TOWARDS NET-ZERO
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Low Carbon Pulse - Edition 13

GLOBAL DEVELOPMENTS IN PROGRESS TOWARDS NET-ZERO EMISSIONS

Welcome to Edition 13 of Low Carbon Pulse – sharing significant current news on progress towards net-zero emissions globally. This Edition covers the period from March 22, 2021 to April 4, 2021.

Here is a link to Part 1 of the second article in the Shift to Hydrogen (S2H2): Elemental Change series, titled *What needs to be decarbonised? And what role can hydrogen play?* Part 2 will be published in May.

PRC to use mixed energy sources to generate electrical energy:

Over the last seven to eight months the strategy of the People's Republic of China (***PRC***) to achieve net-zero GHG emissions by 2060 has being taking shape. As is the case with other North Asian countries, the PRC is more "energy output driven" than it is "energy source driven". It is increasingly clear that the PRC is aiming to use a mix of lower-carbon and carbon-free electrical energy sources, including natural gas, hydrogen gas, renewable electrical energy (***REE***) and nuclear, while at the same time managing more carbon intensive sources of energy, critically, coal, in the medium to long term.

As part of this "energy output driven" strategy, the PRC is looking to retrofit coal-fired power station capacity to use hydrogen (and ammonia) as a fuel source. Most recent estimates indicate that the PRC is contemplating that up to 100 GW of hydrogen powered electrical energy (***HPEE***) will be installed by 2050, increasing to 200 GW *HPEE* by 2060. As is the case with Japan and South Korea, it is apparent that the PRC is agnostic as to the colour of hydrogen (and ammonia) used.

As noted in previous Editions of Low Carbon Pulse, it is expected that gas-fired power station capacity will increase. Best current estimates are that by 2050, the PRC will peak at 330 GW of installed gas-fired capacity, which will decline to 2060 as the net-zero GHG emissions target is approached, and more *HPEE* and *REE* is installed, and GHG are removed from the atmosphere after 2060.

Finally, in respect of *REE*, it is estimated that by 2050 and 2060 the PRC will have 3.2 TW and 3.55 TW of installed solar capacity, 2.2 TW and 2.5 TW of installed wind capacity, and 570 GW and 580 GW of hydroelectric power. With 200 GW and 250 GW of nuclear power by 2050 and 2060. Coal-fired power generation is to be phased out by 2060, and reach peak of 1.1 TW of installed capacity in 2025.

See: *China to adapt power generation to run on hydrogen*

Sinopec provides the gas, Great Wall provides the vehicles:

Sinopec is one of the world's largest producers of hydrogen (grey at the moment). Sinopec has developed hydrogen refuelling infrastructure (***HRI***) in Guangdong, Guangxi, Shanghai, and Zhejiang. By 2025, Sinopec plans to have increase its network of HRI to 1,000. Sinopec is committed to the increased production of hydrogen, to produce clean hydrogen (Blue Hydrogen and Green Hydrogen). By 2050, it is projected that the demand for clean hydrogen in the PRC will be around 60 mtpa. Sinopec is positioning itself to produce hydrogen (and ammonia) of all colours, and to distribute to HRI (see Edition 5 of Low Carbon Pulse – ***PRC + H2 = A year of development***).

On March 29, 2021 it was announced that Great Wall Motors is to launch Fuel Cell Electrical Vehicles (***FCEVs***) into the world's largest vehicle market, the PRC. One of the vehicles is a 840 km range SUV. It is to be expected that municipal and provincial governments within the PRC will continue to support the development of the *FCEV* market, including for longer range, and heavier payload vehicles.

See: *Sinopec sets sights on hydrogen*

The Kingdom of Saudi Arabia (KAS) chilled about Blue LHG:

In 2020 the KAS, national oil company, Saudi Aramco, announced the development of the Jafurah shale gas project at an estimated cost of USD 110 billion. The Jafurah shale gas project resource is estimated at 200 trillion cubic feet of gas, with CH_4 (methane) C_2H_6 (ethane) to be extracted from this world scale resource.

On March 22, 2021 Saudi Aramco announced that it was going to use methane from the Jafurah shale project to produce Blue Hydrogen, and either to liquefy that Blue Hydrogen (as LHG) or to produce Blue Ammonia, or both, rather to liquefy the methane as LNG as had been contemplated previously.

The production of Blue Hydrogen (and Blue Ammonia from it) requires the capture and storage permanently of CO_2 arising from either autothermal reforming (ATR) or steam methane reforming (SMR) of methane.

In Edition 2 of Low Carbon Pulse it was noted that Sabic and Mitsubishi Corporation shipped Blue Ammonia from the KAS to Japan. In Edition 12 of Low Carbon Pulse it was noted that it might be expected that the KAS and the PRC will continue to strengthen ties, including in respect of Blue Hydrogen and Blue Ammonia.

