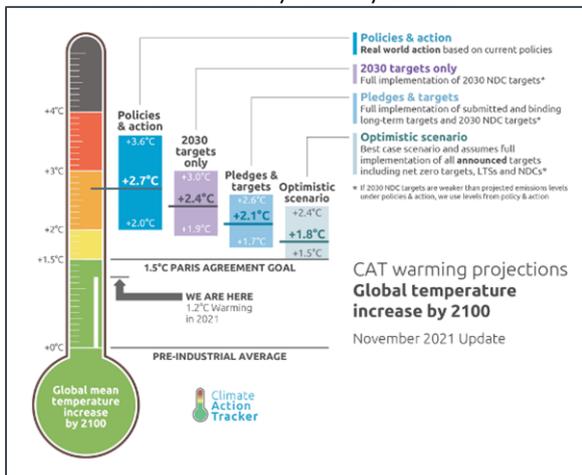
CEO of Fortescue Future Industries, Ms Julie Shuttleworth (watch Ms Shuttleworth's speech [here](#))

"We are still knocking on the door of climate catastrophe ... it is time to go into emergency mode – or our chance of reaching net-zero will itself be net zero"

United Nations Secretary-General, Mr Antonio Guterres on the final day of COP-26

- **Context of Climate Change:** Before **COP-26**, United Nations Secretary-General, Mr Antonio Guterres warned of the **Catastrophic Pathway** of a **2.7°C** (see Edition 28, [Anniversary Edition](#), and Edition 29 of Low Carbon Pulse) increase in average global temperatures in a speech given to the General Assembly of the United Nations. During the **World Leaders' Summit** that took place on November 1 and 2, 2021, various leaders committed to increased **NDC** and to **NZE**.

During **COP-26**, the good folk at the Climate Change Tracker produced one of their excellent visual representations of what increased and new commitment meant. The graphic is included below. In short the best case scenario is to hold the increase in average global temperatures to **1.8°C**. This is positive, but more needs to be done to get hold of the increase in average global temperatures to **1.5°C** (the **Stretch Goal**), including to reduce **GHG** emissions by 45% by 2030.



- **There has been a lot going on at COP-26 and elsewhere:**

One could be forgiven for thinking that **COP-26** was multiple meetings and summits rolled into one. A number of meetings took place just before and at **COP-26**. In addition, many meetings took place on the side-lines at **COP-26**.

- **G20 Rome Summit** took place on October 30 and 31, 2021 (link to [communiqué](#)) and had climate change on the agenda, with the agenda and the outcomes mirroring the **First Pillar**: "Keeping 1.5 degrees within reach will require meaningful and effective actions and commitment by all countries, taking into account different approaches" and achieving **NZE** "by or around mid-century". An agreed means of achieving this was the "phase-out" of coal. In addition, there was agreement on ceasing to fund the development of new unabated coal-fired power generation capacity, and the commitment to provide funding of USD 100 billion a year to developing countries was restated (aligned with the **Third Pillar**).

On reflection it should not have been a surprise that the outcomes outlined in the communiqué were consistent with the **Four Pillars**, and as such, the disappointment expressed in some quarters was probably misplaced.

- **World Leaders' Summit** took place on November 1 and November 2, 2021 (link to [communiqué](#)) at which climate change was on the agenda, and progress was made.

At the **World Leaders' Summit**, held over the first two days of **COP-26**, there were speeches from world leaders (some of whom committed to **NZE** and to increased **NDCs**) and progress on the **Breakthrough Agenda** on the first day, with the second day involving progress on deforestation and methane (**CH₄**) reductions.

- **Breakthrough Agenda and Goals and Agreement:** The four goals of the **Breakthrough Agenda** require the signatories to each of the goals to work together: **1.** to make clean technology and sustainable solutions "the most affordable, accessible and attractive option", for their respective sectors; **2.** to make clean power "the most affordable and reliable option for all countries"; **3.** for zero emission road vehicles to become the new normal; and **4.** for near zero emission steel to become the "preferred choice in global markets" (together the **Glasgow Breakthroughs** and each a **Glasgow Breakthrough**). The **Breakthrough Agenda** details the many global initiatives to make progress towards, and coordinating activities, to achieve each **Glasgow Breakthrough**.

The International Energy Agency (**IEA**) is to produce an annual report on progress of each **Glasgow Breakthrough**, working with the International Renewable Energy Agency (**IRENA**), and UN High-Level Climate Action Champions and "other institutions, bodies and industry leaders".

The **Breakthrough Agenda and Goals and Agreement** did not grab as many headlines as deforestation and the reduction in **CH₄**, but represented real progress, with iron and steel brought within the climate change framework for the first time. Tellingly, countries producing around 35% of global iron and steel production committed to get close to net zero by 2030.

The general statement in the **Breakthrough Agenda** was endorsed as follows: Australia, Belgium, Canada, Cabo Verde, Chile, Denmark, Egypt, European Union, Finland, France, Germany, Guinea Bissau, India, Israel, Italy, Japan, Kenya, Latvia, Lithuania, Malta, Mauritania, Morocco, Namibia, the Netherlands, New Zealand, Nigeria, North Macedonia, Norway, Panama, the Peoples Republic of China, Portugal, Republic of Ireland, Republic of Korea, Senegal, Slovakia, Spain, Sweden, Turkey, United Arab Emirates, UK, and US.

Each of the four **Glasgow Breakthroughs** were endorsed by some, but not all, of the countries that endorsed the statement in the **Breakthrough Agenda**. The **Glasgow Breakthrough** records the signatories to each.

- **Breakthrough on deforestation and land use:** The highlight of the **World Leaders Summit** may be regarded as the pledge to end deforestation and to reverse land degradation by 2030.

As a practical matter, the pledge covers over 85% of the world's forests, and is accompanied by funding support (with over 40 countries committing to taking action to end deforestation by 2030 by committing USD 12 billion in public finance and USD 7.2 billion in private finance by 2030, often referred to as USD 20 billion).

While the commitment to end deforestation and to reverse land degradation by 2030 is progress, it is hoped that countries will end deforestation as soon as possible, likewise reverse land degradation.

It is to be hoped that developing countries are able to realise the value from carbon credit trading at the same time as progress is made to end deforestation and reverse land degradation. In this context, it is important that developing countries place appropriate value on initiatives that give rise to the removal of **CO₂** from the climate system, both for the purposes of use to off-set obligations to acquit **GHG** emission obligations and commitment and for the purposes of absolute removal of **GHG** emissions from the climate system. This will be addressed in the standalone article referred to above (under **In Summary – Paris Rulebook**).

- **High Ambition Coalition (HAC) Leaders' aligned NDCs with 1.5°C:** At the **World Leaders' Summit** (over the first two days of **COP-26**), **HAC Leaders** [announced](#) that they were committed to increasing the **NDC's** to align with holding the increase in average global temperatures to **1.5°C** (**Stretch Goal**) for the purposes of commitments to be made before or at COP-27, to be held in Egypt in 2022.

The **HAC Leaders** include those of countries in the Caribbean and the Pacific, Denmark, France, Germany, the Netherlands, Spain, and the US.

- **Global Methane Pledge - continued momentum:**

While progress on the **Global Methane Pledge** was not part of the formal business at **COP-26**, the approach of **COP-26**, and the presence of world leaders has provided the European Commission (**EC**) and the US with an opportunity to apply diplomacy to increase the number of countries committed to the **Global Methane Pledge**.

Edition [27](#) of Low Carbon Pulse reported on the signing of the **Global Methane Pledge**, signed by the **EC** and the US on September 17, 2021, and stated, "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".

Those hopes have been exceeded.

The [Anniversary Edition](#) of Low Carbon Pulse, noted the progress since October 2020 on recognition of the need to address **CH₄** emissions, culminating in the **Global Methane Pledge**. In the lead up to **COP-26**, over 90 countries had committed to the **Global Methane Pledge**.

By the end of the second day of the **World Leaders' Summit**, it was reported that over 105 countries had committed to the **Global Methane Pledge**.

Among those committing to the **Global Carbon Pledge** was Brazil (a top five methane emitter). Australia, India, the Peoples Republic of China (**PRC**), and Russia have not as yet committed to the **Global Methane Pledge**. It is hoped that India, the **PRC** and Russia will commit, and, as noted below, this may be sooner rather than later in the case of the **PRC** (see **Time for reflection – Know no boundaries**, below). Unfortunately, Australia has ruled out committing.

- **Limiting the increase in global average temperature to well below 2°C imperative:**

In the lead-up to **COP-26** and the **World Leaders' Summit**, authoritative voices from business, industry and science were emphasising the need to stay as close to the **Stretch Goal** as possible, and that the impact of an increase of **2°C** in average global temperatures would be too much.

Chief Scientific Adviser to the UK Government, Sir Patrick Valance, noted that it was crucial that **1.5°C** is kept alive. This was a timely reaffirmation of the core of the Paris Agreement:

"Holding the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels ..."

In an opinion piece, the case is put cogently by the CEO of Statkraft (global leader in hydropower and Europe's largest generator of renewable electrical energy), Mr Christian Rynning Tønnesen. Please click [here](#) to read the opinion piece – it is well-worth a read.

A number of world leaders made a similar point, most powerfully, the Prime Minister of Barbados, Ms Mia Mottley.

An increase of **2°C** above pre-industrial levels will not allow us to avoid the worst effects of climate change, and for some island countries, and for areas of lower lying coastal regions, as Ms Mottley said, a **2°C** increase is a "death sentence".

The United Nations Secretary-General, Mr António Guterres addressed the **World Leaders' Summit**, among other things, again calling time on fossil fuels, and noting the importance of the **Stretch Goal**. Mr Guterres' [speech](#) is worth a read.

- **Time for reflection:**

- **Know no borders:** The Chair of the International Panel on Climate Change, Mr Hoesung Lee, spoke at the opening ceremony of **COP-26**. Mr Lee reflected that: **"our atmosphere and climate know no borders, the true measure of effectiveness of our collective efforts will be the state of its condition"**.

- **Know no boundaries:** On November 10, 2021, the **PRC** and the US (the two largest emitters of **GHG** globally) announced jointly, in the [Declaration on Enhancing Climate Action in the 2020s](#), that they would work together to fight climate change. In concept, it is difficult to over-state the significance of the **Declaration**. It is hoped that the realisation of the **Declaration** is as significant.

The **PRC** and the US highlight the importance of staying close to the **1.5°C** average increase in global temperature prescribed in the **Paris Agreement**. Aligned with this announcement, the Special Climate Negotiator for the **PRC**, Mr Xie Zhenhua, announced that the **PRC** would cut **CH₄** emissions.

- **Boundless opportunities - Net-zero World Initiative:** On November 3, 2021, the [Net-zero World Initiative \(NZWI\)](#) was announced, with founding partners, Argentina, Chile, Egypt, Indonesia, Nigeria and Ukraine. The US Department of Energy will lead the **NZWI**, working with corporations, not for profit organisations, thinktanks and universities, including Breakthrough Energy. The detail of the **NZWI** is well-worth a read.

- **Progress by largest emitters:** The five largest emitters of **GHG** emissions are the **PRC**, the US, India, Russia and Japan.

In four sentences for each of India, Russia and Japan, we reflect on the state of play, noting that each country has considerable heavy lifting to do to achieve **NZE** by their respective dates for the achievement of **NZE**; 2070, 2060 and 2050:

- **India:** In the lead up to, and at **COP-26**, India has "shifted the dial" significantly in its policy settings, and the rate of progress. In many ways India could emerge as a case study in how to continue to achieve economic development while at the same decarbonising and electrifying.

The developed world needs to do more, and to work ever harder, with India so as to allow India to achieve the targets it has set itself.

- **Russia:** The Oxford Institute for Energy Studies (**OIEIS**) released a paper entitled [The Russian Perspective on COP-26 and the Key Challenges of the Road to Net Zero](#) in September 2021. The paper is well-worth a read, providing a clear and direct assessment of the road that Russia must travel to reach **NZE**. Russia has committed to achieving **NZE** by 2060, but this commitment has yet to be adopted formally. For Russia, the challenge in progressing to achieving **NZE** is probably greater than for any other country rich in hydrocarbons, but decarbonising the Russian economy offers a once in a hundred year opportunity.

- **Japan:** During **COP-26**, the **OIEIS** released a paper entitled [Energy Transition in Japan and implications for gas](#). Most of the heavy lifting in policy setting for Japan was done well in advance of **COP-26**: the commitment to **NZE** by 2050 was made in October 2020, and the increased **NDC**, from 26% to 46% compared to 2013 by 2030, was made in April.

For Japan, the focus is how to accelerate decarbonisation of its heavily hydrocarbon reliant economy to achieve the targets it has set itself. One thing is for sure; its corporations are leading the way in the development of many of the means to decarbonise.

- **Progress at COP-26 against each of the Four Pillars in more detail:**

As noted above, in the working week leading up to **COP-26**, Low Carbon Pulse published features on each of the **Four Pillars**. The next page or so considers the progress made in respect of each of the **Four Pillars**.

- In full **Pillar 1** contemplated:

"Countries are being asked to come forward with ambitious 2030 emission reductions targets, that align with reaching net zero by the middle of the century.

To deliver on these stretching targets, countries will need to:

- Accelerate the phase out of coal;
- Curtail deforestation;
- Speed up the switch to electric vehicles;
- Encourage investment in renewables."

Progress was made as follows:

- **Ambitious 2030 emission reduction targets and net zero commitments:** as a general statement, progress was made, and the progress that was made is outlined above (under **In Summary**) and detailed below (under **NDCs and NZE**).

- **From phase out to phase down of unabated coal:** On November 4, 2021, more than 40 countries signed the [Global Coal to Clean Power Transition Statement](#) (**Glasgow Coal Phase Out Agreement**). This initiative is a further development in not developing unabated coal-fired power generation capacity.

Over the final 24 hours of **COP-26** (extend to November 13, 2021) the phrase "**phase-out**" was replaced by the phrase "**phased-down**". Many countries expressed disappointment with this late change, but in the interests of getting agreement, the change was accepted and reflected in the **Glasgow Climate Pact**. For the developed countries that expressed disappointment, it is hoped that they will "lean forward" and provide assistance to developing countries to "**phase-out**" unabated coal-fired power generation capacity.

Rather than being disappointed by the change, the author of Low Carbon Pulse was pleased, not because of the change itself, but because the author has long noted that developing countries should not commit to reductions and outcomes that they know are not achievable.

The commitments made need to be reflected in the laws and regulations of countries making those commitments, and the corporations and the populations of those countries have to be able to comply with those laws and regulations.

- **Curtailed deforestation:** On November 2, 2021, more than 100 countries committed to end deforestation, and to effect by 2030.

The mining and combustion of coal contributes greatly to **GHG** emissions globally including for the purposes of the generation of electrical energy, for the production of clinker in cement manufacture and for the production of iron and steel.

- **Speeding up switch to electric vehicles (EVs) and encourage investment in renewables:** While the **GCP** touches on these matters tangentially, the **Glasgow Breakthroughs** provide key progress with Acceleration of growth in low carbon hydrogen or renewable hydrogen (one **Glasgow Breakthrough**): 32 countries and the European Union have agreed to work together to develop and to deploy low-carbon hydrogen / renewable hydrogen by 2030 so that "affordable renewable and low-carbon hydrogen is globally available by 2030" (**H2 Target**).

The countries that committed to the **H2 Target** are: Australia, Belgium, Canada, Chile, China, Denmark, Egypt, Finland, France, Germany, Guinea Bissau, India, Ireland, Israel, Italy, Japan, Kenya, Lithuania, Norway, Mauritania, Morocco, Namibia, the Netherlands, New Zealand, Panama, Slovakia, South Korea, Spain, Sweden, Turkey, the UK and the US.

