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US resumes pressure on GHG emissions

President Biden has put climate change back on the US agenda



A recent decision by the US court of appeal to scrap a rule instigated by the Trump administration could help President Biden in his effort to limit greenhouse gas emissions. **Junior Isles**

A recent ruling on regulating carbon emissions from power plants could help smooth the way for newly elected US President Joe Biden in his plan to tackle climate change.

The US Court of Appeals for the D.C. Circuit recently scrapped one of the Trump administration's biggest climate change rules with a decision that for the first time offers a binding judicial opinion on the statutory scope of the Environmental Protection Agency's (EPA) regulatory powers on greenhouse gas (GHG) emissions.

Trump's EPA administration tried to roll-back Obama-era greenhouse gas emission standards for power plants with the introduction in 2019 of the Affordable Clean Energy (ACE) rule covering emissions from the power industry.

The Obama-era Clean Power Plan (CPP) had mandated that power plants make 32 per cent reductions in emissions below 2005 levels by 2030. The plan gave states wide flexibility in figuring out how best to meet the new targets, but most coal plants would have been forced into retirement.

The CCP, however, ran into legal difficulties in 2016, and the issues were not resolved before President Trump came into office. Trump's EPA administrator, Andrew Wheeler, a former coal lobbyist, signed the new rule in June 2019, saying that it would lower electricity costs and that the Obama EPA had overreached. He argued that the Clean Air Act (CAA) clearly constrains EPA to only those improvements that can be made on-site at coal fired power plants.

The ACE rule was designed to ease constraints on the power industry while still complying with legal requirements under the federal CAA. It pushed individual coal fired power plants to become more efficient, with the potential consequence of having them run longer and more often, in turn bolstering demand for coal. The agency admitted, however, that this would directly achieve only a small fraction of the emissions reductions that would have been required under the Obama-era CPP.

Announcing their ruling, two of the three-judge panel, judges Patricia Millett and Nina Pillard, both Obama appointees, wrote that Trump's EPA had put all its eggs in a defective basket. The panel ruled that the EPA can consider "beyond the fence-line"

options such as generation-shifting, the strategy envisioned under the CPP in which emissions reductions were driven in part by utilities moving away from coal in favour of less-polluting natural gas and renewables.

"Because promulgation of the ACE Rule and its embedded repeal of the Clean Power Plan rested critically on a mistaken reading of the Clean Air Act, we vacate the ACE Rule and remand to the Agency," the judges said.

Michelle Bloodworth, President of America's Power, which represents coal producers and companies with coal fired power plants, said her group was disappointed with the decision.

"We had intervened in the case to help defend the rule because we feel

Continued on Page 2

Hydrocarbons to reach peak demand sooner than expected

Aggregate fossil fuel demand is set to peak in 2027 – with oil peaking in 2029 and gas in 2037 – partially due to the impacts of Covid-19, according to new research by leading global consultancy, McKinsey & Company.

The 'Global Energy Perspective 2021' report finds that while coal demand peaked already, peaks in demand for oil and gas are not far behind – falling in 2029 and 2037, respectively.

McKinsey notes that the decline in coal use continues, in an environment where the energy, gas and increasingly renewables sectors show net growth that is being driven by economic growth in India and the Association of Southeast Asian Nations (ASEAN).

The slowdown in oil, it says, is driven by declining road transport

and the impact of Covid-19. Gas demand continues to grow for some time due to high growth in some sectors such as chemicals, other industries and construction. "After peak, the decline in gas demand is driven by the energy sector, as the gas changes its role from base load supplier to flexibility provider," it said.

The pandemic has resulted in a profound reduction in energy demand, from which McKinsey expects it will take between one to four years to recover – with electricity and gas demand expected to bounce back more quickly than demand for oil.

However, demand for fossil fuels will never return to its pre-pandemic growth curve. Over the long-term, the impacts of behavioural shifts due to Covid-19 are minor compared to "known" long-term shifts such as

decreasing car ownership, growing fuel efficiencies and a trend towards electric vehicles, whose impact is estimated to be three-to-nine times higher than the pandemic's by 2050.

Christer Tryggestad, Senior Partner at McKinsey, said: "While the pandemic has certainly provided a substantial shock for the energy sector across all fuel sources, the story of the century is still a rapid and continuous shift to lower-carbon energy systems.