See*: Saudi Arabia Skips LNG, Bets Big on Hydrogen*

Hyundai Heavy and Saudi Aramco partner on heavy lifting:

On March 23, 2021 it was reported that Hyundai Heavy Industries is developing on-board carbon, capture and storage systems, and containment systems for new CO_2 carriers, capable of carrying CO_2 and LPG at the same time. The duel gas CO2 and LPG carriers are being developed in partnership with Saudi Aramco.

See: *Hyundai Heavy unveils slew of CO2 shipping projects*

Indonesia – it is a big numbers game:

It has been reported that Indonesia is considering committing to net-zero GHG emissions by 2070. As reported, it is considered that this commitment is achievable given the current level of development within Indonesia, but that it will be a challenge. At around about the same time as the reports on net-zero GHG, it was reported (some may say that reporting re-emerged) that Indonesia is seeking to achieve net-zero plastic by 2040. The combination of the two net-zero targets indicates that Indonesia is committed to addressing emissions and pollution over the medium to longer term.

It is reported that on March 17, 2021 the Climate Change Management Director General, Ruandha Agung said:

> *"By 2050, we will start working toward the goal of net-zero emissions. Hopefully, Indonesia can reach the goal by 2070*."

As is the case with India (reported in Edition 12 of Low Carbon Pulse), ahead of COP 26, to be held in Glasgow, Scotland, in November 2021, Indonesia is likely to come under pressure to commit to net-zero GHG emissions formally, and probably sooner than 2070.

As with India, it would be a great outcome if Indonesia were to commit to achieving net-zero GHG sooner than 2070, but in doing so, it would be even better if developed countries were to commit to provide support to Indonesia to achieve net-zero GHG emissions.

(By the end of Q2, the Ashurst Global Towards Zero Emissions team will publish a longer form article on the policy settings around plastics across ASEAN, including Indonesia.)

See*: Indonesia mulls net-zero emissions target by 2070*

President Joko Widodo of Indonesia is one of the 40 world leaders invited to the Leaders' Summit convened by US President Joe Biden for April 2021.

Biden invites world leaders to climate summit on April 22 and 23:

On March 26, 2021 it was announced that President Joe Biden is to host a Leaders' Summit on Climate Change. The Leaders' Summit will be virtual, and will be streamed live.

The announcement of the Leaders' Summit noted that: "By the time of the Summit, the United States will announce an ambitious 2030 emissions target as its new Nationally Determined Contribution under the Paris Agreement".

The key themes for the Leaders' Summit are to include, galvanising efforts during the next decade to limit global warming to the Stretch Goal, mobilising public and private sector finance to allow achievement of net-zero GHG emissions, the economic benefits of progress toward net-zero, and encouraging technology innovation and development.

This is a positive development, and is consistent with narratives, and clarity of thought emerging, in respect of the need for all developed countries to do more by increase GHG reductions ahead of 2030. Achieving the Stretch Goal is possible, but capital needs to be deployed now to achieve a 7.5% to 10% compound rate of increase in renewable electrical energy capacity to be certain of achieving this.

Also it is hoped that during 2021 developed countries commit to the provision of support to enable developing countries to increase their GHG emission reductions, in particular Pakistan, India, Bangladesh, Sri Lanka and Indonesia.

PARIS AGREEMENT GOALS	
Stabilsation Goal	to hold the increase in global average temperature to well below 2^{O}C above pre-industrial levels
Stretch Goal	to pursue efforts to limit the temperature increase to 1.5OC above pre-industrial levels

See*: President Biden Invites 40 World Leaders to Leaders Summit on Climate*

Taqa on Track:

On March 31, 2021, Taqa (the Abu Dhabi National Energy Company) announced plans to develop 27 GW (12 GW domestically, 15 GW globally) of renewable electrical energy by 2030.

Taqa Group Chief Executive and Managing Director, Jasim Thabet, noted that the objective of Taqa is "to become a champion for low carbon power and water".

Nuclear as part of energy transition to net-zero:

There continues to be a strong narrative around the use of nuclear energy in progress towards net-zero, both for and against. At the moment, it is clear that the European Commission continues to grapple with the use of nuclear energy, in particular whether nuclear energy will be considered as sustainable for the purposes of being entitled to various benefits under European Union law.

If nuclear energy is included in the taxonomy of the European Union as sustainable, it will qualify for financing, and other, benefits, subject always to compliance with environmental requirements.

See*: EU experts to decide nuclear power qualifies for green investment label-document*

Corporations in transition:

It is clear that at a macro, and at a micro level, climate change is existential. A clear manifestation of this is the transition of *International Oil Companies* to *International Energy Companies*. In this context, there is recognition of a new concept of "reservoir to bowser", and the need to develop renewable electrical energy, and in due course, hydrogen, businesses.

Over the last couple of weeks, two venerable names in different industries and sectors have announced a change in the nature of activities to be undertaken by them:

- First, Coal India Limited (***CIL***), the world's largest coal miner, announced on March 25, 2021 that it is invest in a joint venture to develop 3 GW of solar energy, and other clean power projects. *CIL* is to joint venture with state-owned enterprise NLC India in this enterprise. The enterprise is to compete in tenders for solar and other clean power projects. The scale of coal use in India and production by *CIL* indicates the road to be travelled: India uses about 1 billion tonnes of coal a year, with CIL's production being in the region of 710 mtpa. India plans to have 175 GW of installed renewable energy capacity by the end of 2022, and 450 GW by 2030.