- In full **Pillar 2** contemplated:

"The climate is already changing and it will continue to change even as we reduce emissions, with devastating effects. As COP-26 we need to work together to enable and encourage countries affected by climate change to:

- Protect and to restore ecosystems; and
- Build defences, warning systems and resilient infrastructure and agriculture to avoid loss of homes, livelihoods and even lives".

Progress was made through emphasis on adaptation (paragraphs 6 to 13 of the **GCP**) and adaptation finance (paragraphs 14 to 19), mitigation (paragraphs 20 to 39), and mitigation and adaptation finance (paragraphs 40 to 60), and loss and damage (paragraphs 61 to 74).

Indeed the **GCP** is dominated by the coverage of adaptation and mitigation, and associated matters. The reason for this is that it is in the area of adaptation and mitigation that most needs to be done among Parties to the **Paris Agreement**, and least has been done so far.

In addition to the action detailed in the **GPC**, as noted above, on the second day of the **World Leaders' Summit** the pledge to end deforestation and to reverse land degradation by 2030 was committed to by countries having 85% of the world's forests.

The International Renewable Energy Agency (**IRENA**) and the Alliance of Small Island States (**AOSIS**) signed an agreement on November 8, 2021 (**Adaptation Day**) at **COP-26**. The agreement is reported to provide for **IRENA** and **AOSIS** to work together to mobilise climate finance and to advance the deployment of renewable energy across the Small Island Developing States (**SIDS**).

This agreement follows an agreement in September 2021 (in contemplation of **COP-26**) under which **IRENA** and **AOSIS** are going to work to install 10 GW of renewable electrical energy capacity across the **SIDS**.

- In full **Pillar 3** contemplated:

"To deliver on our first two goals, developed countries must make good on their promise to mobilise at least USD 100 billion in climate change funding a year by 2020.

International financial institutions must play their parts and we need to work towards unleashing the trillions in private and public sector finance to secure global net zero".

Progress was made in the sense of a clear acknowledgment (through an expression of "deep regret" - see paragraph 44 of the **GCP**) that the goal of mobilising USD 100 billion a year by 2020 "had not yet been met". Developed countries are urged to mobilise "fully on the USD 100 billion a year commitment urgently through to 2025" (paragraph 46), and at least to double "their collective provision of climate finance for adaptation to developing countries from 2019 levels by 2025" (paragraph 18).

- In full **Pillar 4** contemplated:

"We can only rise to the challenges of the climate crisis by working together.

*At **COP-26** we must:*

- *Finalise the Paris Rulebook (the detailed rules that make the Paris Agreement operational); and*
- *Accelerate action to tackle the climate crisis through collaboration between governments, businesses and civil society".*

Progress was made through the agreement of the **Paris Rulebook**. As noted above, for the author the measure of success of **COP-26** (as expressed in Edition [29](#) of the Low Carbon Pulse) was the agreement of the **Paris Rulebook**. As noted above, the **Paris Rulebook** will be considered in a stand-alone article early in 2022.

In addition to the framework provided by the **Paris Rulebook**, the **GCP** urges action "to [scale-up further] investments in climate action and calls for a continued increase in the scale and effectiveness of climate finance from all sources globally, including grants and other highly concessional forms of finance" and "to provide enhanced and additional support for activities addressing loss and damage associated with the adverse effects of climate change". It is fair to say that on the side-lines, Mark Carney was working tirelessly to facilitate collaboration and, in so doing, acceleration.

- **NDCs and NZEs:**

While a good number of countries have committed to achieving **NZE** and have increased their **NDCs**, based on population and projected population growth to 2060, the commitment made by the following may be regarded as of particular significance during **COP-26** (with combined current population of 2,170 billion people of 7.9 billion people):

- **Brazil** committed to achieving **NZE** by 2050 (213 million people);
- **India** committed to achieving **NZE** by 2070 (see under **India - Five prime commitments** below for details of further progress) (1.38 billion people);
- **Indonesia** committed to achieving **NZE** by 2060, and to reducing **GHG** emissions by 29% by 2030, or by 41% by 2030 with support from developed countries (273.5 million people).

Given the **ETM SEAP** (see next item under **Central Banks and Policy Banks Progress – Retirement of coal**), Indonesia may phased out coal-fired power generation by 2040 (sixteen years earlier than previously – see Edition [18](#) of Low Carbon Pulse detailing the planned phase out of coal-fired power generation in Indonesia);

- **Nigeria** committed to achieving **NZE** by 2060 (206 million people); and
- **Vietnam** committed to achieving **NZE** by 2050 (98 million people).

Countries from which at least 80% (some sources suggest 90%) of **GHG** emissions arise annually have now committed to achieving **NZE**.

Countries that may be regarded as the key coal producers and users, have now committed to achieving **NZE**: Australia, India, Indonesia, Japan, the PRC, Republic of Korea, Russia, South Africa, the US and Vietnam.

- **Central Banks and Policy Banks Progress:** In the lead up to **COP-26**, Editions [26](#), [27](#), [28](#) and [29](#) covered the roles to be undertaken by Central Banks and Policy Banks.

- **Retirement of coal:** Editions [25](#) and [27](#) of Low Carbon Pulse covered the "acquire to retire program". On November 3, 2021, the Asian Development Bank, Indonesia and the Philippines announced the Energy Transition Mechanism (**ETM**) Southeast Asia Partnership (**SEAP**).

The **ERM SEAP** provides a framework to allow the acceleration of the retirement of coal-fired power stations.

In launching the **ERM SEAP**, the Indonesian Finance Minister, Ms Sri Mulyani Indrawati, noted that if Indonesia was to retire coal-fired power generation capacity by 2040, it needed "funding to retire coal earlier and to build the new capacity of renewable energy" (see Editions [26](#) and [27](#) of Low Carbon Pulse).

To illustrate the level of funding required: the Indonesia Government has identified 5.5 GW of coal-fired power generation capacity that could be retired by 2030, at a cost of between USD 25 and 30 billion. The costs of electrical energy supplied to consumers of electrical energy is managed by the Government through its ownership of PT PLN (the Indonesian state-owned power utility corporation). Ms Sri Mulyani Indrawati noted that the cost of electrical energy would have to continue to be managed to ensure that the renewable electrical energy displacing the existing non-renewable electrical energy remained affordable.

- **Invigoration of role of Policy Banks:** The **GCP** calls upon "multilateral development banks" (with other financial institutions and the private sector) to enhance the mobilisation of finance generally, and specifically in respect of adaptation and mitigation, including "how climate vulnerabilities should be reflected in the provision and mobilization of concessional financial resources and other forms of support. In addition, the **GCP** "calls for multilateral development banks and other financial institutions to accelerate the alignment of their financing activities with the goals of the Paris Agreement".

While the Policy Banks have heard and read all of this before, the role of the Policy Banks, and the coordination between them, is central to achieving progress to reduce **GHG** emissions, and to achieving progress to **NZE**.

• **Business and Industry Progress during COP-26:**

- **Where there is a will there is a way:** For the author of Low Carbon Pulse, the quote of **COP-26** from the private sector was:

"What is stopping any other heavy, hard to abate industries from doing the same [i.e., doing what FMG is doing]? Nothing. Just the will to make it happen!"

Ms Julie Shuttleworth, CEO of Fortescue Future Industries. (Watch Ms Shuttleworth's speech [here](#)).

- **Green Hydrogen Catapult:** On November 6, 2021, it was reported widely that the **Green Hydrogen Catapult** (comprising a coalition of leaders from Acwa Power, CWP Global, Fortescue Future Industries, H2Green Steel, Iberdrola, Maersk Mc-Kinney Moller Center, Orsted, Snam and Yara), with the support of UN High Level Champions for Climate Action, committed to secure finance so as to develop and to deploy 45 GW of electrolysers by 2026.
- **Mission Possible:** On November 8, 2021, Mission Innovation (see Edition [19](#) of Low Carbon Pulse), [announced](#) a public-private partnership to accelerate research and development in carbon dioxide removal (**CDR**).
- **Breaking through:** On November 8, 2021, Mr Bill Gates (through [GatesNotes](#)) reflected on the time spent at **COP-26**. The reflections are well-worth a read.

Mr Gates notes that the "**climate conversation has shifted dramatically, and for the better**". Mr Gates hones in on three principal shifts: **1.** Increased and clear understanding of the role of clean energy innovation, and its place on the agenda; **2.** Increased, and now central role, of the private sector alongside Governments and not-for-profit organisations; and **3.** Increased visibility for climate adaptation. As part of this increased visibility Mr Gates notes the launch of the **Agricultural Innovation Mission for Climate**.

- **Mark Carney posts:** In a number of posts during **COP-26**, Mr Mark Carney, noted that "tremendous progress" had been made, including that there is "a clear pathway" to mandatory climate-related reporting with **G7** and **G20** both supporting the *IFRS Foundation Sustainability Standards Board*, 90 Central Banks have joined the Network for Greening the Financial System (with the countries of those Central Banks covering 80% of **GHG** emissions globally). The *Glasgow Financial Alliance for Net Zero (GFANZ)* is "the gold standard for net zero commitments in the financial sector" and the "FSB Task on Climate-related Financial Disclosures (**TCFD**) ... help us move to ... finance the transition to net zero". The **GFANZ** is reported to be made of more than 450 financial institutions, including banks, asset managers, and insurers.

• **Less Progress during COP-26 (and therefore more progress required):**

- **Beyond Oil and Gas Alliance (BOGA):** Edition [28](#) of Low Carbon Pulse noted that Costa Rica and Denmark are leading **BOGA**. The primary purpose is to persuade countries to commit to a firm date by which they will cease to produce oil and gas. As of November 11, 2021, **BOGA** had 11 signatories.
- **Increased awareness:** The author of Low Carbon Pulse listened to and watched tens of hours of streaming and read tens of thousands of words during **COP-26**. While there is a level of understanding, the nature and the quality of understanding would be enhanced greatly if Governments undertake public information programs.

• **Links to outcomes:**

The following table provides links (drawn from <https://ukcop26.org/the-conference/cop26-outcomes/>) to documents detailing outcomes from **COP-26**.

PROGRESS AT COP-26				
Breakthrough Agenda	COP-26 Catalyst For Climate Action	Adaption Research Alliance (ARA) Joint Statement on Launch	The COP 26 Health Programme	Zero Emission Vehicles Transition Council: 2022 Action Plan
International Aviation Climate Ambition Coalition	COP 26 Declaration on Accelerating the Transition to 100% Zero Emission Cars and Vans	Clydebank Declaration for Green Shipping Corridors	New Mission Innovation Missions	The Global Action Agenda for Innovation in Agriculture
Chair's Summary - Policy Dialogue on Accelerating Transition to Sustainable Agriculture through Redirecting Public Policies and Support and Scaling Innovation	Co-Chairs Conclusions of Education and Environment Ministers Summit at COP 26	Supporting the Conditions for a Just Transition Internationally	Focus of Energy Transition Council (ETC)	Joint Statement in Support of the UK-IEA Product Efficiency Call to Action to Raise Global Ambition Through the SEAD Initiative
Global Coal to Clean Power Transition Statement	Statement on International Public Support for the Clean Energy Transition	Mission Innovation-Breakthrough Energy Collaboration Agreement	COP26 World Leaders Summit - Presidency Summary	MDB Joint Climate Statement
Green Grids Initiative - One Sun One World One Grid: One Sun Declaration	Political Declaration on the Just Energy Transition in South Africa	COP26 World Leaders Summit - Statement on the Breakthrough Agenda	Forests, Agriculture and Commodity Trade	Agricultural Commodity Companies Corporate Statement of Purpose

- **Other publications in the context of COP-26:**

- **UNDP Carbon Pricing and Fossil Fuel Subsidies:** The United Nations Development Programme (**UNDP**) has published [A Guide to Carbon Pricing and Fossil Fuel Subsidy Reform: A Summary for Policymakers \(UNDP Guide\)](#). The **UNDP Guide** is a welcomed publication, and is well-worth a read.

Background: The **UNDP Guide** ties policy to the achievement of the [Sustainable Development Goals \(SDG\)](#). As noted in previous editions of Low Carbon Pulse, a detailed consideration of the **SDG** is beyond the scope of Low Carbon Pulse (although not the sibling publications).

Key messages: The key messages from the **UNDP Guide** are: **1.** Carbon pricing is key to reducing emissions and achieving reductions consistent with **NDCs**, and economic benefits; **2.** Carbon pricing can be imposed in a number of ways, but principally through an emissions trading scheme or a tax, or both (see Edition [11](#) of Low Carbon Pulse); **3.** Carbon pricing is intended to increase the cost of the use of "polluting fuels and technologies", but must avoid civil unrest; **4.** Carbon pricing should be viewed as both a policy setting to reduce **GHG** emissions and as a revenue raising tool; **5.** International momentum on carbon pricing is gathering pace.

By way of further background: As a general statement the fossil fuel subsidies are effected directly, typically, through subsidising the cost of fossil fuel to users, including not charging the full cost of production or exempting fossil fuels from a duty, impost or tax that might otherwise apply, or, indirectly, by not regulating activities such that the activities are undertaken that would ensure that the adverse effects of fossil fuel production and use are avoided or mitigated, and the full cost, cradle to grave, of development to decommissioning are subject to a fiscal regime works consistently.

- **Lazard Annual Levelizer:** Lazard (leading investment bank) published its annual [Levelized Cost of Energy Analysis](#) ahead of **COP-26**. The headline from the Lazard Report is consistent with other-findings during 2021, with photovoltaic solar and wind renewable electrical energy generation having an established cost advantage over coal, natural gas and nuclear electrical energy generation.

- **Global Stock Take:**

Mr Lucas Kruitwagen from the University of Oxford (with fellow researchers), has undertaken a study to develop a *Global Inventory* of utility scale photovoltaic solar facilities (being facilities with electrical energy generation capacity greater than 10 kW, excluding residential roof-top photovoltaic solar).

This research was published in [nature.com](#) magazine on October 27, 2021. The research located and mapped 68,661 facilities with between 350 and 500 GW on a plus or minus basis, but including an estimate of 423 GW utility scale photovoltaic solar capacity installed globally to the end of 2018.

- **Oversize is the right size:**

On November 3, 2021, the author came across the pithy phrase "*oversize is the right size*" in relation to the development of renewable electrical energy capacity in the context of [research](#) done by Caldeira.

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

The research is well-worth a read. While the research does not provide a solution based on the use of renewable electrical energy and **BESS**, given that a solution for the 200 hours a year needs to be found, the research does illustrate the continued direction of travel for renewable electrical energy. The obvious solution may appear to be oversized in some locations due to a higher percentage or to increase the **BESS** capacity, or both.

- **Profile and shape sizing – a view from the roof:**

On November 2, 2021, [reneweconomy.com.au](#) reported on the impact on the profile, and shape, of, and price of, electrical energy dispatched across the Australian National Electricity Market of the ever increasing dispatch of renewable electrical energy from roof-top photovoltaic solar installations. The report notes that Australia now has 13 GW of roof-top photovoltaic capacity, with that capacity being added to at a rate of around 3 GW a year.

Climate change reported and explained:

As noted in recent Editions [26](#), [27](#) and [28](#) of Low Carbon Pulse, the purpose of this section of Low Carbon Pulse is to report the facts and stats as they relate to climate change, and as necessary to provide an explanation. This section was not included in Edition [29](#) of Low Carbon Pulse so as to manage the length of that edition.

- **Concentration of CO₂:** Accordingly, the US National Oceanic and Atmospheric Administration (**NOAA**), in the week from October 31 2021 to November 6, 2021 recorded the concentration of **CO₂** in the climate system was 414.17 parts per million (**ppm**).

In the same week in 2020, the concentration of **CO₂** was 411.93 **ppm**.

In the same week in 2011 (ten years ago), the concentration of **CO₂** was 389.8 **ppm**.