"The share of electricity in the energy mix is set to grow by around 50 per cent by 2050 and it's set to capture all global energy growth as hydrocarbon consumption plateaus. However, in our Reference case, fossil fuels continue to play a significant role for the foreseeable future."

Indeed, while energy systems

around the world will shift to renewables, which are able to compete with the marginal cost of fossil power already today in most places, by 2050 more than half of all global energy demand continues to be met by fossil fuels in McKinsey's Reference Case scenario.

As a result, while the earlier peak of hydrocarbon demand means a substantial reduction in forecasted carbon emissions, the world remains significantly off of the 1.5°C pathway and will run out of its carbon budget for 2100 in the early 2030s.

According to McKinsey's estimates, annual emissions would need to be around 50 per cent lower in 2030 and about 85 per cent lower by 2050 than current trends predict to limit the global temperature increase to 1.5°C above pre-industrial levels.

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that the ACE rule follows the plain language of the Clean Air Act, and the rule takes a sensible approach to regulating carbon dioxide emissions from the nation's coal fleet, whose emissions have declined significantly even without carbon regulations," she said.

The court's ruling stopped short of endorsing any particular regulatory scheme, leaving some ambiguity with which the EPA will have to grapple as it works out what will be its third attempt at writing a rule limiting carbon dioxide from power plants.

The new ruling, however, will make it easier for the Biden administration to create rules that help drive the nation's power grid towards net zero carbon dioxide emissions by 2035, a goal that Biden has laid out.



Lakewood says Biden administration can now take "science-based" approach

Clare Lakewood, Legal Director of the Center for Biological Diversity's Climate Law Institute, said the decision "frees up the new Biden administration to begin working immediately on the science-based greenhouse pollution rules we desperately need to make up for lost time".

According to a recent analysis by researcher Rhodium Group, US GHG emissions rose less in 2020 than in any year since the second world war as the pandemic brought the US economy to a halt, but they are expected to rebound strongly when the economy recovers.

Kate Larsen, a director at Rhodium and one of the report's authors said: "Typically, a major recession like the one we experienced in 2009 – and are experiencing now – provides a real hit to economic activity and emissions. But then they largely get back on track for the type of growth that was anticipated."

This presents a challenge to the Biden administration. As a result of last year's shock, the US is likely to exceed its 2020 targets under the Copenhagen accord to cut emissions by 17 per cent from 2005 levels, Rhodium found. But reducing them by the 26-28 per cent by 2025 targeted by the Paris agreement remains a challenge.

Experts argue that Biden will have to accelerate his plans, noting that emissions would begin to rise again rapidly as vaccines were rolled out and economic activity returned to normal.

"If there's no action taken to build back cleaner and greener, emissions in the US would continue to rise slowly and largely stay around previous levels through 2030, absent new policy," said Larsen.

On a positive note, the report revealed a continued slowdown in power sector emissions, which were more than 10 per cent lower despite relatively flat electricity demand, as utilities were weaned off coal fired generation.

Low-carbon investment passes milestone but auctions hinder renewable growth

- Low carbon investment crosses \$500 billion mark
- Auctions in small and medium renewables sector create barriers

Junior Isles

The world invested unprecedented amounts in low-carbon assets last year, according to new analysis by BloombergNEF (BNEF).

A new, broad measure of 'energy transition investment', compiled by BloombergNEF (BNEF), shows that the world committed a record \$501.3 billion to decarbonisation in 2020, beating the previous year by 9 per cent despite the economic disruption caused by the Covid-19 pandemic.

BNEF's analysis shows that companies, governments and households invested \$303.5 billion in new renewable energy capacity in 2020, up 2 per cent on the year, helped by the biggest ever build-out of solar projects. This was no doubt driven by falling costs. A separate report by Wood Mackenzie said solar is expected to become the cheapest source of new power in every

US state and in Canada, China and 14 other nations by the end of the decade.

BNEF also said there has been a \$50 billion surge for offshore wind, while \$139 billion was spent on electric vehicles and associated charging infrastructure – up 28 per cent and a new record.