  See: *World's biggest coal company bets on solar power*

- Secondly, Wilhelmsen Group (***WG***) has established a new division to its business, New Energy. The establishment of New Energy mirrors the transition that *WG* CEO, Mr Thomas Wilhelmsen sees coming:

  > "*In the next few decades, we will see a shift from oil and gas to renewable energy. The speed of change and investments needed, requires a dedicated focus to capitalise on the opportunities which will arise*".

  The perspective of Mr Wilhelmsen echoes the perspective of policy makers around the globe, and, increasingly, the perspective of institutional and private equity investors: the change that is upon the global energy sector, and as such upon all energy users, represents opportunity of a scale that has not been seen since the industrial revolution.

  See: *Shipping major Wilhelmsen switches focus to renewables*

Climate Action 100 + wants +++ climate action:

In previous Editions of Low Carbon Pulse, the increasing focus of investors on net-zero GHG emissions, and how corporations are going to achieve net-zero GHG commissions consistent with the Paris Agreement has been noted (see Editions 3, 9 and 12).

On March 23, 2021 the investor group ***Climate Action 100+*** (comprising 575 leading investors globally, including the world's two largest, BlackRock and State Street) reported on leading corporations' progress.

As might be expected, the report concluded that as yet no corporation surveyed for the purpose of the report has "earmarked" sufficient capital to meet GHG reduction commitments consistent with net-zero GHG emissions by 2050. As noted above, capital needs to be deployed to achieve the Stretch Goal.

The survey results are not surprising, and to many the purpose of the report has been achieved – clear identification by ***Climate 100 +*** that capital needs to be deployed by corporations now.

Increasingly the capital flows of investors will drive the need for increased capital deployment by corporations, and with this there will be convergence of the expectations of the members of ***Climate 100 +*** and capital deployment of corporations surveyed for the report.

See: *Climate Action 100+ investor group calls on the world's biggest polluters to lift their game*

Sustainable financing from the World Bank / IFC:

It is understood that the World Bank and its associated organisations are considering new policies for funding and support, including for energy projects. The International Finance Organisation (***IFC***) and the Multilateral Investment Guarantee Agency (***MGA***) are reported as planning to align to the net-zero GHG outcomes of the Paris Agreement in respect of new direct financing, as to 85% by July 2023, and as to 100% by July 2025.

Among other things, the Paris Agreement contemplates "making finance flows consistent with a pathway towards low greenhouse gas emissions (the Stabilisation and Stretch Goals and net-zero) and climate-resilient development" (see Article 1(c)).

See: *World Bank plans climate shift but no fossil fuel halt: Report*

The darkest hour is before the dawn:

Whenever a new publication or report places an estimated cost on energy transition, it tends to grab a headline or two. The Ashurst Global Towards Net-Zero team does not report on each cost estimate, first, because the cost estimates are best understood by those that have developed them, and secondly, the bases of estimates tend to be many and varied.

The reported fact is that the world is, on average, 1.1^{O}C warmer now than it was in 1850. If GHG emissions continue at the current rate of progress, by the end of the 21st century, the world will be considerably warmer than the Stretch Goal under the Paris Agreement.

On March 16, IRENA issued a publication that is preview to a longer form publication. The preview to the ***World Energy Transitions Outlook*** (titled "Preview to World Energy – Transitions Outlook – 1.5^{O}C Pathway"), is helpful. What is most telling from the Preview is the scale of the development of renewable energy capacity required to achieve the Stretch Goal under the Paris Agreement, i.e., limiting the rise in global temperature to a 1.5^{O}C increase compared to pre-industrial levels.

What appears to have caught the imagination of a number of commentators is the estimated cost of achieving the scale of development of renewable energy capacity. For other commentators, it is both the cost of doing so, and who is going to pay for this development that is of interest. Ultimately the discussion best had is the one that IRENA is promoting: "What needs to be done? How best to do it?".

As is the case on the publication of the IEA's *The World's Roadmap to Net Zero by 2050*, the Ashurst Global Towards Zero Emissions team will report on the IRENA full-form publication following its release.

Another Hydrogen Valley:

It would seem that each country with a Hydrogen Roadmap, Plan or Strategy, has or is going to have a hydrogen valley or a hydrogen corridor. On March 24, 2021 it was announced that Italy is to develop its first hydrogen valley. As is the case in other countries, the involvement of Government is key, with ENEA (the National Agency for New Technologies, Energy and Sustainable Economic Development) integral. The purpose of establishing the valley is to cluster organisations to develop a national supply chain for the production, transportation, storage and use of hydrogen: the Government will fund the development of a campus to house those involved in the project. The role of ENEA includes engaging organisations (including corporations, research institutions and universities) contractually on tasks.