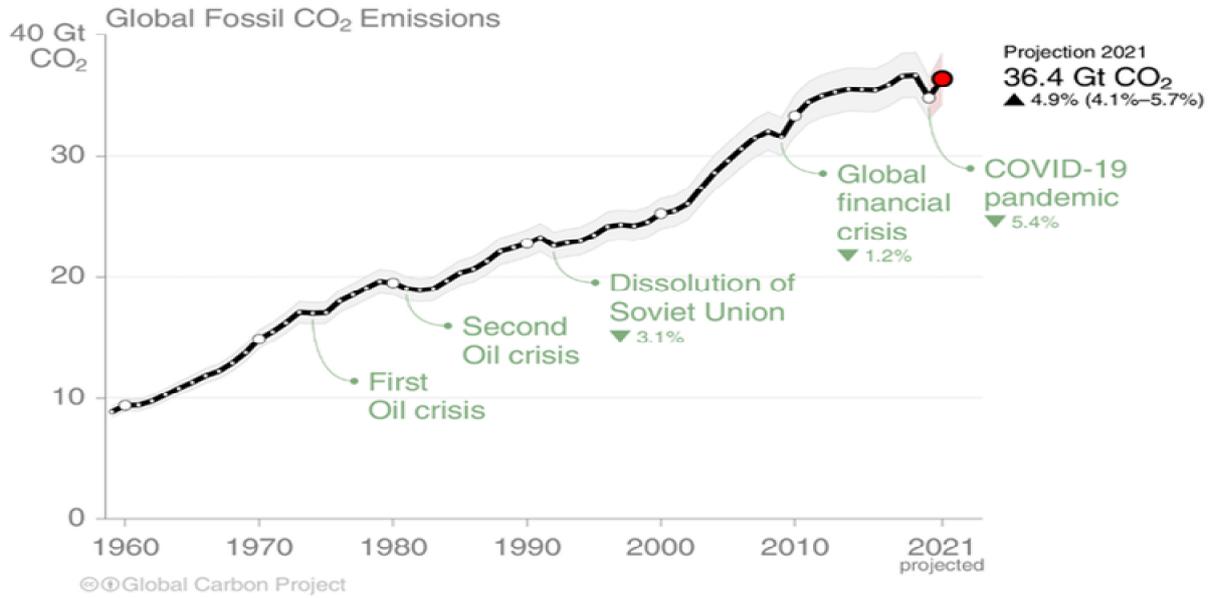
- **Mass of CO₂:** As the end of calendar year 2021 approaches, the early analyses and estimates of total **GHG** emissions from fossil fuels are being published.

On November 4, 2021, a Global Carbon Project (**GCP**) [study](#) is projecting that in 2021 **36.4** giga tonnes (**Gt**) of **CO₂-e** will be emitted into the climate system, compared to 2019 **36.7 Gt** of **CO₂-e**. After the reduction in **GHG** emissions arising in 2020, the level of **GHG** emissions arising in 2021 represents a bounce back – see the graphic at the top of the next page. The bounce-back is a function of a bounce-back to the use of fossil fuels.

At the same time as **GHG** emissions arising from fossil fuel use have been increasing, **GHG** emissions from land-use appear to have been declining. This finding is recognised as requiring further work in the study.

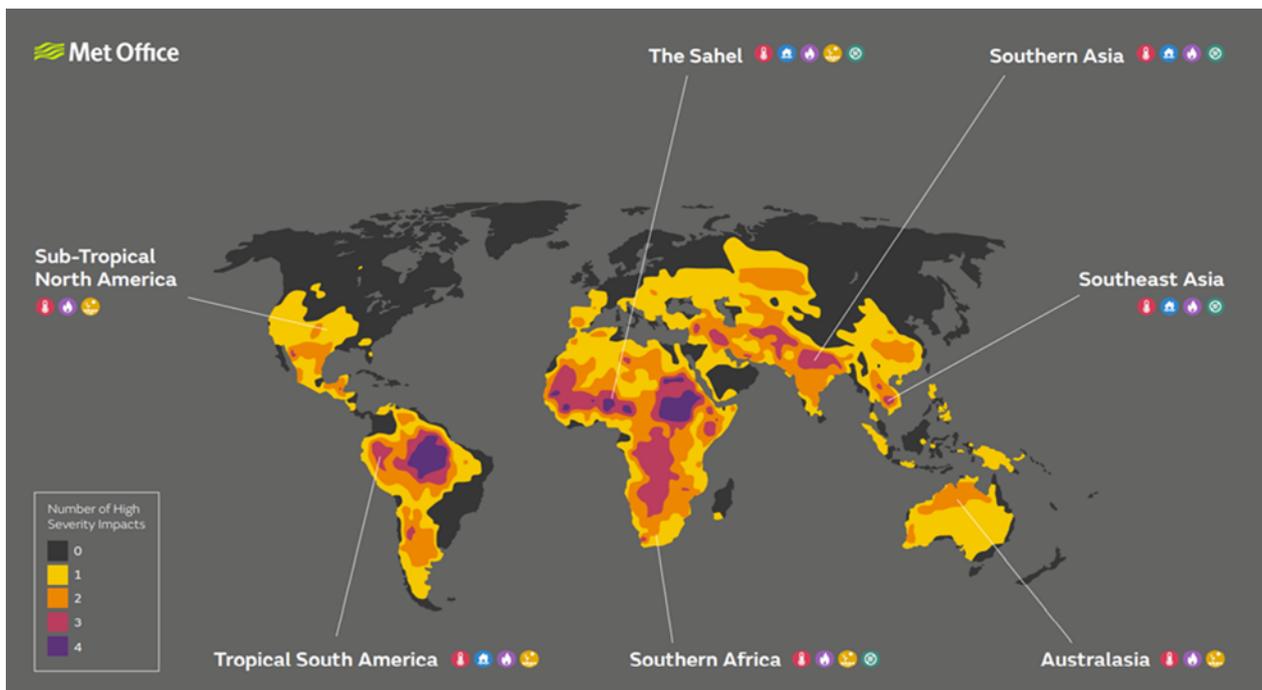
Closer inspection of the **GCP** study (yet to be peer reviewed) indicates the importance of working with the **PRC** and India in accelerating the transition from the use of fossil fuels to produce electrical energy to renewable resources to produce electrical energy.

The graphic below illustrates that the use of fossil fuels remains the default position.



Global fossil CO₂ emissions. Source: Global Carbon Project, <https://www.globalcarbonproject.org/carbonbudget/>

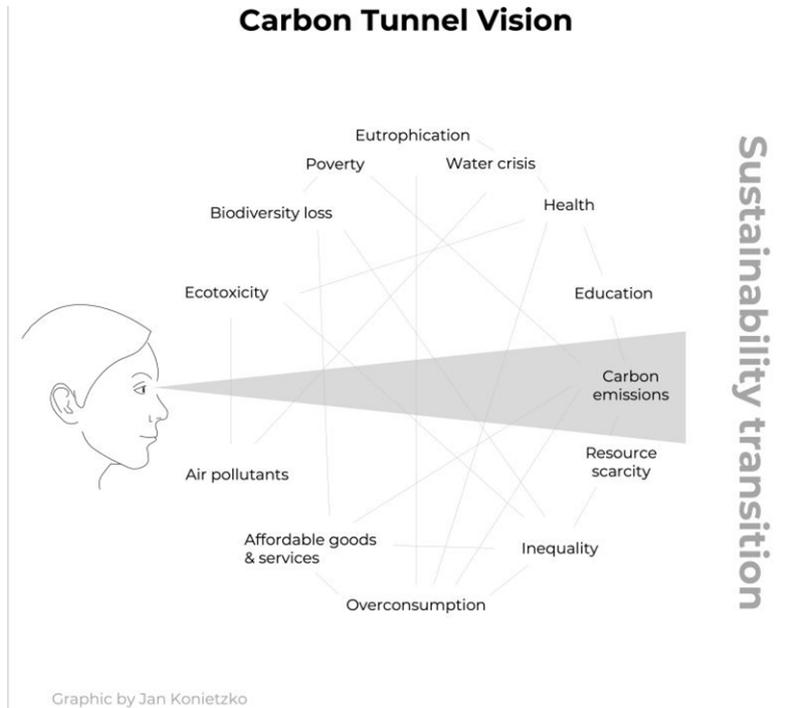
- Mass a mess:** On November 11, 2021, [The Washington Post](#) reported that there is likely to be undercounting of **GHG** emissions at a country level. The report emphasises the need for accurate monitoring, determination, and audit and verification. This is not a question of berating countries for not achieving targets; it is a means of ensuring that together **GHG** emissions are reduced. It is hoped that the implementation of the **Paris Rulebook** will allow effective monitoring, determination, audit and verification going forward.
- New Met Office study:** On November 9, 2021, the UK Met Office published a [new study](#). The headline from the study is that if the increase in average global temperatures increases by **2°C** above pre-industrial levels up to 1 billion people globally could face extreme heat stress. It is important to reflect that in average global temperatures have increased by **1.1°C** above pre-industrial levels.



Visualisation and Listening Platforms and Tools, and useful materials:

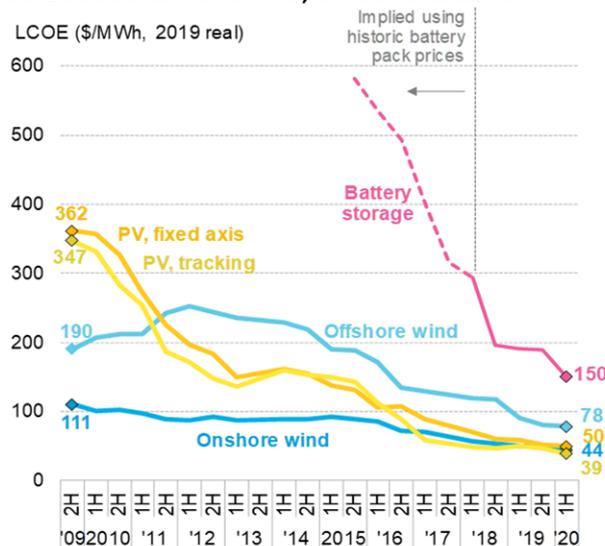
- Carbon Tunnel Vision:** Since the start of September 2021, Low Carbon Pulse has focused on the issues and trends ahead of **COP-26**. As has been noted previously in Low Carbon Pulse, the purpose of Low Carbon Pulse is not to address progress towards achievement of the Sustainable Development Goals (**SDGs**) of the United Nations Environment Programme; rather its purpose is to monitor progress towards achievement of **NZE**.

On November 9, 2021, the author of Low Carbon Pulse came across a graphic by Mr Jan Konietzko which while not tied specifically to the **SDGs**, provides a helpful reminder that while our focus is on Carbon Emissions, and their reduction, and that this is the principal existential issue. It is necessary to have in mind the broader context of the reduction of **GHG** emissions, and in progressing to the achievement of **NZE** to seek to address **SDGs** on that journey.



- Renewables are getting cheaper:** Edition 29 of Low Carbon Pulse included a graphic demonstrating that the cost of renewable electrical energy was the lowest in history. Continuing the theme, the cost of renewable electrical energy is getting cheaper. The following graph demonstrates this trend:

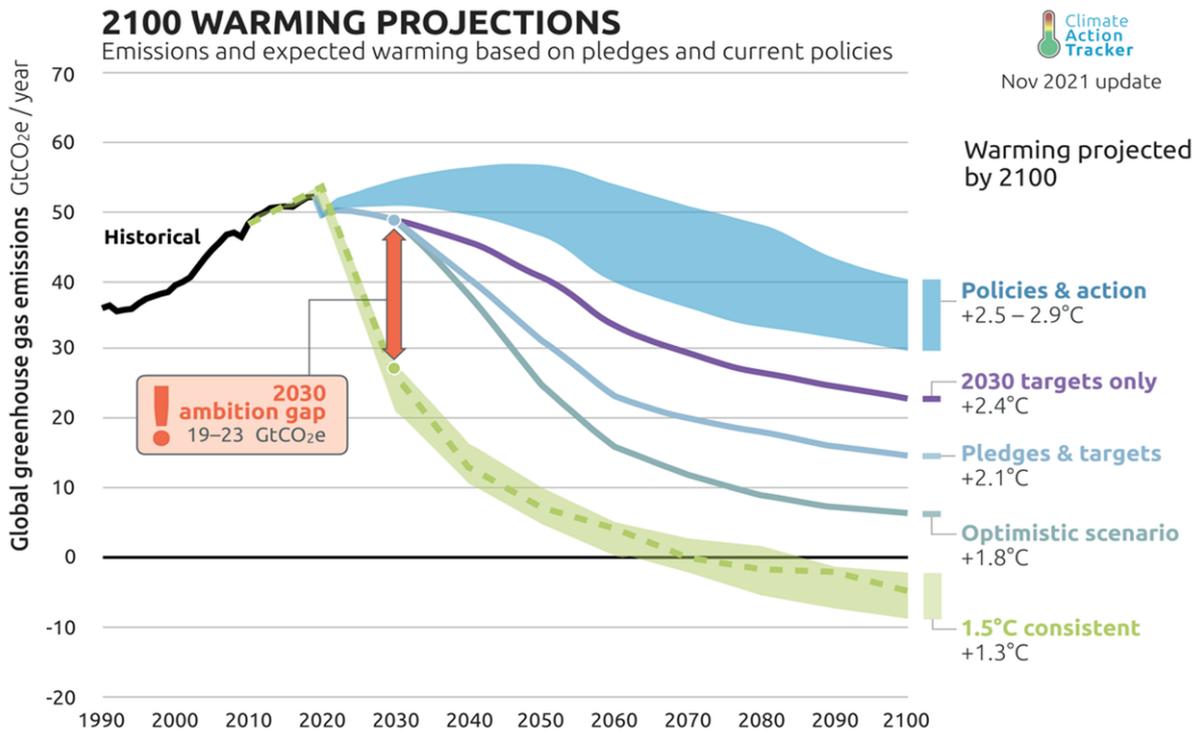
Figure 2: Global LCOE benchmarks – PV, wind and batteries



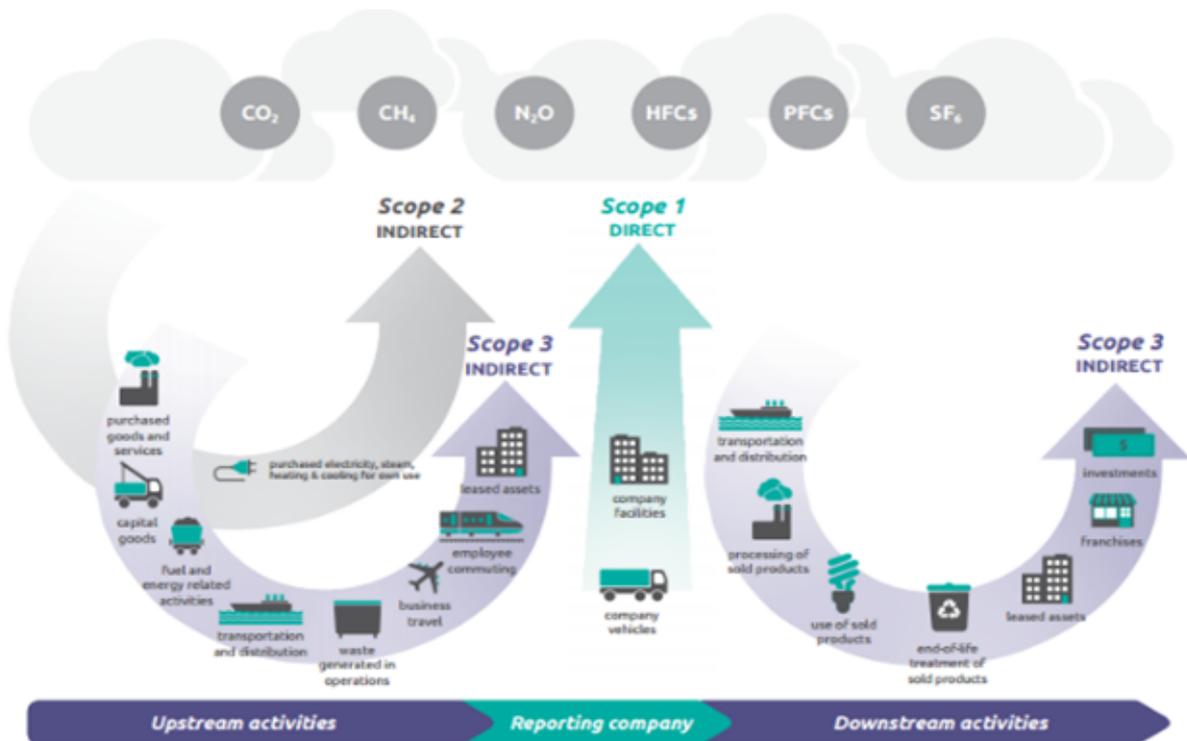
Source: BloombergNEF. Note: The global benchmark is a country weighted-average using the latest annual capacity additions. The storage LCOE is reflective of utility-scale projects with four-hour duration, it includes charging costs.