Other areas of energy transition investment also showed strength. Domestic installation of energy-efficient heat pumps came to \$50.8 billion, up 12 per cent, while investment in stationary energy storage technologies such as batteries was \$3.6 billion, level with 2019 despite falling unit prices. Global investment in carbon capture and storage (CCS) tripled to \$3 billion, and that in hydrogen was \$1.5 billion, down 20 per cent but the second-highest annual number to date.

Albert Cheung, head of analysis at BNEF, said: "Our figures show that the world has reached half a trillion dollars

a year in its investment to decarbonise the energy system. Clean power generation and electric transport are seeing heavy inflows, but need to see further increases in spending as costs fall. Technologies such as electric heat, CCS and hydrogen are only attracting a fraction of the investment they will need in the 2020s to help bring emissions under control. We need to be talking about trillions per year if we are to meet climate goals."

Despite seeing growth in the face of the pandemic, a separate study recently claimed renewables expansion could be even faster with the right policy framework.

A study commissioned by the energy policy think-tanks Energy Watch Group, World Future Council/Global Renewables Congress and Haleakala Stiftung examined the result of policy frameworks on the expansion of renewables and the impact on climate

goals. It found that the increasing use of auction schemes – especially in the small and medium (up to 50 MW) market segments – create substantial barriers to the exponential growth of renewables that is needed to meet the climate targets set by the Paris climate agreement.

The study, which based its analysis on empirical observations in more than 20 countries worldwide, concludes that a new policy mix needs to be urgently implemented to allow for an aggressive expansion of renewable energies.

The authors recommend adjusting the use of individual policy instruments depending on the market segment, suggesting: continued use of auctions for large-scale projects; the use of feed-in tariffs or feed-in premiums for small and medium sized projects; and use of self-consumption policies for very small-scale projects.

Consortiums drive green hydrogen production

As governments and businesses eye net zero carbon emissions by 2050, efforts are being ramped up to increase the production of green hydrogen, with last month witnessing the announcement of several major initiatives in Europe.

Most recently Shell, Mitsubishi Heavy Industries (MHI), Vattenfall and municipal company Wärme Hamburg signed a Letter of Intent signifying an important step towards the consortium's development of a "Green Energy Hub", which will produce green hydrogen from wind and solar power, at the site of the Hamburg-Moorburg power plant.

The letter outlines how they will jointly work together on the production of green hydrogen, including with the construction of a scalable electrolyser with an initial output of 100 MW. Subject to final investment decisions and according to the current state of planning, once the site has been cleared, the production of green hydrogen is

anticipated some time during 2025.

The partners intend to apply for funding under the EU programme "Important Projects of Common European Interest" (IPCEI). This should take place in the first quarter of 2021 with the submission of a first outline of the project.

The agreement follows a similar move earlier in the month by Siemens. Siemens Gamesa and Siemens Energy announced that they are combining their ongoing wind to hydrogen developments by contributing to an innovative solution that fully integrates an electrolyser into an offshore wind turbine as a single synchronised system to directly produce green hydrogen.

The companies intend to provide a full-scale offshore demonstration of the solution by 2025/2026. The German Federal Ministry of Education and Research have said that the developments can be implemented as part of

the ideas competition "Hydrogen Republic of Germany".

Over a timeframe of five years Siemens Gamesa plans to invest €80 million and Siemens Energy is targeting to invest €40 million in the developments. Siemens Gamesa will adapt its development of its SG14-222 DD offshore wind turbine to integrate an electrolyser system into the turbine's operations. Siemens Energy will develop a new electrolysis product to meet the needs of the harsh maritime offshore environment and be in perfect sync with the wind turbine.

The announcement came shortly after Siemens Gamesa said that, together with Ørsted, ITM Power, and Element Energy, it had been awarded €5 million in funding to demonstrate and investigate a combined wind turbine and electrolyser system designed for operation in marine environments.

The Fuel Cells and Hydrogen 2 Joint Undertaking (FCH2-JU), a public-

private partnership of the European Commission, awarded the consortium behind the OYSTER project with the funding to investigate the feasibility and potential of combining an offshore wind turbine directly with an electrolyser and transporting renewable hydrogen to shore.