See: *Plans unveiled for Italy's first hydrogen valley*

Solar round up:

- On March 23, 2021 it was announced that work has commenced on the AUS 768 million, 720 MW / 400 MWh solar storage New England Solar Farm (comprising 2.4 million solar panels, and 150 power conversion units and lithium Battery Electrical Energy Storage (***BESS***)).

  The New England Project has been described as Australia's largest hybrid solar *BESS* project to date. The Project developer UPC / AC Renewables Australia has commended the support of the local community and landowners for the Project to allow it progress over the last three years.

See: *Work begins on 720 MW / 400 MWh solar+storage project in Australia*

- On March 23, 2021 it was reported that the use of floating solar photovoltaic panels on canals in California is viable. Floating PV on waterways is being used successfully in India. It is to be expected that PV panels on canals (and waterways) will be used increasingly, especially in countries, and regions of countries, with higher ambient temperatures.

  See: *Solar canals already competitive with ground-mounted PV*

- On March 23, 2021 it was reported that Sunseap Group has commenced operations of its floating photovoltaic solar farm in the Strait of Johor. For the island state of Singapore, the use of the waters around its coast offers accretive renewable electrical energy supply. Sunseap Group continues to maximize opportunities for renewable electrical energy generation across (and around) Singapore, including through world scale roof-top solar installations.

  See: *Singapore now home to one of the world's largest floating solar farms*

- On March 30, 2021 it was reported that Plug Power plans to develop a Green Hydrogen production plant in Pennsylvania using renewable electrical energy supplied by renewable energy giant Brookfield Renewable from its Holtwood hydroelectric facility. Plug Power anticipates that the plant will commence production by the end of 2022, with the plant to produce up to 15 tonnes of Green Hydrogen a day.

  Low Carbon Pulse has reported on Plug Power's business development previously, most recently in Edition 11 in respect of the planned 120 MW electrolyser to be located at STAMP in New York.

  The development of the Green Hydrogen production plant in Pennsylvania continues Plug Power's plans to be producing 500 tonnes of Green Hydrogen a day by 2025.

  See: *Hyundai Heavy unveils slew of CO2 shipping projects*

- Low Carbon Pulse has covered the USD 26 billion Newcastle Waters Station in Australia's Northern Territory since the announcement of its development by the Sun Cable consortium. On March 31, 2021 it was reported that the approvals process for the development of what will be the world's largest solar farm is continuing, with an associated development application having been lodged for the first phase of the solar manufacturing and assembly facility.

  From various reports, whether or not the project will produce Green Hydrogen and Green Hydrogen using renewable electrical energy from the project or export that electrical energy to Singapore through a submarine interconnector is a matter that appears to be being kept open.

  See: *Sun Cable submits plans for gigawatt-scale solar manufacturing plant in Darwin*

- On April 1, 2021 it was reported by Tenergie that its first photovoltaic 33,000 m_2 greenhouse in the Bouch-du-Rhone region of France, with installed capacity of 2.1 MW, has achieved high yields on higher value food, and generated 3.1 GWh of renewable electrical energy since established in 2017. The use of PV in higher-value crop farming appears likely set to continue, and to expand, both in France, and in other countries.

  See: *French photovoltaic greenhouse delivers 3.1 GWh and 4 tons/hectare of asparagus in one year*

Wind round up:

- On March 22, 2021 Australia's first off-shore wind field project – the 2 GW Star of the South (***SOTS***) Project (owned in part by Danish infrastructure and renewable energy giant Copenhagen Infrastructure Partners) - outlined the route of the interconnector from the location of the *SOTS* (off-the south coast of Gippsland, Victoria) to connect with the NEM, involves "making landfall" at Reeves Beech. Australia is not known for off-shore wind field project development, but the Bass Strait (between Victoria and Tasmania), has world class off-shore wind resources.

  See: *Australia's first offshore wind project reveals underground transmission route*

- On March 23, 2021 it was reported that off-shore wind field resources in the Gulf of Mexico are sufficient to provide Texas (the ***Lone Star State***) with over 150% of its electrical energy demand. As noted in Edition 10 of Low Carbon Pulse, the answer to the recent challenges faced by the *Lone Star State* is to increase the renewable electrical energy generation from wind. The off-shore wind fields of the Gulf, provide the State with an ideal opportunity to do this.

  See: *Offshore wind 'could deliver 166% of Texas power'*

- On March 24, 2021 it was announced that RWE (the German renewables electrical energy giant) has made a positive final investment decision to develop its 1.4 GW USD 4.1 billion Sofia off-shore wind field in the UK (the ***Sofia Project***). The Sofia Project is to start on-shore work in Q2 of 2021, with off-shore work to construct expected to proceed during 2023, with completion scheduled for Q4 of 2026. RWE was awarded a "contract for difference" for the Sofia Project in 2019, at a strike price of GBP 39.65.