As noted on previous editions of Low Carbon Pulse (and sibling publications), the development and deployment of renewable electrical energy is at the core of achieving progress towards **NZE**.

- Climate Action Tracker:** Previous editions of Low Carbon Pulse have included links to and graphics from the Climate Action Tracker. During **COP-26**, the good folk at Climate Action Tracker shared a powerful and sobering graph, which represents the data included in the thermometer graphic:



- Scope 1, 2 and 3 emissions:** For details on Scope 1, 2 and 3 **GHG** emissions the authority is the [Greenhouse Gas Protocol](#) (mentioned in sibling publications of Low Carbon Pulse). To provide an understanding of each Scope at a glance, the following diagram is helpful:



IEA Statistics Report on GHG emissions from energy:

On November 11, 2021 the **IEA** released its report, [Greenhouse Gas Emissions from Energy, Statistics Report](#).

Consistent with recent reports from the **IEA**, the theme from the report is that the rate of development and deployment of renewable electrical energy capacity needs to increase. The Appendix to Edition 33 of Low Carbon Pulse will include a detailed review.

Germany:

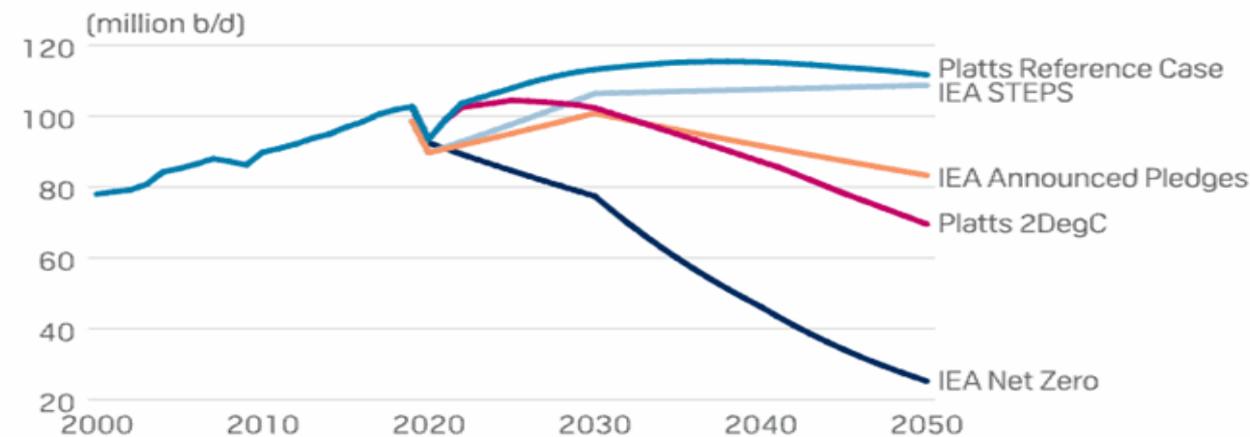
- **Blending begins:** On November 1, 2021, it was reported widely that Avacon (a subsidiary of energy giant E.ON) and the German Technical and Scientific Association for Gas and Water (**DVGW**) are to commence blending of hydrogen with natural gas, starting with a 10% hydrogen and 90% natural gas blend from December 2021, with a planned progression to a 15% to 85% mix during Q1 of 2022.
- **ISSB in Frankfurt am Main:** As noted above (under **Business and Industry Progress during COP-26 - Mark Carney posts**), the IFRS Foundation is establishing International Sustainability Board Standards (**ISSB**) to be headquartered in Frankfurt am Main, the German financial capital. The purpose of the **ISSB** is to develop bases of disclosure and reporting that are comparable, of high quality and transparent on a par with the requirement for disclosure and reporting for the purposes of financial statements.
- **Germany and Scotland – Northern Green Giants:** On November 10, 2021, ScottishPower (one of the two giant Scottish energy companies, the other being [SSE plc](#)) made a [press release](#) contemplating collaboration between Germany and Scotland in the production of hydrogen in Scotland and export to Germany. The contemplated collaboration is outlined in the [Draft Hydrogen Action Plan](#) released by the Scottish Government (on November 10, 2021). The **Draft Hydrogen Action Plan** sizes the potential market at €20 billion.
- **RWE and Shell – Other North Green Giants:** Editions [5](#) and [16](#) of Low Carbon Pulse reported at length (and over time) on the NorthH2 and the AcquVentus projects, both of which involve RWE and Royal Dutch Shell plc. On November 11, 2021 RWE and Shell announced another major and significant combination of their cooperation, with the signing of a memorandum of understanding under which each corporation commits to advance jointly projects for the production, use and distribution of Green Hydrogen, and other decarbonisation projects, across Europe. While the focus is on Green Hydrogen, Blue Hydrogen may be produced, using CCS / CCUS.
See: [Green hydrogen and decarbonisation solutions: Shell and RWE want to drive energy transition forward](#)
- **RWE AG late news:** On November 15, 2021 (outside the two week news cycle for the rest of Edition 30 of Low Carbon Pulse), RWE AG published its new strategy on **GHG** emissions to 2030 - €50 billion and 50 GW of renewable electrical energy capacity.

GCC counties update:

- **United Arab Emirates (UAE) Leadership:** On November 3, 2021, the **UAE** announced the establishment of a platform with **IRENA**, the Energy Transition Accelerator Financing (**Etaf**) platform.
The **Etaf** platform is intended to accelerate the transition to renewable electrical energy in developing countries. It is understood that the **UAE** has committed USD 400 million, to be provided by the Abu Dhabi Fund for Development.
See: [UAE and Irena plan to raise \\$1 billion for renewables innovation](#)
- **UAE Hydrogen Leadership:** On November 4, 2021, the **UAE** published its *Hydrogen Leadership Roadmap (H2LR)*, which includes five key means to enable: clear legal and regulatory framework, and as clarity commercial development. The **H2LR** has three core objectives: **1.** New sources of value creation through export of low carbon hydrogen and derivatives; **2.** Creating new opportunities through low carbon iron and steel, and **3.** Contributing to the **UAEs** 2050 **NZE** commitment (see Edition [29](#) of Low Carbon Pulse).
Consistent with these three objectives, the **H2LR** is intended to provide the means to decarbonise domestic use of energy carriers and to provide the means to become a global hub for the production and export of clean hydrogen as a clean energy carrier.
The **UAE** is targeting a 25% share of the key clean energy carrier markets, including Germany, India, Japan, ROK, and East Asia, and Europe generally.
- **UAE and Germany mapping a way forward:** The relationship between the **UAE** and Germany continues to develop – on November 4, 2021 it was reported widely that a task force has been established to increase the levels of cooperation between the **UAE** and Germany.
This initiative builds on the role that Siemens fulfilled in the development of the first photovoltaic solar to hydrogen project and the [study](#) on the role of hydrogen in energy transition that was published in January 2021.
- **UAE and Pakistan aligning:** On November 9, 2021, it was announced that the **UAE** and Pakistan had signed a memorandum of understanding (**MOU**) increase cooperation on climate change mitigation and environmental protection more broadly. The **MOU** was signed at **COP-26**.
- **Abu Dhabi plans additional 2 GW of PV solar:** On November 10, 2021, [energy & utilities](#), reported that Abu Dhabi is planning to deploy a further 2 GW of photovoltaic capacity (in two projects) in the near term.
It is reported that the Department of Energy (**DOE**) plans this deployment as one of nine clean energy initiatives within Abu Dhabi.
These initiatives include the two waste-to-energy plants in Abu Dhabi and Al-Ain, the tender process for which is underway. These projects are in line to follow the Emirates Waste to Energy Company (Bee'ah and Masdar) project in Sharjah, and the Besix, Hitachi Zosen Inova and Itochu Corporation project in Dubai. The use of waste to energy in the GCC countries provides a means of effective disposal of waste, and the use of BECCS to capture and to store the **GHG** emissions that arise on combustion / thermal treatment of the waste.
- **Oman and Siemens mapping a way forward:** On November 11, 2021, the Oman Hydrogen Centre (OHC) signed a memorandum of understanding (**MOU**) with Siemens Energy Oman to collaborate on the development and deployment of hydrogen energy projects and on hydrogen initiatives in the Sultanate of Oman.

- **Fossil Fuel reduction:** On November 11, 2021, S&P Global Platts shared its perspective on the progress of the Kingdom of Saudi Arabia and the **UAE** towards **NZE** through the reduction in the production of oil. The following diagram demonstrates the dynamic of the required reductions in oil production to achieve the required reductions in **GHGs**:

GLOBAL OIL DEMAND SCENARIO DIVERGENCE



Note: Shows scenarios normalized to include oil liquids including biofuels

Source: S&P Global Platts Analytics, IEA

- **ACWA Power awarded 1.1 GW wind project in Egypt:** On November 11, 2021, [energy & utilities](#), reported that ACWA Power (leading power and utility corporation) was the successful tenderer to develop an onshore 1.1 GW wind farm, and had been awarded "a power purchase agreement ... by the Council of Ministers".
- **UAE location for COP-28:** On November 11, 2021, **UAE** as named as the host-nation for COP-28 in 2023. **UAE** hosting COP-28 may be regarded as clear recognition of the engagement of the GCC countries, and **UAE** in particular in progress towards the achievement of **NZE**, and critical role that each GCC country will play in progress towards **NZE**.

India:

- **One Sun, One World, One Grid (OSOWOG):** On November 2, 2021, Indian Prime Minister, Mr Narendra Modi, and the UK Prime Minister, Mr Boris Johnson, announced a transnational grid initiative – **OSOWOG**. In an ear-catching speech at **COP-26** Mr Modi noted:

"The One Sun, One World, One Grid and the [Green Grids Initiative](#) is an idea whose time has come. If the world has to move to a clean and green future, these interconnected transnational grids are going to be critical solutions".

- **Five prime commitments:** As noted above (under **NDCs and NZE**), the Mr Modi committed India to achieving **NZE** by 2050. Please click [here](#) for a transcript of Mr Modi's speech.

In addition, Mr Modi committed as follows: **1.** By 2030, India will increase its non-fossil fuel capacity to 500 GW (a 50 GW increase in this commitment); **2.** By 2030, India will satisfy 50% of its energy demand from renewable energy; **3.** By 2030, India will reduce its **GHG** emissions by 1 giga tonne (1 billion metric tonnes); and by 2030, India will reduce the carbon intensity of its economy to less than 45%.

Just as President Barack Obama stole the show in the second week, Prime Minister Modi (with Prime Minister Mottley of Barbados) stole the show in the first week.

As has been noted in Low Carbon Pulse for some time, India is taking centre stage. This is critical globally, because the decarbonisation of India (as its population grows, the urbanisation of that population increases, and its economy develops), will be critical to the achievement of **NZE** globally.

- **USD 15 billion = 15 GW of Green Hydrogen Capacity:** The India Hydrogen Alliance (**IH2A**) (see Editions [17](#) and [20](#) of Low Carbon Pulse) is leading and shaping thinking around the development of the hydrogen economy in India, and then its members are making that thinking a reality.

The **IH2A** estimates that the development of 15 GW of Green Hydrogen production capacity by 2030 will cost around USD 15 billion. The cost includes the development of electrolyzers that will require 30 GW of installed renewable electrical energy capacity. Using current technologies vital statistics, this deployment will allow the production of 3 million metric tonnes per annum of Green Hydrogen.

This estimate is contained in a [publication](#) from the **IH2A** that provides a digest of the developments in, and associated with, the development of the hydrogen economy in India. The publication is well-worth a read, and future editions of Low Carbon Pulse will include a link to it.

- **Adani to invest USD 70 billion:** On November 11, 2021, Adani (the world leading logistics-to-energy conglomerate) announced plans to invest USD 70 billion by 2030 in the development and deployment of renewable electrical energy. Adani intends to become the world's largest renewable electrical energy corporation.

The Adani investment plans include the development of giga-factories. Further, by 2030, Adani intends to be the producer of the cheapest hydrogen globally.

See: Adani [website](#)

Indonesia:

It has been a busy time for policy setting in Indonesia. In addition to the announcement of the commitment to the achievement of **NZE** by 2060 and the promise offered by Energy Transition Mechanism (**ETM**):

- On November 3, 2021, Indonesia is to regulate to price carbon through an carbon emissions trading scheme. Indonesia President, Mr Joko Widodo, announced the regulation at **COP-26**. (Edition [21](#) of Low Carbon Pulse reported on the contemplated introduction of a carbon price based on an earlier draft of the regulation.) Corporations will be able to trade carbon permits / units, with the trading to take place on a bourse like platform.
The Indonesian scheme will comprise a cap and trade scheme (see Edition [12](#) of Low Carbon Pulse), under which a capped number of carbon permits / units will be issued, with corporations having to bid for those permits / units, and a carbon credit scheme.
- As noted above, on November 4, 2021, in statements surrounding the announcement of the **ETM** and the **NZE** by 2060 commitment, on a number of occasions, the Long-Term Strategy for Low Carbon and Climate Resilience 2050 was mentioned.

PRC:

Everyday a range of interesting facts and stats emerge from news feeds and publications reviewed for the purposes of compiling Low Carbon Pulse. One of the more interesting facts of late is that the power demand for the iron and steel sector in **PRC** is equal to the power demand of Germany. It is worth sitting with this fact for a few minutes. The folk at IHS Market have provided a helpful [diagram](#) that indicates that the power demand in the **PRC** is driven by industry. To manage the length of this Edition 30 of Low Carbon Pulse, Edition 31 will include new items from November 2021.

Japan:

• Pan-Pacific Panasonic:

- Edition [18](#) of Low Carbon Pulse reported on Panasonic Corporation's plans to make its Kusatu fuel-cell factory a stand-alone plant powered by renewable electrical energy (**REE**) alone. Panasonic's plans are progressing, and Panasonic plan to commercialise the concept of a 100% **REE** fuel-cell factory by 2023. The 100% **REE** power supply for the fuel-cell factory involves the use of photovoltaic solar and lithium-ion battery electric storage systems, and fuel-cell technology to generate electrical energy from hydrogen.
- On November 6, 2021, it was reported that Panasonic Corporation and CIMC Enric (part of the China International Marine Containers or **CIMC**) had signed a memorandum of Understanding (**MOU**) to develop jointly hydrogen heat and power systems. It is understood that the fulfilment of the intent of the **MOU** will contribute to the development of an energy park pilot project, consistent with the plans of the Ministry of Science and Technology's plans outlined in 2020.

See: [Panasonic in Hydrogen Power Talks with China's CIME Enric](#)

- **Floating Off-shore Wind Group (FOW)**: On November 12, 2021, it was reported widely that Equinor, JGC Japan Corporation, OW Ocean Winds (a joint venture between EDP and Engie), Sumitomo Corporation Global Metals and TODA Corporation had established the **FOW**.