  Chief Commercial Officer of RWE Renewables noted that the Sofia Project would help deliver on the 40 by 30 ambitions of the UK (see Edition 1 of Low Carbon Pulse).

  See: *RWE Sanctions Development of 1.4 GW Sofia Offshore Wind Farm*

  On March 29, 2021 further progress was reported with Sembcorp Marine and GE Renewable having won electrical transmission works valued at USD 826 million for the Sofia Project.

  See: *Sembmarine and GE land $826m deal for one of world's largest wind farms*

- In Edition 8 of Low Carbon Pulse noted that the Crown Estate Scotland had opened the process for applications for ScotWind seabed leasing. In Edition 9 of Low Carbon Pulse, the successful bids received by the Crown Estate and UK Treasury were reported.

  As a result of the level of the successful bids for leases in the waters around England and Wales, the Crown Estate Scotland increased the cap per square kilometre for bids. The cap was increased from GBP 10,000 and GBP 100,000 per square kilometre for seabed leases. With 8,600 square kilometres under tender, if the caps are reached, the Crown Estate Scotland is set receive tender responses in an amount equal to GBP 860 million. The proceeds of the tender are payable directly into consolidated fund for Scotland, and as such available for public expenditure in Scotland.

  See: *Scottish* seabed windfarm auction set to bring in £860m

- On March 30, 2021 it was reported that Equinor's Hywind project, 15 miles off Aberdeen, has broken records for maximum output from an off-shore wind field. Hywind uses floating off-shore wind technology, in some of the most storm prone waters off Scotland. The floating wind technology is awe-inspiring in its dimensions - 75 metres of the superstructure submerged beneath the water, and 175 metres above the water, with the blades being 154 metres in diameter. Given the success of Hywind it is reported that Equinor is looking for opportunities to continue to deploy the technology.

  See: *Roaring success of Scottish windfarm shows global potential*

- On March 31, 2021 it was reported that the first off-shore wind field is being planned for The Philippines. Triconti ECC, comprising Philippine, Swiss and German interests, is reported as having undertaken feasibility studies for up to 1.2 GW of off-shore wind field capacity in Aparri Bay (northern Philippines) and the Guimaras Strait (central Philippines).

  See: *Philippines to build first offshore wind farm*

- On April 1, 2021 Orsted (global renewable energy giant) announced plans to develop a 2 GW off-shore wind field to provide electrical energy to 1 GW of electrolyser capacity (to be developed in two equal phases of 500 MW), which would then deliver Green Hydrogen to industrial users though hydrogen pipelines in Belgium and The Netherlands (***SeaH2Land project***). The production of Green Hydrogen would provide Green Hydrogen to ArcelorMittal, Dow and Yara. While a final investment decision remains to be taken, as currently contemplated it is planned that *SeaH2Land* will be producing Green Hydrogen by 2030.

See: *Orsted to link a huge offshore wind farm to 'renewable' hydrogen production*

- In Edition 12 of the Low Carbon Pulse the potential of off-shore wind in the US was described. As foreshadowed in Edition 7 of Low Carbon Pulse, the Biden Administration has announced a plan to expand the development of offshore wind capacity, with 30 GW contemplated by 2030 (***30 by 30***). This is good news, but this alone is not going to achieve the clean electrical energy target by 2030.

  To accompany this news, and to facilitate the development of *30 by 30,* the Energy Department is committed to the provision of USD 3 billion in loan guarantees, and the Interior Department has identified a "Wind Area" from Long Island to the New Jersey coast. (The US has approximately 120 GW of on-shore installed wind capacity.)

  Vineyard Wind 1 project (the first of the large-scale off-shore wind field) has appointed DEME to transport and to install wind turbines for the project. The Vineyard Wind 1 project is being developed by Vineyard Wind, a joint venture between Avangrid Renewables, and, world infrastructure and renewable electrical energy investment giant, Copenhagen Infrastructure Partners.

  See: *Biden administration announces plan to expand wind power*

Green Hydrogen (and ammonia and methanol) roundup:

- Edition 10 of Low Carbon Pulse (***Brazilian government and industry caucus around Green Hydrogen Hub***) outlined developments in respect of the USD 5.4 billion Enegix Energy project (***Base One Project***). Enegix Energy has provided further details as to the scale of the *Base One Project*, critically that the project is to produce 600 million kg (or 6 million tonnes) of Green Hydrogen a year from full operation in 2025. To provide electrical energy for the *Base One Project*, Enegix Energy is contemplating 3.4 GW of renewable electrical energy (solar and wind).

  See: *$5.4 Billion Project Aims to be World's Largest Green Hydrogen Producer in 2025*

- On April 2, 2021 it was reported that the proposal for funding from the European Union for the Wacker Chemie AG (***Wacker***) Green Hydrogen and renewable methanol is progressing (the RHYME Project **r**enewable **hy**drogen and **me**thanol). *Wacker* intends to develop a 20 MW electrolyser plant with Linde GmbH, and to use H_2 and CO_2 to derive renewable methanol. Both the Green Hydrogen and the renewable methanol will be used as feedstock in chemical production by *Wacker*. The funding sought for the RHYME project is from the EU Innovation Fund (to provide funding until 2030): the EU set aside a € 10 billion fund to support innovative technologies.

  See: *WACKER* and Linde Project for Generating Green Hydrogen Reaches Next Selection Stage for EU Funding

Northern Europe Clean Hydrogen Coastline:

In Edition 12 of Low Carbon Pulse ("***Hydrogen Republic of Germany***") lauded "as a case study in planning and integration" plans of the City of Hamburg (including the port, connected to the North Sea by the Elbe River) for the Hamburg Hydrogen Industry Network (*HH-WIN*), and the integration of those plans with those of Bremen, Lower Saxony, Macklenburg-Western Pomerania and Schleswig-Holstein, and the development of 500 MW of electrolyser capacity by 2025.

On March 24, 2021 a number of major industrial companies (including EWE, ArcelorMittal and FAUN Group) in Northern Germany announced plans to develop a network, spanning the Dutch, German, and Danish coastline, to develop an integrated hydrogen network (***Clean Hydrogen Coastline***) comprising 400 MW of electrolysers and storage by 2026.

In two line simple sentence CEO of steel manufacturer ArcelorMittal, Mr Reiner Blackscheck sums up what is required for industrials (including in Difficult to Decarbonise Industries) to transition of Green Hydrogen:

- "*… the transformation process [requiring] the technology change in order to use Green Hydrogen in production. To do this, we need a functioning supply of hydrogen at economic costs so that we can keep the Bremen steel location competitive over the long term*".

To provide demand for "a functioning supply of hydrogen", ArcelorMittal plans to invest up to USD 1.4 billion to develop both a direct reduction iron ore (***DRI***) facility (using natural gas (predominantly CH_4) as the reducing gas in the first instance until the provision of Green Hydrogen from across the *Clean Hydrogen Coastline* network), and an electric arc furnace (***EAF***).

The sponge iron* produced at the DRI will be used the ArcelorMittal's Bremen and Eisenhuttenstadt steel mills. EWE and FAUN plan to develop HRI to provide further demand for the functioning supply of hydrogen.

The need for supply and demand to develop in tandem is critical. Germany and Japan (at government and corporate level) have a particular focus on this, and how to achieve it.

See: *$1.5bn plans unveiled to integrate hydrogen into the northwest German coastline* and *ArcelorMittal to transition two German steelmaking plants to green hydrogen*

The integrated hydrogen network may be regarded as consistent with the plans outlined in a publication titled "European Hydrogen Backbone" outlined How Dedicated Hydrogen Infrastructure Can Be Created". The Publication was sponsored by Enagas, Energinet, Flyxys Belgium, Gasunie, GRTgas, NET4GAS, OGE, ONTRAS, Snam, Swedegas, and Terega.

***Direct Reduction Iron** (DRI) aka **Sponge Iron**: iron ore that is subject to a direct reduction by using a reducing gas (at a high-heat temperature.
Pig Iron: iron ore that is subject to melting with charcoal (derived from coking coal) and limestone.

Lacq Hydrogen Project – no lack of ambition:

On April 2, 2021 plans were announced to develop and to deploy 6,800 km of pipeline across Europe by 2030, and a 22,900 km hydrogen network across Europe by 2040. The development and deployment would accelerate the development of the Green Hydrogen industry in Spain: the Aragon region of Spain would provide renewable electrical energy from world class solar resources to produce Green Hydrogen.

See: *Huge Franco-Spanish hydrogen project set create green hydrogen infrastructure*

Green steel round-up:

- On March 18, 2021 the WindH2 project started operations in Germany. WindH2 is an association of leading corporations: steel giant Salzgitter, Avacon (a subsidiary of E.ON) and Linde (world leading industrial gases corporation). The project involves the use of wind-power to produce renewable electrical energy using seven turbines provided by Avacon installed on the Salzgitter site, providing 30 MW of installed renewable energy capacity. This renewable electrical energy will be used to power two PEM electrolysers to derive Green Hydrogen, with the Green Hydrogen used in the Salzgitter Low CO_2 Steelmaking technology. Linde will continue to provide hydrogen.

  See: *Salzgitter, Avacon and Linde commission WindH2 project*

- On March 24, 2021 it was announced that HYBRIT is to develop a new green steel mill in Gallivare, Sweden, to produce fossil-free sponge iron (also known as direct reduction iron). The Gallivare green steel mill will have a total steel-making capacity of 2.7 mtpa by 2030. The Gallivare green steel mill will join the pilot green steel mill at Lulea that has proved up the technology. In addition, there are plans to develop an underground storage facility to store Green Hydrogen.

  The project is part of an integrated supply chain, from "mine-to-mill-to-manufacturer", among the HYBRIT partners (LKAB, SSAB and Vattenfall), to transform their respective businesses: for LKAB as the supplier of iron ore, SSAB as the steel mill owner and operator, for Vattenfall as a producer, and retailer, of electrical energy and heat, and the producer and supplier of Green Hydrogen. (Vattenfall is ultimately a Swedish state-owned company.)