The stated purpose of the **FOW** is to promote actively the development and deployment of floating off-shore wind field capacity in the coastal waters of Japan. The **FOW** proposed three initial actions aligned with this purpose: **1.** To set a target of 2-3 GW of floating off-shore wind field capacity by 2030, and to set medium-term and long-term targets; **2.** To promote strategic development plans for large-scale development and domestic industrial use; and **3.** To create an attractive **FOW** business environment, and to accelerate it.

Australia:

- **Federal Government**: Editions [28](#) and [29](#) noted the scrutiny to which the Australian Federal Government is subject to, from the international community. The Federal Government continues to share its view that technology, and not policy settings, will achieve reductions in **NZE** emissions. The consensus is that both are needed, because policy settings will drive the development and deployment of technology.

In the near term, Australia did not commit to the **Beyond Oil and Gas Alliance**, to the [Global Coal to Clean Power Transition Statement](#) or to the **Global Methane Pledge**, but did commit to the **Glasgow Breakthroughs** and an emission technology development deal with the Republic of Korea – see below.

- **A Clean Energy Finance Corporation (CEFC) First**: On November 8, 2021, Australia's CEFC announced that it has committed funding to allow Orica (leading chemicals company) to update its processing plants to reduce **GHG** emissions arising from the production of ammonium nitrite, in particular to abate nitrous oxide (**N₂O**); one of the three principle **GHGs** with **CO₂** and **CH₄** (see Edition [24](#) of Low Carbon Pulse). This is a first for the CEFC in that it is the first direct investment in the manufacturing sector in Australia.
- **State Governments**:
 - **New South Wales**: Edition [4](#) reported in the plans of the NSW Government to promote the development and deployment of renewable electrical energy in the State, and Edition [26](#) of Low Carbon Pulse reported on the level of interest in **New England Renewable Energy Zone** or **New England REZ**.

On November 1, 2021, it was reported widely that the New South Wales Government has invited registrations of interest for its third renewable energy zone (**REZ**) – the **South West REZ**.

There are three more **REZs** to come to market, the **Illawarra REZ** and the **Hunter-Central Coast REZ**. Please click [here](#) to view the NSW Government's electricity roadmap.

NSW REZS – THE STORY SO FAR ...

Central West Orana REZ – interest expressed by the private sector to develop 27 GW of renewable electrical energy capacity

New England REZ – interest expressed by the private sector to develop 34 GW of renewable electrical energy capacity

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

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

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

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

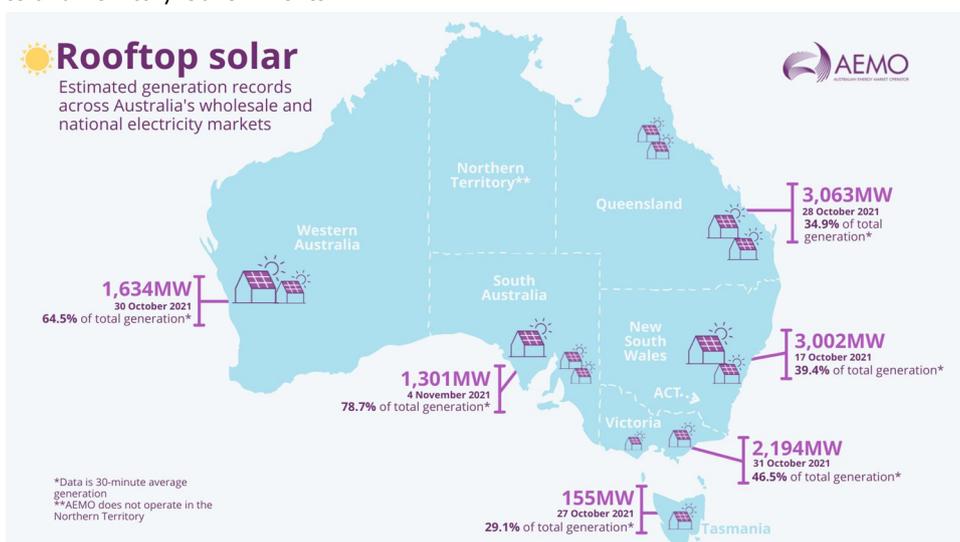
- **South Australia:** On October 29, 2021, the State of South Australia launched its [Hydrogen Prospectus](#) for the development of Three Hydrogen Hubs, at Cape Hardy / Port Spencer, Port Adelaide and Port Bonython.

Edition 3 of Low Carbon Pulse outlined the plans for the Hydrogen Hubs back in 2020.

As has been noted in previous editions of Low Carbon Pulse, the State and Territory Governments of Australia are trail blazing on the road to **NZE**, and each State Government recognises its role in facilitating the shift to hydrogen, and the value to its State of the shift. The Government of South Australia is in the vanguard of the States, and is leading the way with policy settings that will set a benchmark globally.

- **State by State – roof-top by roof-top:** Previous editions of Low Carbon Pulse have reported on the impact that matching load with dispatch of photovoltaic solar is having across Australia.

On November 9, 2021, the Australian Energy Market Operator (**AEMO**) published an insight piece with an accompanying map to show the current installed capacity across each Australian State and Territory. The levels and rates of installation of roof-top photovoltaic solar panels are a function of a number of factors, but critically the support offered by State and Territory Governments.



Republic of Korea:

- **ROK aligned with Australia:** During the **G20** Summit in Rome, Australian Prime Minister, Mr Scott Morrison, and **ROK** President, Mr Moon Jae-in, agreed that their countries would partner in the development and deployment of the development of technology to decarbonise industrial and transport activities.

The communique noted that Australia and **ROK** will: collaborate across existing and emerging low and zero emissions technologies, including technologies for clean hydrogen and clean ammonia supply; low emissions iron and steel; hydrogen fuel cell electric vehicles; hydrogen power generation; carbon capture, utilisation and storage; energy storage; solar; and critical minerals supply chain ...".

- **KEPCO and gencos to exit coal by 2050:** On November 10, 2021, [The Korean Herald](#), reported that Korea Electric Power Corp (**KEPCO**), and its six power generation subsidiaries (Korea Hydro & Nuclear, Korea South-East Power, Korea Midland Power, Korea Western Power, Korea Southern Power and Korea East-West Power), will phase-out coal, and have ceased to use coal for the purposes of the generation of electrical energy by 2050.

The activities of **KEPCO**, and its subsidiaries, give rise to around 37% of the **GHG** emissions arising in the **ROK** (or 270 million metric tonnes per annum of **GHG** emissions).

US:

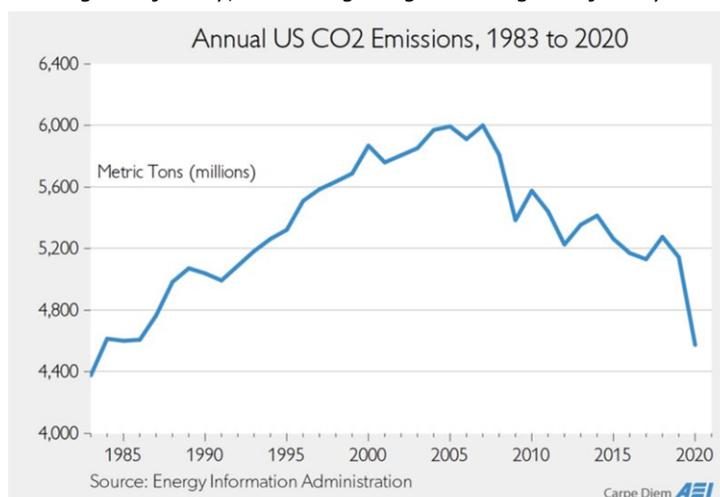
- **While you were sleeping:** Editions 23 and 25 of Low Carbon Pulse reported on the passing of the Bipartisan Infrastructure Deal (Infrastructure Investment and Jobs Act) by the US Senate.

On Saturday November 6, 2021 the White House released a [Fact Sheet](#) providing details of the Bipartisan Infrastructure Deal, the Deal having passed on Friday November 5, 2021.

- **While you were flying:** On November 10, 2021, the US [set](#) the goal of achieving net-zero **GHG** emissions from the US aviation sector by 2050. This follows the announcement in September of a reduction of 20% in **GHG** emissions by 2030, reflecting the shift to sustainable / synthetic aviation fuel (**SAF**).

- **The arc of US CO₂ emissions:** On November 11, 2021, the newly announced CEO of FFI North America, Mr Paul Browning, shared a graph showing the arc of US CO₂ emissions from 1983 to 2020.

While the information in the graph will not be new to many readers of Low Carbon Pulse, the key takeaway from the graph is that the US is on the right trajectory, and that getting on the right trajectory can be achieved quickly.



Bioenergy:

- **UK Biomass Policy Statement:** On November 4, 2021, the UK Government released its [Biomass policy statement: a strategic view of the role of sustainable biomass for net zero](#) (Biomass Strategy). The Biomass Strategy will be considered in detail in the *November Report on Reports*, to be published as the Appendix to Edition 33 of Low Carbon Pulse.
- **Low carbon whisky:** Edition 23 of Low Carbon Pulse reported on the use of "green biogas" to power and to propel whisky delivery vehicles. On November 11, 2021, the Anaerobic Digestion and Bioresources Association (**ADBA**) reported on the approval of the development of Scotland's lowest-carbon grain distillery, St Boswells Distillery, in the rolling green and pleasant land of the Scottish Borders.
St Boswell's is to use anaerobic digestion to take the spent cereal and convert the residual grain mulch into **CH₄** and residual material that can be used a soil conditioner for crops.
- **Not low carbon enough ... not yet anyway:** Given the focus on Glasgow specifically and Scotland, generally there has been an associated focus on the decarbonisation of the whisky industry in Scotland. While the industry is clearly making progress directionally to achieve **GHG** reductions and **NZE**, it is acknowledged by the industry that achieving **NZE** is going to be a challenge, and that it needs to do more.
- **More than a grain of truth:** On November 14, 2021, a piece came to the attention of the author of Low Carbon Pulse tying back to the use of the residual grain mulch. In Italy, Consorzio Italiano Biogas (**CIB**) is completing the development of a bioenergy production facility. The residual grain mulch is derived from the processing of the growth and cropping of native grains to produce flour and pasta.
Like the spent cereal in the production of whisky, the residual mulch is subject to anaerobic digestion to derive biogas (a combination of **CO₂** and **CH₄**, and traces of other gases).
The biogas is processed further to remove **CO₂** and traces of other gases, to upgrade the biogas to produce biomethane. The biomethane may be used to fire power generation or as pipeline gas to be delivered to the ultimate customer.

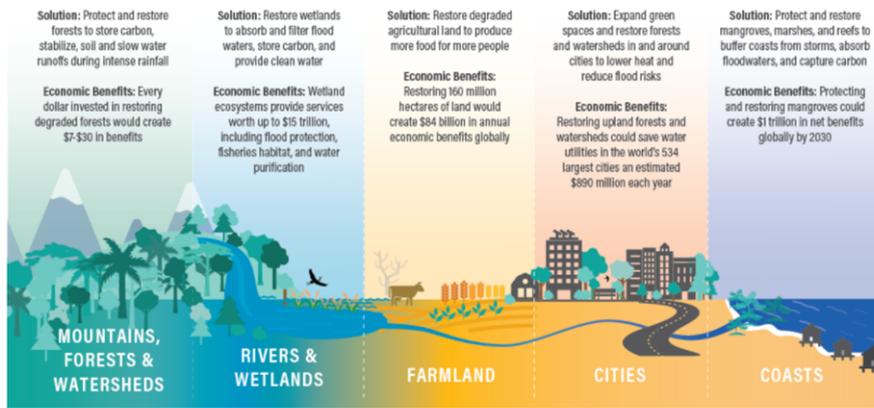
Blue and Green Carbon:

- **Great Green Wall (GGW):** On November 5, 2021, the European Commission (**EC**) extolled the virtues of the **GGW** project: the project is intended to restore degraded land across the Sahel Region of Africa, spanning 21 countries by the development of sustainable land management projects to form a 8,000 km "wall" across the width of Africa, covering an area of 100 hectares of degraded land. It is estimated that the restoration of the degraded land will provide a carbon sink into which 250 million tonnes of carbon may be sequestered.
It is difficult to think of a project that illustrates more graphically the connection between the achievement of Sustainable Development Goals and land-use, and the connection of land-use to achieving progress towards the achievement of **NZE**.
(The 21 countries are: Algeria, Benin, Burkina Faso, Cameroon, Chad, Cape Verde, Djibouti, Egypt, Eritrea, Ethiopia, Gambia, Ghana, Libya, Mali, Mauritania, Niger, Nigeria, Senegal, Somalia, Sudan and Tunisia).
See: [The Great Green Wall \(GGW\)](#)
- **Energy Voice speaks to issues for Africa:** On November 5, 2021, [energyvoice.com](#), published an article entitled [Jobs, cash and power, it's all on the line for Africa's COP26 hopes](#). The article is excellent, noting that, "Africa is forecast to see more impact from climate change than others, even while going through its own critical energy access struggle.
For those on the continent, particularly in sub-Saharan Africa, a lack of electricity continues to be a major problem." (See Edition 20 of Low Carbon Pulse.)

Consistent with the **GCP**, developed countries need to support African countries in the development and deployment of renewable electrical energy, the restoration of degraded land, and provide value to the use of land that allows for the maximisation of carbon removal and retention.

- **Green Carbon:** There has been an increasing focus on the use of nature based solutions to remove **GHG** emissions. Edition 32 of Low Carbon Pulse (the *Magic Johnson Edition*) will cover Green Carbon and nature based solutions in full, but for the time being, this graphic is a good scene setter.

Nature-Based Solutions Can Deliver Big Economic Benefits



Source: Verdone and Seidl, *Roots of Prosperity* (Forests); Millennium Ecosystem Assessment (Rivers & Wetlands); A. Wu, *How Can Restoring Degraded Landscapes Deliver Financial Returns?* (Farmland); The Nature Conservancy, *Beyond the Source* (Cities); Global Commission on Adaptation, *Adapt Now* (Coasts). WORLD RESOURCES INSTITUTE

BESS and HESS:

Long Duration Energy Storage Council (LDESC) established: On November 4, 2021, the **LDESC** was established to provide guidance to Governments to the transmission grid operators on the objective of working towards global deployment of 85 – 140 TWh of long duration energy storage by 2040.

The founding members of the **LDESCs** are (in alphabetical order): Alfa Laval, Ambri, Azelio, Baker Hughes, Breakthrough Energy, BP, CellCube, Ceres, Echogen Power Systems, EnergyDome, Enlighten, EOS, ESS, Inc., Ezinc, Form Energy, Greenko, Highview Power, Malta, Neom, Quidnet Energy, Redflow, Rio Tinto, Siemens Energy, and Stiesdal.

See: Long Duration Energy Storage Council [website](#)

CCS / CCUS:

- **Making CCS work:** On November 1, 2021, it was reported widely the Beach Energy Ltd and Santos Ltd took a final investment decision (**FID**) to sanction the development of a carbon storage project at the natural gas complex at Moomba, South Australia to store up to 1.7 million metric tonnes per annum (**mmtpa**) of **CO₂**. CEO of Santos Ltd, Mr Kevin Gallagher, is reported to have stated that: "We forecast a full lifecycle cost of less than USD24 per tonne of **CO₂**, including cash costs in operation of USD6-8 per tonne of **CO₂**". Mr Gallagher went on to note that: "It is also an important milestone in our plan for Santos to achieve net-zero Scope 1 and 2 emissions by 2040".