  Hybrit Development AB, owned by LKAB, SSAB, and Vattenfall, was established to develop technology to enable the production of steel using hydrogen, rather than coal. Significant support has been provided by the Swedish Energy Agency, through Industriklivet.

See: *HYBRIT: SSAB, LKAB and Vattenfall to begin industrialization of future fossil-free steelmaking by establishing the world's first production plant for fossil-free sponge iron in Gällivare*

Progress to Green Steel and scale in Green Hydrogen:

In previous Editions of Low Carbon Pulse, it has been noted that the supply of Green Hydrogen to the steel industry, both self-sourced and third party sourced, is likely to result in the accelerated development of the Green Hydrogen industry: the scale of use of Green Hydrogen in the green steel industry will allow scale to be achieved in production, with an established demand side (for green steel production), allowing decisions to be made to produce more, or to have capacity to produce more, Green Hydrogen (see Edition 5 of Low Carbon Pulse).

This narrative is being developed by the European Green Hydrogen Acceleration Center (***EGHAC***) which was established with the assistance of EIT InnoEnergy and Breakthrough Energy. EIT InnoEnergy has now played a role in the H2 Green Steel Initiative.

In an interesting article in the **environment journal**, the benefit for the development of the Green Hydrogen industry of the focus on the Difficult to Decarbonise Industries is explained cogently. "To build organically the existing chain to produce Green Hydrogen would take years. Recognising that the world simply does not have that time…" green steel can underpin supply.

See: How the pull of green steel can make green hydrogen competitive

The nomenclature of BESS:

While most readers will know the nomenclature of Battery Electrical Storage Systems (***BESS***) some may not. In Low Carbon Pulse when referring to BESS, MW and MWh figures are used to describe the size of the *BESS*: the MW figure describes the maximum output of the stored electrical energy of the *BESS*, and the MWh figure describes the period MWh in storage, for example, 100 MW, and 100 MWh indicates that at the maximum output the *BESS* can deliver 100 MWh for an hour, in contrast to 100 MW and 400 MWh indicates that at maximum output the *BESS* can deliver 100 MWh for 4 hours. As is becoming increasingly apparent, as *BESS* use is increasing, the higher each number, and the quicker the response time, the better from a grid integrity and stability perspective. Hence "Big Batteries".

In the recent Energy Storage Summit USA 2021, these issues were discussed, as were the factors that will inform the size of *BESS* by location, including the energy density per square kilometre. In this context, "long-range" *BESS*, having capacity to supply for over 6 hours, is likely to be used less in areas of higher energy density than areas of lower energy density because in areas of higher energy density land use and value is likely to be at a premium. Given these dynamics, it is apparent that a broad range of multi-faceted *BESS* solutions are likely to be developed, on grid, and off-grid, at meter, and behind the meter, including micro-grids.

In this brave new world of *BESS*, *BESS* storage of 10/12/24 hours is being contemplated for business users, and up to 72 hours for telecommunications companies, including to guard against the consequences of land-borne weather events.

See: Long-duration storage: multitude of solutions set to step up to the plate

The possible use of Fuel Cell Storage Systems:

Like issues arise for data centres. Currently the last resort of background power for data centres tends to be diesel generation sets. It has been reported that Microsoft is considering (including undertaking research on) the use of hydrogen fuel-cell technology as an alternative to diesel generation.

The work that Microsoft is continuing to do is consistent with its commitment to be carbon negative by 2030, i.e., Microsoft is committed to the removal of more GHG emissions from the atmosphere than the mass of GHG emissions arising in real time from its activities, and if Microsoft's plans eventuate, overtime to remove a greater mass of GHG emissions than GHG emission arising from its activities since its establishment (see Edition 2 of Low Carbon Pulse).

See: Microsoft: Hydrogen fuel cells will enable data centers to completely rethink electrical systems

Hydrogen from waste and waste water:

On March 31, 2021 it was announced that Pure Hydrogen and Wildfire Energy have agreed to develop a new facility to derive hydrogen from waste (***H2fW plant***) in Queensland, Australia. It is contemplated that the *H2fW* plant will produce up to 1,500 kgs of hydrogen a day. The ***H2fW plant*** is to use Wildfire Energy's Moving Injection Horizontal Gasification (***MIHG***) process. At the moment it is understand that the hydrogen will be cooled and compressed for delivery to customers.

See: *New Australian waste-to-hydrogen plant unveiled that will produce 1,500kg per day*

On March 30, 2021 it was announced that Ways2H and Japan Blue Energy have completed the development of a waste water facility (located at the Sunamachi Water Reclamation Centre, Tokyo) that derives hydrogen from waste water sludge. Between 45 to 50 kg of hydrogen will be derived each day: one tonne of waste water sludge yields 45 to 50 kg of hydrogen. The hydrogen will be used for FCEVs.

Later in April 2021, the Ashurst Global Towards Net-Zero Emissions team will publish the first of a series of features on hydrogen for industry (***H24I*** series).

Net-zero GHG emission commitment update:

It is estimated that close to 1,500 corporations globally have committed to achieving net-zero GHG emissions. Depending on the carbon footprint of any individual corporation, comprising its Scope, 1, 2 and 3 emissions, the means of achieving this commitment will vary from straight-forward to complex. The means of decarbonising a footprint for each corporation is different and distinct, and it is likely to change over time.

As a general statement, there are three ways to progressing to net-zero GHG emissions: first, decarbonising the activities undertaken by a corporation, including GHG emissions arising from its own activities, and decarbonising production and use of goods and services provided by it, secondly, using carbon-off-set mechanisms (most typically, using a carbon sink to sequestrate carbon arising, directly and indirectly from the activities of the corporation); and thirdly, using capture and storage of CO_2 permanently (***CCS***) or capture and use of CO_2 (***CCUS***) in respect of the emission of CO_2 arising from both their activities or the activities of their suppliers, for example electrical energy generation using fossil fuel and other carbon intensive sources and any process from which CO_2 arises, including cement production, chemical and petrochemical production, and steel production (the ***Difficult to Decarbonise Industries***).

Leaving to one side the regulation versus a carbon price debate (as noted in Edition 12 of the Low Carbon Pulse) typically a carbon price is achieved by imposing a carbon tax and introducing an emissions trading scheme, sometimes a carbon tax only. The introduction of a carbon price, will send price signals, and, if the basis of the carbon price works effectively, the carbon price will signal transition to low or lower, or no, carbon options.

At least in part, the carbon price (and as a result the carbon tax and emissions trading scheme), needs to be set to reflect the estimated costs, direct, and indirect, overtime, of the emission of GHGs. In a recent paper, Mr Matthew Kotchen (an economist at Yale University) has calculated that the cost of the production and use of fossil fuels in the US economy is in the region of USD 62 billion a year. While each bases of the determination of a carbon price is subject to considerable debate, as a basis for discussion, Mr Kothchen's analysis appears sound.

See: Fossil fuel companies get $62B a year in implicit subsidies, economist reports

SCOPE OF GHG EMISSIONS	
Scope 1	GHG emissions arising directly from activities and assets controlled or owned by the corporation.
Scope 2	GHG emissions arising indirectly from supply of energy, including electrical energy and heat by the corporation.

Scope 3	GHG emissions arising indirectly in the supply chain of the corporation, including supply of energy.

To illustrate Scope 2 and 3 emissions, set out below is recent news:

- **Scope 2**: It has been reported that Volkswagen Group (***VAG***) is well on the way to achieving its target of deriving 100% of the electrical energy load of its European fabrication and manufacturing plants by 2023. In 2020, the *VAG* increased its renewable load from 80% to 95%.

  See: *Volkswagen's European Factories Up to 95% Powered by Renewables*
- **Scope 3:** It has been reported that the 110 suppliers of components and equipment, and fabricating and manufacturing contractors, of Apple, Inc are progressing towards 100% renewable electrical energy to the extent that their activities relate to the production of Apple components and products. What this means is the approximately 8 GW of electrical energy capacity is required to enable Apple, Inc to address its Scope 3 emissions, thereby contributing to achieving Apple's commitment to carbon neutrality by 2030. The Ashurst Global Towards Zero Emissions team is seeing an increased focus of Scope 3 emissions across many supply chains.

  See: *Apple's suppliers embrace renewable energy*

Rubber hits the road:

On April 2, 2021, Ford made an announcement in respect of each of its Scope 1, 2 and 3 emissions, with the commitment to reduce Scope 1 and 2 to 76% of 2017 emissions by 2035, and Scope 3 to 50% of 2019 emissions by 2035.

See: *Ford announces new carbon neutral targets*

(See Edition 3 of Low Carbon Pulse for ***World Business Council on Sustainable Development*** **and** ***Equinor announces its own road map to 2050 net-zero target – "every step of the way"***.)

Sweden on the move:

In addition to being an early mover in green steel, Sweden has reached 1 GW of installed photovoltaic renewable electrical energy capacity, and PowerCell continues to develop 100 kw fuel cell systems for use in agricultural equipment manufacturer.

See: *Sweden hits 1 GW milestone*

Publication round up:

- **Wind industry on track to install 1 TW of capacity by 2030:**

  In a recent Wood Mackenzie paper estimates that the wind industry will install 1 TW of renewable electrical energy capacity.

  See: *Global wind power installations hit record levels in 2020*
- **Net-zero stock take:**

  On March 23, 2021, the Energy & Climate Intelligence Unit published *"Taking Stock: A global assessment of net zero targets - Scrutinising countries, states, and regions cities and companies*.

  See: *Taking stock: A global assessment of net zero targets*

Both publications provide interesting insights.

The author of this Edition of Low Carbon Pulse is Michael Harrison.

Key Contacts

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

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