It is understood that key to **FID** was the agreement of the Australian Federal Government to issue carbon credits in respect of the **GHG** emissions avoided by the capture and the storage of **CO₂**, with the value of the carbon credits understood to be broadly equivalent to the development cost. The registration of the CCS project by the Clean Energy Regulator means that carbon credits will be issued over the 25 year period of the project.

The focus therefore is on the cash costs in operation of USD6-8 per tonne of **CO₂** – to the knowledge of the author the lowest cash cost of operation for CCS globally.

- **See:** [Santos announces FID on Moomba carbon capture and storage project](#); [Beach and Santos announce FID on Moomba carbon capture & storage project](#)
- **Santos DACs:** On November 5, 2021, Santos Ltd announced that it was partnering with the **CSIRO** (Commonwealth [of Australia] Scientific and Industrial Research Organisation, being the national science agency of Australia) low cost direct air capture technology. The partnership intends to continue work to develop the CSIRO Carbon Assist™ technology. The technology will be tested at the natural gas complex at Moomba, South Australia, with the **CO₂** captured to be stored at the Moomba Carbon Storage project.
See: [Santos partners with CSIRO on development of new technology to negate carbon emissions](#)
- **UK Phase 2 of CCS Cluster Sequencing Process:** Editions 23, 28 and 29 reported on Carbon Clusters and Hydrogen Hubs around the UK. As reported in Edition 29 of Low Carbon Pulse, the UK Government selected the **East Coast Cluster** (comprising Net Zero Teesside and Zero Carbon Humber) and **HyNet North West** as the two CCS projects (each a **Track-1-Cluster**) that were to receive government support in the **Track 1 CCS Programme** (see Edition 23 of Low Carbon Pulse), i.e., **Phase 1 of the Cluster Sequencing Process:** the policy setting provided for the selection of two CCS projects (as outlined in Edition 23). In addition to the **East Coast Cluster** and **HyNet North West**, the **Scottish Cluster** was announced as a reserve cluster.

On November 8, 2021, the UK Government called for submissions from organisations wanting to take part in **Phase 2 of the CCUS Cluster Sequencing Process**. Phase 2 is stated to be "open to Power, Industrial Carbon Capture and Hydrogen production projects which meet the technology specific eligibility criteria".

- **Oxy Low Carbon Hub expands:** On November 9, 2021, it was reported widely, that Occidental Petroleum Corporations Oxy Low Carbon Ventures LLC (OLVC) is to expand the Gulf Coast CCS Hub by the development of a new CCS Sequestration Hub in Southern Texas.
See: Oxy Low Carbon Ventures [website](#)
- **ExxonMobil and Petronas teaming:** Edition [29](#) of Low Carbon Pulse reported on ExxonMobil's focus on South East Asia for the development of CCS. On November 9, 2021, it was reported widely that ExxonMobil and Petronas had signed a memorandum of understanding to explore jointly the potential to develop carbon capture and storage technology projects in Malaysia. It is understood that a key aim of the work will be to allow Malaysia to reduce **GHG** emissions arising from activities within the country.
- **Transitioning to CCS in Norway:** Editions [27](#) and [28](#) reported on development of the sub-sea bed of Norwegian Continental Shelf for use for storage of **CO₂**. On November 12, 2021, Rex International Holding Ltd, through its 90% owned subsidiary, Lime Petroleum AS, has teamed with Nautilus Carbon Services AS to secure a **CO₂** storage site.

CO₂ and its use:

CO₂ liquefaction: Thunder Said Energy has released an interesting [paper](#) on the liquefaction of **CO₂** on a smaller scale. Because of the properties of **CO₂**, most importantly a triple point of 5-bar and -57°C, it is possible to liquefy **CO₂** using 100 kWh of electrical energy per tonne of **CO₂**. The paper is well-worth a read, exploring the industries that may benefit from the dynamics explained in the paper.

E-fuels and Future Fuels (increasingly "Now Fuels"):

- **Linde hopping along:** Previous editions of Low Carbon Pulse have reported on progress of various initiatives and projects of Linde (one of the Big Three industrial gas suppliers globally), including in respect of Leuna.
On November 2, 2021, Linde announced further progress with the development of a new 24 MW PEM (proton exchange membrane) electrolyser facility at the Leuna Chemical Complex in Leipzig-Halle, Germany. The electrolyser to be installed at the facility will be manufactured by ITM Linde Electrolysis GmbH, a joint venture between ITM Power and the Linde. It is great to see these leading corporations working together.
Green Hydrogen produced at the facility will be supplied to industrial customers of Linde using the existing hydrogen network and will be liquified and distributed to provide fuel from the mobility / transport sector. The facility is scheduled to commence production of Green Hydrogen in 2022.
See: Linde [website](#)
- **Aman Green Hydrogen Project:** On November 4, 2021, the Islamic Republic of Mauritania and CWP signed The [Glasgow Declaration](#).
The commercial purpose of the **Glasgow Declaration** is to allow the development of the second phase of the Green Hydrogen project to be developed at Aman, using 30 GW renewable electrical energy from photovoltaic solar and wind sources to produce up to 10 million metric tonnes per annum of Green Ammonia. The scale of the Aman project is significant in a global context.
The form of the **Declaration** is significant because it recounts the **Glasgow Breakthroughs** in particular, "**to accelerate the development and deployment of green hydrogen as a critical tool for decarbonising heavy industry and transport**", the African Green Hydrogen Alliance, and its role in support of the Green Hydrogen Catapult. In other words, the **Declaration** recounts the growing framework for the development and deployment of Green Hydrogen projects.
- **Mid-West Pilot Project:** On November 4, 2021, APA Group, Pilot Energy and Warrego Energy announced the formation of a consortium to undertake, and to fund jointly, the development of a pilot Blue Hydrogen and CCS project in the Mid-West region of Western Australia.
See: [Consortium to investigate delivery of low cost hydrogen](#); [Consortium formed to progress Pilot's Mid West blue Hydrogen and Carbon Capture & Storage \(CCS\) Project](#); Warrego Energy's [announcement](#)
- **Namibia perfectly placed:** Edition [26](#) of Low Carbon Pulse reported on consideration of the development of a Green Hydrogen project in Namibia. On November 5, 2021, it was reported widely that Hyphen Hydrogen Energy had been selected by the Government of Namibia to develop a large-scale Green Hydrogen project (**NH2 Project**).
The **NH2 Project**, to be located in the Tsau / Khaeb national park, is to produce 300,000 metric tonnes of Green Hydrogen a year. It is reported that the renewable electrical energy for the **NH2 Project** will comprise 2 GW mixed photovoltaic solar and wind, and **BESS**, with a total capital cost of USD 4.4 billion.
The location in the Tsau / Khaeb national park is a function of: "*The Tsau / Khaeb national park [being] among the top 5 locations in the world for low-cost hydrogen production, benefiting from a combination of co-located onshore wind and solar resources near the sea and land export routes to market*".
The **NH2 Project** will be capable of expansion to 5 GW of renewable electrical energy and 3 GW of electrolyser capacity, with a total capital cost of USD 9.4 billion on expansion.
See: Hyphen Hydrogen Energy [website](#)
On November 13, 2021, it was reported that the Namibian Ports Authority (**NPA**) had signed a memorandum of understanding (**MOU**) with the Port of Rotterdam Authority (**PORA**). The **MOU** contemplates that Namport, Namibia, will become the key export port of Green Hydrogen and Green Hydrogen-based fuels produced by the **NH2 Project**. Under the **MOU**, **NPA** and **PORA** will work together to connect Namibia with the Port of Rotterdam, and as such, European buyers of Green Hydrogen and Green Hydrogen based-fuels. The development of port capacity is key in the context of any Green Hydrogen Hub.
See: Port of Rotterdam [website](#)
- **Haldor Topsoe and Hyundai Oil Bank look for opportunities:** On November 8, 2021, Haldor Topsoe announced that it and Hyundai Oil Bank were working together to identify opportunities with Blue Hydrogen and Green Hydrogen, and waste plastic recycling, bio-refining and e-fuels.

As might be expected, they are also working on CCS and CCUS capacity development. This is an exciting combination, marking the likely convergence of the use of chemical technology to recycle waste plastics at scale.

See: [Haldor Topsoe and Hyundai Oilbank sign Memorandum of Understanding to develop green energy solutions](#)

- **Blue Hydrogen Power Project Progresses:** Edition [21](#) of Low Carbon Pulse reported on the development of the 600 MW Blue Hydrogen fuelled power project at Keadby (**Keadby BH2 Power**): the Blue Hydrogen being produced from natural gas feedstock, with the **CO₂** arising to be captured and stored.

On November 2, 2021, Equinor (leading international energy corporation) announced that it has the pre-FEED contracts had been awarded for the development of the Blue Hydrogen production plant.

See: Equinor [website](#)

- **Patriot Energy to Clean the Kimberley:** On November 8, 2021, it was reported widely that Patriot Hydrogen is to supply **75 P2H** hydrogen generation units to Kimberley Clean Energy which intends to decarbonise the length of its value chain. It is understood that the generation units will create clean hydrogen, including from the use of biomass and waste.

See: Kimberley Clean Energy [website](#); Patriot Hydrogen [website](#)

- **Giants, Norsk Hydro and Shell break bread:** On November 9, 2021, Norsk Hydro and Shell signed a memorandum of understanding to identify projects for the development of Green Hydrogen capacity.

It is understood that Norsk Hydro's Green Hydrogen business, Hydro Havrand will concentrate on the production and supply of Green Hydrogen – "produced from renewable [electrical energy] in hubs centred around Hydro and Shell's own business, and where they see strong potential for scaling production for customers in heavy industry and [mobility] transport".

See: [Hydro and Shell join forces to explore renewable hydrogen projects](#)

- **FFI humming along, this time in Argentina and PNG:**

- **Pampas Facility:** On November 1, 2021, the first day of the **World Leaders' Summit** and the second day of **COP-26**, Fortescue Future Industries (**FFI**) announced plans to develop a 15 GW USD 8.4 billion Green Hydrogen production project (**GHPP** or **Pampas Facility**) in Rio Negro province, Patagonia, Argentina by 2030.

On development, **GHPP** will produce 2.2 million metric tonnes per annum of Green Hydrogen – sufficient to decarbonise the German iron and steel industry. The **GHPP** will be developed in stages, with the pilot phase (600 MW USD 1.2 billion) being completed by the end of 2024, followed by the progress phase (1.4 GW), with the final phase to be completed by 2030.

- **PNG facilities:** On November 6, 2021, **FFI** signed a Master Development Agreement under which **FFI** is to undertake feasibility studies with a view to developing renewable energy projects in Papua New Guinea, and the development of Green Hydrogen attendant on the proving up through the feasibility studies.

- **Norway considering State-Owned Hydrogen company:** On November 12, 2021, it was reported widely that the Norwegian Government is considering establishing a hydrogen energy carrier corporation, possibly in combination with Equinor (owned as to 67% by the Norwegian Government) or Statkraft (owned as to 100% by the Norwegian Government), or both of them.

Previous editions of Low Carbon Pulse have advocated that there is a role for Government in the development of hydrogen supply (most recently see Edition [27](#) of Low Carbon Pulse). Norwegian Climate Minister, Mr Espen Barthe Eide said: "**The idea is ... [to] be an engine to drive large hydrogen investments in Norway**".

- **Woodside Energy progressing in Tasmania:** Previous editions of Low Carbon Pulse have reported on the plans of Woodside Energy Ltd (**WEL**) to develop a Green Hydrogen production facility in Bell Bay, Tasmania (please click [here](#) to view the Low Carbon Pulse Compendium). On November 12, 2021 it was reported widely that **WEL** had secured a site for the production facility, and planned to make a final investment decision during 2023.

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

- **Hydrogen at mine site:** On November 11, 2021, Unique Metals and Xodus announced that they had signed a memorandum of understanding to use hydrogen to power and to propel forklift trucks and to produce electrical energy at Unique Metals HyMetals Project.

See: websites of [Xodus](#) and [Unique Metals](#)

- **Investment required at mine site:** During **COP-26**, the author of Low Carbon Pulse read many articles on the level of investment required to achieve **NZE**. As noted in previous editions of Low Carbon Pulse, Low Carbon Pulse does not include estimates of costs, noting that the estimates change. This said, on November 11, 2021, an article in [Kitco News](#), authored by Mr Neils Christensen, struck a chord, and as such we are going to make an exception.

The article is well-worth a read, picking up on great report from Bank of America (published on November 8, 2021), in particular picking up on the conclusion that the mining industry "**needs to spend USD 72 billion annually out to 2030 just to prevent bottlenecks to achieving Net-Zero**".

In context, the business as usual capital investment by the mining industry over the last decade has averaged around USD 99.5 billion annually.

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

- **Port of Newcastle:** On November 8, 2021, the Australian Renewable Energy Agency (**ARENA**) announced funding support for a study to assess the potential of the Port of Newcastle (still the world's busiest port for the export of coal from the Hunter Valley, NSW). The Hunter Valley region has long produced and exported coal.

The Port of Newcastle has considerable potential as a location for a hydrogen hub (and as a possible carbon cluster).

See: [ARENA](#) website

- **ITM Power to develop second UK giga-factory:** On November 9, 2021, it was reported widely, that leading Green Hydrogen technology company, ITM Power intends to develop its second giga-factory in the UK (1.5 GW of capacity).

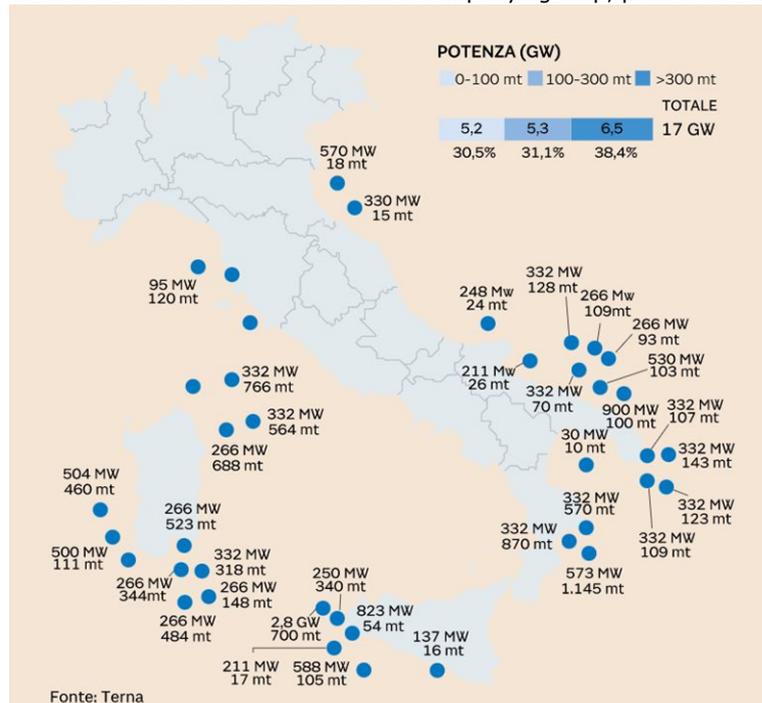
The second giga-factory is to be located close to its first giga-factory, with both sites in Sheffield, South Yorkshire, England.

See: [Intention to Purchase Site in Sheffield for the Second UK Giga Factory Collaboration with University of Sheffield](#)

- **A new twinning:** As a young fella one of the games played on long car journeys was to observe the signs for each town and to see with which town it was twinned. At **COP-26** a new twinning initiative was [launched](#), the H2 Twin Cities initiative. The purpose of the initiative is to connect cities and communities around the world to develop and to deploy clean hydrogen solutions.
- **Amsterdam Hydrogen Hub:** On November 11, 2021, it was reported widely that Amsterdam has launched a Hydrogen Hub (**AHH**). The **AHH** involves collaboration by the Port of Amsterdam, Amsterdam Airport, Schiphol, Vattenfall, Liander, NZKG, Gasunie, Oram Nobian and the province of North Holland and the municipalities of Amsterdam and Zaanstad. It is understood that the principal aim of the hub is to achieve the large-scale transition of the Amsterdam Area and North Sea Canal Area into a hydrogen economy by 2050 through the import and export of hydrogen.

Wind round-up:

- **Ørsted Hai Phong proposal:** On November 2, 2021, Ørsted proposed the development of a USD 11.9 to 13.6 billion 3.9 GW off-shore wind field (**OWF**) project off-shore Vietnam. The **OWF** will be located 14 km off Bach Long Vy Island, and around 100 km from the mainland. Ørsted has the backing of the Danish Government.
See: Ørsted [website](#)
- **Eastern Horizons in view:** On November 5, 2021, Dominion Energy (**DE**) submitted plans for approval by Virginia State Corporation Commission for the development of the 2.6 GW off-shore wind field project off of the US State of Virginia (**Coastal Virginia Offshore Wind** or **CVOW** project). The **DE** announcement follows the announcement by Siemens Gamesa (leading manufacturer of wind turbines) on its development of the US's first wind turbine blade manufacturing facility at the Port of Virginia.
See: [Dominion Energy Continues to Advance Coastal Virginia Offshore Wind Project; Finalizes Selection of Major Offshore Suppliers; Global leadership grows: Siemens Gamesa solidifies offshore presence in U.S. with Virginia blade facility](#)
- **Northern Horizons expand:** On November 5, 2021, Aker Offshore Wind and Aker Clean Hydrogen, working in collaboration with **DNV**, announced plans to develop an off-shore wind field project to the north of the Shetland Isles off the north of Scotland with the renewable electrical energy generated to be used to power multiple floating installations that will produce Green Hydrogen to haulage to a net-zero refinery on Shetland. The Shetland refinery will liquefy the Green Hydrogen and use it as feedstock to produce Green Ammonia and other hydrogen-based fuels for use within the UK and globally. The project is called Northern Horizons.
See: [Northern Horizons: A Pathway for Scotland to Become a Clean Energy Exporter](#)
- **From the Balerics to the Baltic (again):** On November 8, 2021, global international energy giant, Iberdrola, announced plans to develop an off-shore wind field in the Baltic Sea, the 300 MW Windanker project. This will be the third off-shore project developed by Iberdrola, after the operational 350 MW Wikingen project, and the under-development 476 Baltic Eagle project.
See: [Iberdrola develops Windanker, its third offshore wind farm in the Baltic Sea, with €800 million planned investment](#)
- **Italian off-shore wind set to boom:** Editions [28](#) and [29](#) of Low Carbon Pulse have reported on progress in respect of off-shore wind field developments. On November 9, 2021, Mr Gionvanni Battista Picotti published an insightful piece on the development of the off-shore wind fields with an accompanying map, please see the map below.



- **Crown Estates eyes the horizon again:** On November 11, 2021, The Crown Estate outlined [plans](#) to develop up to 4 GW of off-shore wind field capacity in the Celtic Sea. The Chief Executive at The Crown Estate, Mr Dan Labbad, noted the need to continue to work closely with the UK and Welsh Governments, regional authorities and the market as the plans become better defined.

Solar and Sustainable Energy Round-up:

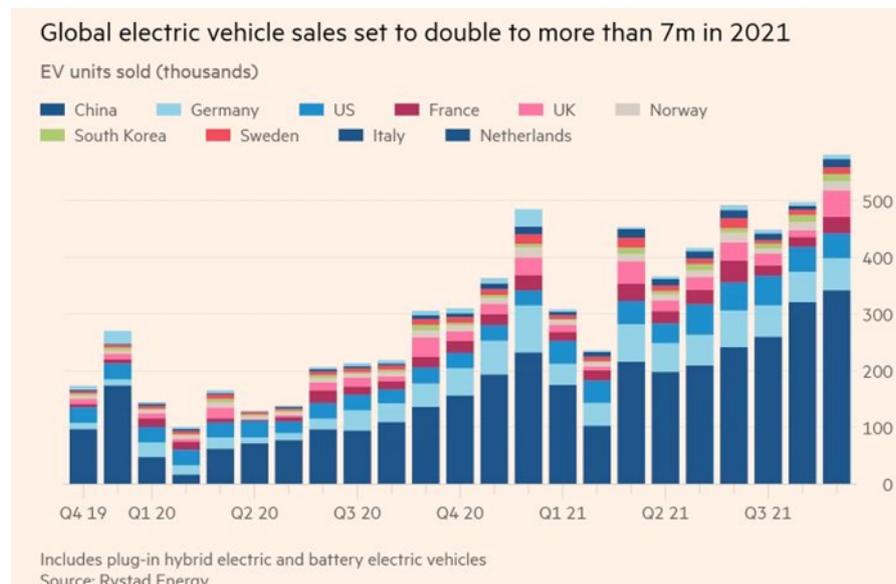
In addition to other news items covered above in respect of solar and sustainable energy, the following news items are noteworthy:

- **France to build new nuclear:** In November, 2021, it was reported widely that French President, Mr Emmanuel Macron, had addressed the French people to announced that a formal decision was imminent about the development of further EPR reactors.
- **Chile proposes 15,000 km HVDC interconnector:** On November 14, 2021, Chile proposed the development of a High Voltage Direct Current interconnector to transmit electricity from renewable electrical energy production in South America to Asia.

Round-up on Land Transport:

• Buses and Coaches (and ambulances):

- **Wrightbus:**
 - **Right technology:** On October 8, 2021, it was reported widely that Wrightbus' fuel cell technology (**FCT**) double-decker bus was to be show-cased at the Global Investment Summit (which took place on October 19, 2021, see Edition [29](#) of Low Carbon Pulse).
 - **Right for Brighton:** On November 4, 2021, Go-Ahead Group plc ordered 20 fuel cell electric (**FCE**) buses from Wrightbus. The **FCE** buses are to be delivered and deployed during 2022.
- **New Flyer:** On October 14, 2021, it was reported widely that NFI Group (a leading bus and coach manufacturer) that Champaign-Urbana Mass Transit District (**MTD**), in Illinois, being "the first-in-America renewable transportation project", was to use the fuel-cell Xcelsior CHARGE H2 buses manufactured by NFI Group company, New Flyer of North America Inc. The buses are powered and propelled by **FCT** using renewable hydrogen.
- **New coach for Brisbane:** In late October 2021, it was reported widely that a coach manufactured by Hyzon Motor Inc., was operating in Brisbane, Queensland.
- **NH2S:** On November 2, 2021, it was reported widely, that the National Health Service in the UK (as part of the London Ambulance Service) is to trial the use of a **FCT** powered and propelled ambulance. The ambulance being trialled has been developed by UK corporation, ULEMCo, is equipped with a fuel cell in the power train of the ambulance, and has a range of 300 miles (or 482 kms).
- **Ballard abroad:** On November 4, 2021, Ballard Power Systems Inc. announced an order for 40 FCmove™ HD (70kW) modules for use to power and to propel fuel cell electric buses (**FCEB**) across Europe and the UK during 2022.
- **Long-distance coach travel:** On November 12, 2021, a consortium comprising FlixMobility, Freudenberg Fuel Cell e-Power Systems and ZF Friedrichshafen AG announced plans to develop a long-distance coach for use across Europe - the HyFleet project. The long-distance coach is planned to be developed and deployed by the end of 2024, and will travel up to 200,000 kms a year, and is capable of travelling 1,000 kms between refuelling.
- **Motor cars – the daily drive:**
 - **EV progress:** During October, as the figures for sale of motor cars across Europe were compiled, it became apparent that September 2021 was the first month in which the best-selling motor car in Europe was an EV.
 - **EV sales:** On November 9, 2021, Alessandro Blasi, Special Advisor to the IEA Executive Director shared a useful perspective on the development of the EV market, accompanied by a bar chart to demonstrate the sale of EV across selected markets:



- **Industrials:**

- **JCB – Green PRyze:** On October 20, 2021 JCB committed to accelerating the switch of its construction and works equipment to the use of hydrogen.

On November 1, 2021, it was reported widely that **FFI** (a subsidiary of Fortescue Metals Group Limited, established by Dr Andrew Forrest, AO) and JCB and Ryze Hydrogen had signed an agreement to supply Green Hydrogen for Ryze Hydrogen to distribute across the UK to match demand of customers across the UK.

A quick reminder: Dr Forrest has set the corporations that he established the target of producing 15 million metric tonnes per annum (**mmtpa**) of Green Hydrogen by 2030, moving to 50 **mmtpa** by 2040. As noted above, FMG is continuing to identify projects globally that will allow it to match its targets with production.

- **JCB – Main Prize:** On November, 2021, JCB was awarded the Royal Automobile Club's Dewar Trophy (a prestigious engineering award) for its hydrogen-fuel engine design.

- **Intermodal and Logistics:**

On October 13, 2021, Maersk Japan announced that it was piloting an intermodal transportation solution (**ITS**) in Japan. Among other things, the **ITS** involves the use of renewable diesel (to achieve immediate **GHG** emission reductions).

- **Trains:**

- **PRC testing fuel cell hybrid:** On November 3, 2021, hydrogenfuelnews.com, reported that the first hydrogen fuel cell hybrid locomotive developed in the **PRC** commenced pilot testing in the final week of October 2021. The hydrogen fuel cell hybrid train project is a joint venture between CRRC Datong Co., Ltd., (a subsidiary of the State Power Investment Corporation Limited (SPIC) and the Hydrogen Energy Co., Ltd.

- **Porterbrook – repurposing with promise:** On November 5, 2021, it was reported widely that Porterbrook has repurposed a locomotive, the HydroFLEX, the UK's first hydrogen-ready passenger train, using **FCT**, using Green Hydrogen, and oxygen to power and to propel the train.

See: HydroFLEX [website](#)

- **Alstom and Eversholt fast friends:** On November 10, 2021, [Global Railway Review](#), reported that Alstom and Eversholt Rail had signed an agreement for the delivery of 10 three car hydrogen multiple units (**HMUs**). The HMUs are to be designed, built and commissioned by Alstom, with the build to be undertaken in the UK.

- **Trucks:**

- **Daimler AGO-GO-GO:**

- **125 years ago:** On October 6, 2021, [Daimler Truck AG](#) published an article to note that it was the 125th anniversary of production of the first motorised truck.

- **eActros active:** On October 6, 2021, Daimler Truck AG announced that the Mercedes-Benz eActros has commenced operation with customers in Germany and the Netherlands.

- **Licensed to run:** On October 25, 2021, it was reported widely that Daimler Trucks is able to test its **FCT** trucks on public roads as a result of being licensed to do so. This may seem like an everyday, run-of-the-mill event, but it reflects the pace at which Daimler Truck is travelling in developing and deploying **FCT** to power and to propel **FCEVs**.

- **Building network:** On October 27, 2021, Daimler Truck AG announced that it and BP plan to develop and to deploy a hydrogen infrastructure network across the UK to allow the introduction of **FCEVs** onto UK roads.

See: [Daimler Truck AG and BP to pioneer deployment of hydrogen infrastructure, supporting the decarbonization of UK freight transport](#)

- **BEV and FCEV:** On November 4, 2021, Daimler Truck AG noted that it was developed **BEV** trucks and **FCEV** trucks. This dual track approach is noteworthy because it illustrates that Daimler AG anticipates a market of sufficient size and segmentation to support both technologies.

- **Licence to chill:** On November 4, 2021, Daimler Truck AG announced the development of fuel cells that will maintain the temperature of liquid hydrogen below its boiling point at minus 253°C. This is significant because the use of liquid hydrogen, rather than compressed, allows **FCEV** trucks to carry a greater mass of hydrogen.

- **From reservoir to bowser:** On November 11, 2021, Daimler Truck AG and TotalEnergies signed a new agreement to work together to develop and to deploy ecosystems for heavy-duty truck / heavy-goods vehicles powered and propelled by hydrogen across Europe. The agreement sits alongside the work that each corporation is doing to source and to distribute, to delivery hydrogen to and to dispense hydrogen at hydrogen refuelling infrastructure.

- **Diesel to GO:**

On November 11, 2021, [electric & hybrid](#), reported that the UK is to phase-out by 2040 the use of internal combustion engine (**ICE**) heavy good vehicles (**HGVs**) powered and propelled by diesel. From the start of 2040, all new **HGVs** in the UK will have to be powered and propelled by a power source using a zero-emission technology. This commitment to phase-out **ICE HGVs** powered and propelled by diesel was given on Transport Day at **COP-26**.

- **Hyzon – taking the hy-road:**

- **Hy-road in NZ:** On November 3, 2021, Hirlinga Refuelling New Zealand commenced construction of the first of four high-capacity hydrogen refuelling infrastructure facilities in New Zealand, in partnership with Hyzon.

- **The arc becomes a circle:** Editions [22](#) reported on the commitment of Ark Energy Corporation to purchase **FCEV** trucks from Hyzon Motors Inc to be used to transport zinc from the Sun Metals Zinc Refinery in Townsville, Queensland (refinery being owned by Ark Energy's sibling corporation Sun Metals Corporation, Ark Energy and Sun Metals owned by Korea Zinc Company Limited, the largest zinc, and lead and silver, producer in the world).

On November 8, 2021, Australian Renewable Energy Agency (**ARENA**) announced that it has approved, conditionally, funding support for the deployment of a 1 MW electrolyser with hydrogen storage and refuelling infrastructure to produce Green Hydrogen to be used by the **FCEV** trucks to be supply by Hyzon to Ark Energy.

On November 8, 2021, Australia's Clean Energy Finance Corporation (**CEFC**) announced that it finance the purchase of the **FCEV** trucks, and the Green Hydrogen and the hydrogen storage and refuelling infrastructure.

- **Hyzon and Itochu focus on the mining sector:** On November 9, 2021, Hyzon Motors Inc and Itochu Corporation (leading Japanese trading house) announced that they have aligned to pursue jointly opportunities for the use of hydrogen opportunities across the metals and minerals sector. It is understood that the alignment is focused on the development jointly of hydrogen supply chains and the development and deployment of **FCEV** and **FCT** across the sector.

- **Giga Carbon Neutrality (GCN) on the road:** On November 11, 2021, it was reported widely, that **GCN** had unveiled its range of zero-emission commercial vehicles. While early days, it is reported that **GCN** intends to bring its zero emission vehicles to market by 2024.

- **Mobility and Transportation:**

- **H2X Sarawak:** On November 4, 2021, hydrogencentral.com, reported that H2X is to commence the manufacture of **FCEVs** in Sarawak, Malaysia. SEDC Energy (a wholly-owned subsidiary of the Sarawak Economic Development Corporation (**SEDC**)) signed a memorandum of understanding with H2X Global to establish a joint venture to manufacture and to assemble **FCEVs** and to undertake strategic transport projects. It is understood that the joint venture will manufacture and assemble the Warrego Pick up to City Buses and the H2X Hydrogen Powered Generators.

- **Eni and Air Liquide combine:** On November 4, 2021, Eni and Air Liquide have combined to invest in the development and deployment of hydrogen refuelling infrastructure across Italy so as to support the transition to the use of hydrogen in the mobility / transport sector. Eni and Air Liquide have signed a letter of intent for these purposes, with Eni having existing distribution and retail capacity across Italy, and Air Liquide having expertise across the value supply chain for hydrogen.

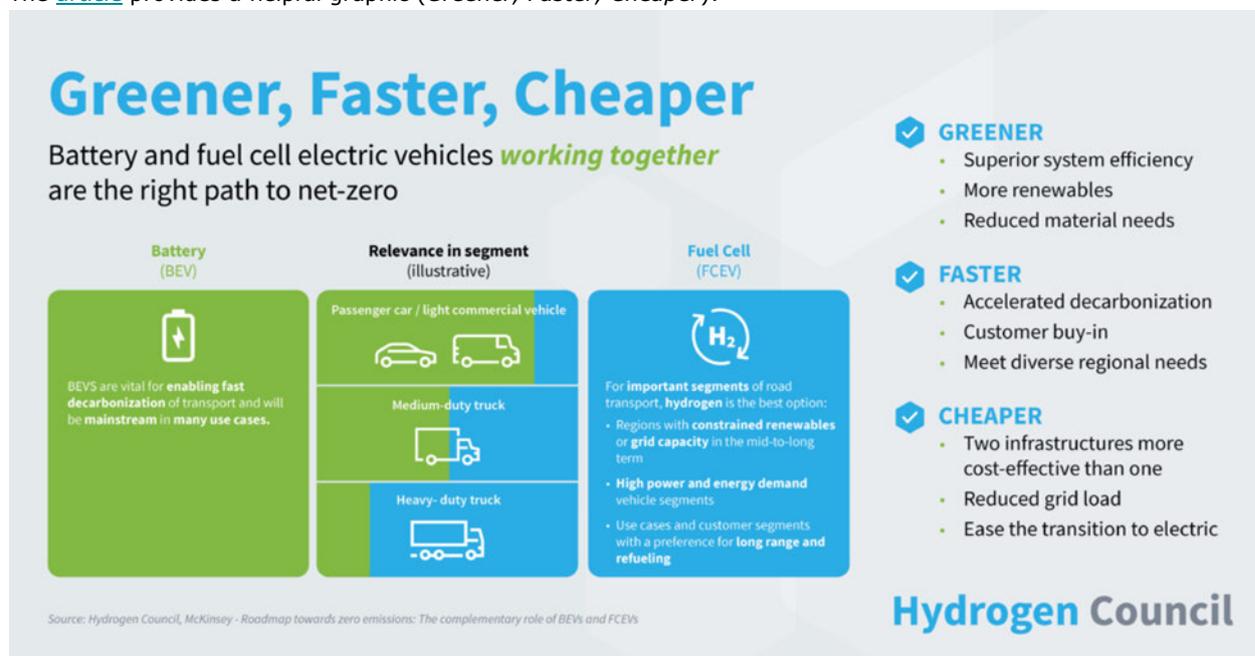
See: Air Liquide [website](#)

- **Snam and Shell matched:** On November 5, 2021, Snam (a leading energy infrastructure corporation) and Shell Energy Italia (a subsidiary of Royal Dutch Shell, on the leading international energy corporations) signed a memorandum of understand (**MOU**). It is understood that the **MOU** provides for Snam and Shell Energy Italia to work together, domestically, within Italy, and internationally, to develop energy efficiency and sustainable mobility / transportation solutions. The **MOU** contemplates that in working together Snam and Shell Energy Italia will identify projects that they may develop jointly, specifically projects for use of hydrogen by the industrial sector and the mobility / transportation sectors.

See: [Snam and Shell Energy Italia Sign Cooperation Agreement on Energy Transition](#); Shell [announcement](#)

- **Hydrogen Council abroad:** On October 27 2021, the Hydrogen Council issued an assessment of the use of a combination of battery and fuel cell technologies.

The [article](#) provides a helpful graphic (*Greener, Faster, Cheaper*):



Ports and Shipping Forecast:

- **Global Energy Ventures and Wärtsilä:** On October 6, 2021, Global Energy Ventures Limited (**GEV**) announced that its compressed hydrogen (**C-H2**) carrier, having a 430 metric tonne (**mt**) capacity, had received approval in principle (**AIP**) from the American Bureau of Shipping (**ABS**). The 430 mt **C-H2** carrier has been described as a pilot hydrogen carrier project. Edition 26 of Low Carbon Pulse reported on the **AIP** for the 2,000 mt **C-H2** carrier. Each **C-H2** carrier is to be powered and propelled using fuel cell technology.

On November 5, 2021, Wartsila's role in respect of the **AIP** was reported, with Wartsila having worked with **GEV** ship designer to develop an optimal power and propulsion system, using Wartsila's dual-fuel engines to power two electric drive fixed-pitch propellers.

See: [Wärtsilä's decarbonisation focus emphasised with Approval-in-Principle for GEVs pilot hydrogen vessel](#); Global Energy Ventures [website](#)

Edition [19](#) of Low Carbon Pulse reported on the **Zero Emission Shipping Mission**, one of three **MI Missions**. Mission Innovation published something of a progress [check](#) (entitled Shipping out: **The challenges and opportunities of decarbonising the world's most global industry**) on October 6, 2021.

- **Solvang and Wärtsilä:** On October 20, 2021, it was reported widely that Wärtsilä (leading engine and power technology corporation) is to work with Solvang ASA (leading shipping company) to develop a carbon capture and storage system on board one of Solvang's ethylene carriers, the 2019 build Clipper Eos. The intention is to deploy the system on board the carrier by 2023.

See: [Wärtsilä and Solvang to collaborate on retrofitting carbon capture and storage system on Clipper Eos](#)

- **Hydrogen – sea port to sea port:** On November 6, 2021, the Ports of Antwerp and Zeebrugge and Chilean Ports have agreed to collaborate to make the transportation of Green Hydrogen from one continent to another a reality.

See: Port of Antwerp [press release](#); Port of Zeebrugge [press release](#)

- **Port of Gothenberg (PoG) to develop hydrogen production facility:** On November 3, 2021, the **PoG** announced plans to develop a hydrogen production facility with the port to produce hydrogen to be used to power and to propel land-side equipment within the port. While the scale of the planned hydrogen production facility may appear small, 4 MW to produce 2 metric tonnes of hydrogen a day, the approach being taken by the **PoG** reflects the need to balance supply with demand, and there is no better way to achieve this balance than to be the user of the producer, supplier and user of the hydrogen. As such, this plan is significant.

See: [Hydrogen production facility planned for the Port of Gothenburg](#)

- **Mitsui OSK and Vale sailing:** On November 8, 2021, Mitsui OSK Lines Ltd announced that it was working with Vale to conduct jointly a study to consider the installation of a wind propulsion system (Rotor Sail) on a 200,000 tonne in service bulk carrier (used principally for the carriage of iron ore).

While the principle will be understood, Mitsui OSK explains: "The Rotor Sail produces propulsive force as the wind generates differential pressure around the slewing rotor while the vessel is underway. It offers high efficiency because the natural energy of the wind directly propels the vessel rather than being converted in to electricity ...".

Regular readers of Low Carbon Pulse will recall that Wallenius Marine is developing a similar vessel, the Oceanbird.

See: [MOL, Vale International Announce Joint Study on Use of Wind Propulsion System 'Rotor Sail' on Bulk Carrier](#)

- **Mitsui OSK, MOL Drybulk and Japan Engine Corporation (J-ENG) hydrogen testing:** On November 9, 2021, Mitsui OSK Lines, MOL Drybulk and J-ENG announced that they are trialling a hydrogen-fuelled engine on an in-service vessel. Mitsui OSK explained that this is a world first, with the low-speed, two-stroke hydrogen fuelled marine engine being trialled. J-Engine, working with Kawasaki Heavy Industries and Yanmar Power Technology, is the engine technology provider.

See: [MOL, MOL Drybulk, J-ENG Sign Agreement for Trial of Hydrogen-fueled Engine equipped Onboard](#)

- **Danish Maritime Authority pressing on:** On November 9, 2021, the Danish Maritime Authority (**DMA**) released a [summary](#) of the research of **DMA**, the Technical University of Denmark (**DTU**) and Oxford Research. The research was commissioned by the **DMA** as part of its role in, and commitment to, the Zero-Emission Shipping Mission (**ZESM**): **ZESM** is intended to accelerate international public-private collaboration to scale-up and to deploy new green maritime solutions, with Governments of Denmark, Norway and the US leading **ZESM**, working with the **Global Maritime Forum** (see Edition [19](#) of Low Carbon Pulse). By way of reminder, **ZESM** has three principal goals: **1.** to develop, demonstrate and deploy zero-emission fuels, ships and fuel infrastructure in a coordinated fashion along the full value chain; **2.** by 2030, to have developed ships capable of running on hydrogen-based fuels (being zero-emission fuels) – such as Green Hydrogen, green ammonia, green methanol, and advanced biofuels – that make up at least 5% of the global deep-sea fleet, measured by fuel consumption; and **3.** by 2030, to have at least 200 of these "well-to-wake" zero-emission fuelled ships in service and utilizing these fuels across their main deep-sea shipping routes.

The summary provides four main conclusions in respect of readiness and innovation needed to progress to achieve the **ZESM** goals by 2030. The conclusions are that: **1.** The technologies to produce green fuels are available, but are not developed and deployed yet; **2.** A technology natural approach is to be preferred to stimulate further innovation; **3.** Three "cross-cutting" innovations are required: **(a)** demonstration plant development; **(b)** standards development; and **(c)** scale-up of the development and deployment of renewable electrical energy and develop further efficiency of technology; **4.** Fuel specific innovations are required in all three parts of the supply value chain: **(a)** fuel production; **(b)** bunkering infrastructure; and **(c)** vessel and fuel storage system design.

- **PORA pressing on, ever more quickly:** Previous editions of Low Carbon Pulse have reported on the progress being made by the Port of Rotterdam Authority or **PORA** (see Editions [20](#), [23](#), and [25 of Low Carbon Pulse](#)) to prepare for hydrogen and hydrogen-based fuels. On November 9, 2021 **PORA** announced that the import of hydrogen would be feasible by 2025. This is based on a study conducted by **PORA**, with all areas within the Port of Rotterdam (from Pernis to Maasvlakte 2 having the ability to import hydrogen).

See: [PORA](#) website

- **AP Moller – Maersk to develop Green Methanol Tug:** Edition [26](#) of Low Carbon Pulse reported (at length) on the order of ## container vessels to be powered and propelled by Green Methanol. On November 9, 2021, AP Moller – Maersk and its towage subsidiary Svitzer announced the development of a tug to be powered and propelled using fuel cell technology, using Green Methanol as the fuel. This will be a world first.

See: [AP Moller-Maersk](#) website

- **FFI converting MMA Leveque to Green Ammonia:** On November 11, 2021, FFI announced that it is progressing the conversion of the MMA Leveque to be able to be powered and propelled by close to 100% Green Ammonia.
See: [FFI](#) website
- **Clydebank Declaration:** On November 10, 2021, the [Clydebank Declaration](#) was agreed at **COP-26**. The Clydebank Declaration emphasises the importance of limiting "the increase in global average temperature to **1.5°C** above pre-industrial levels", expressed great concern that if "no further action is taken, international shipping emissions are expected to represent 90% to 130% of 2008 emissions levels by 2050", and recognised that "a rapid transition in the coming decade to clean maritime fuels, zero-emission vessels, alternative propulsion systems, and the global availability of landside infrastructure to support these, is imperative for the transition to clean shipping".
In addition the signatories to the Clydebank Declaration commit to facilitate the development of Green Corridors, with at least six Green Corridors by "the middle of this decade ... [and] many more corridors ... by 2030". A Green Corridor is a route between two or more ports that are "zero-emission maritime routes".
The signatories to the Clydebank Declaration are: Australia, Belgium, Canada, Chile, Denmark, Fiji, Finland, France, Germany, Republic of Ireland, Italy, Japan, Republic of the Marshall Islands, Morocco, the Netherlands, Norway, Spain, Sweden the UK, and the US.

Airports and Aviation loop-round:

- **Rolls Royce flies on SAF:** On October 25, 2021, Rolls Royce tested an engine (one of four) fuelled by a sustainable / synthetic aviation (**SAF**) derived from liquid waste produced by World Energy (with the other three engines powered and propelled by conventional aviation fuel). On a test flight using the Rolls Royce Trent 1000 turbofan engine the **SAF** fuelled engine performed well on a test flight from Tuscan, Arizona, to Texas, and back to Tuscan.
- **Increased SAF safe:** On October 26, 2021, Airbus, Boeing, Dassault Aviation, GE Aviation, Rolls Royce, Safran and Go Beyond restated commitments to decarbonisation of the aviation industry, through developing aircraft and engine design, use of **SAF** and exploring the use of hydrogen, and continuing to develop technology so as to enable net-zero-carbon aviation. Depending on the source of the feedstock for **SAF**, it is reported that the use of **SAF** 90% of **GHG** emissions arising from the aviation industry could be achieved on a net-basis. Key to making this progress is to allow fuel comprising 100% **SAF** to be used to power and to propel aircraft, increasing the current proportion of 50% conventional **SAF**, 50% fossil fuel sourced. If one were to pick a likely trend, it would be that hydrogen fuel cell technology will be used to power aircraft, and **SAF** will be used to used to propel them.
- **Zeroing in on first commercial flight:** On October 27, 2021, it was reported that Zero-Avia is planning the first commercial flight for its 19-seat aircraft in 2024 between London and Rotterdam and The Hague in 2024.
On November 1, 2021, it was reported widely that ZeroAvia is to develop a 76-seat aircraft, working with Alaska Air Group to retrofit the engines on a De Havilland Q400 aircraft. This follows the announcement that Zero-Avia is planning the first commercial flight for its 19-seat aircraft in 2024 between London and Rotterdam and The Hague.
- **SAS to SAF:** On November 2, 2021, **SAS** (Scandinavian Airlines System) announced a partnership to supply **SAF**. On November 2, 2021, Vattenfall announced the exploration by Vattenfall, SAS, Shell and LanzaTech to produce **SAF** (or electro-fuel or an e-fuel) using the LanzaJet™ "Alcohol to Get" technology using "fossil free electricity and recycled carbon dioxide from district heating". Initial thinking is to produce 50,000 metric tonnes of **SAF** a year. As production of the **SAF** increased, SAS contemplates using this source to provide up to 25% of its demand for aviation fuel.
- **Airport supply and demand:** On November 5, 2021, Milan Malpensa Airport, Italy, announced that it intended to develop and to deploy a Green Hydrogen production facility to assure it of supply of Green Hydrogen. [International Airport Review](#) reported that Snam (a leading energy infrastructure corporation) had partnered with Milan Airports and SEA. It is understood that in the first instance the Green Hydrogen will be used to power and to propel land-side vehicles. The Green Hydrogen production facility and associated infrastructure will have funding support from [Horizon 2020](#) one of the European Union initiatives.

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
Danish Maritime Authority, Oxford Research, and the Technical University of Denmark	<u><i>Innovation needs for decarbonization of shipping</i></u>
Global Carbon Project	<u><i>Global Carbon Budget 2021</i></u>
IEA	<u><i>Greenhouse Gas Emissions from Energy, Statistics Report</i></u>
Kruitwagen, L., Story, K.T., Friedrich, J. et al	<u><i>A global inventory of photovoltaic solar energy generating units</i></u>
Lazard Ltd	<u><i>Levelized Cost of Energy Analysis</i></u>
The Met Office	<u><i>One billion face heat-stress risk from 2°C rise</i></u>
Oxford Institute for Energy Studies	<u><i>Energy Transition in Japan and implications for gas</i></u>
Oxford Institute for Energy Studies	<u><i>The Russian Perspective on COP-26 and the Key Challenges of the Road to Net Zero</i></u>
Thunder Said Energy	<u><i>Small-scale CCS: transport liquid CO2?</i></u>
Tong, D., Farnham, D.J., Duan, L. et al.	<u><i>Geophysical constraints on the reliability of solar and wind power worldwide</i></u>
UAE Ministry of Energy & Infrastructure and the Federal Ministry for Economic Affairs of Germany	<u><i>The Role of Hydrogen for the Energy Transition in the UAE and Germany</i></u>
United Nations Development Programme	<u><i>A Guide to Carbon Pricing and Fossil Fuel Subsidy Reform</i></u>

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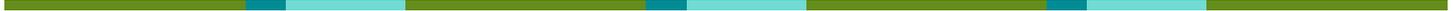
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