The consortium will develop and test a megawatt-scale fully marinised electrolyser in a shoreside pilot trial. The project, coordinated by Element Energy, is planned to start in 2021 and will run to the end of 2024.

ITM Power is responsible for the development of the electrolyser system and the electrolyser trials, while Ørsted will lead the offshore deployment analysis, the feasibility study of future physical offshore electrolyser deployments, and support ITM Power in the design of the electrolyser system for marination and testing. Siemens Gamesa and Element Energy are providing technical and project expertise.

Investment in distribution needed, says landmark study

European distribution grids will need investments of €375-425 billion until 2030, according to a landmark study conducted by the industry bodies Eurelectric and E.DSO.

The first of its kind study, which was carried out by Monitor Deloitte on the basis of detailed empirical data from 10 European countries, reveals a need to ramp up grid investments by 50-70 per cent in the 2020s compared to the previous decade. At the same time, it highlights a range of notable societal benefits that come with timely modernisation of the continent's electric infrastructure.

A significant part of the investment needs is driven by the ongoing energy transition: expansions and replacements related to integration of variable renewables such as solar and wind, 70 per cent of which will be connected at the distribution level, as well as to the progressive electrification of industry, transport and buildings.

The single biggest investment driver, however, is modernisation of the infrastructure due to ageing. The study finds that approximately one third of EU's grids is already over 40 years old. This share is likely to surpass 50 per cent

by 2030.

Despite average annual investment needs of €34-39 billion, representing a 50-70 per cent increase on the amount spent in 2019, the impact on electricity prices and grid tariffs is likely to be moderate if policy makers and regulators provide the right framework conditions and a smart tariff design.

Moreover, the societal benefits in relation to sustainability, economy and competitiveness, brought about by this transformation will outweigh the economic impacts: The EU could save over €175 billion in fossil fuel

imports annually, and ultimately reduce the average electricity costs by €28-37 billion in the long term.

On releasing the study, Kristian Ruby, Secretary General of Eurelectric, said: "Grid investments are urgently needed for the energy transition and they hold a huge potential for job creation. With the right framework conditions we can make the 2020s the decade of distribution grids. We call on policymakers to improve investment frameworks and tariff design, facilitate access to EU funds and accelerate authorisation and permit granting processes."



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US slips out of coal, into wind and solar

- Texas expansion knocks coal into third place
- New York to tap into offshore wind and Canadian hydropower

Janet Wood

Wind and solar will represent the lion's share of new US generation in 2021, according to the US Energy Information Administration. It says that this year solar is expected to be 39 per cent, wind 31 per cent of new capacity and battery storage 11 per cent. A new nuclear plant will provide 3 per cent, leaving just 16 per cent from gas. Much of the new capacity was well in train

before the election of President Joe Biden revived the climate agenda.

Recently oil major Total has picked up the renewables baton, announcing plans to join 174 Power Global to develop 1.6 GW of solar projects. "This transaction is a first significant step for Total in the US utility scale solar market, in line with our 2025 ambition to achieve 35 GW of renewables production capacity worldwide," said Julien Pouget, Total's Renewables Director.

Five of Total's solar plants will be in Texas, where last year wind power provided a quarter of the oil-rich state's power. Coal had an 18 per cent share of the state's power market.

At the other end of the country New York State has granted consent for two offshore wind projects. Empire Wind II (1260 MW) and Beacon Wind (1230 MW) – were both proposed by Norway's Equinor. "These projects will also create value through economies

of scale and support our strategic ambition of becoming a global offshore wind major," said Anders Opedal, CEO of Equinor.

These projects will join New York's first projects, which totalled 1696 MW: Equinor's Empire I and Sunrise Wind, a joint development by Ørsted and Eversource.

Meanwhile Canada is boosting its ability to export to the Northeastern USA. New York has opened bidding

for three transmission projects including a 330 mile line from the Canadian border to New York City – its first new transmission lines since 1978. The 1.2 GW transmission line proposed by LS Power, an independent power producer, would run underground and under the bed of the Hudson River. Hydro-Québec will be able to transfer 1.2 GW to Massachusetts after Avangrid began construction in January on a new transmission line through Maine.

Mitsubishi Power claims leading position on storage

Mitsubishi Power claims it won the largest share of the storage market in the Americas in 2020, under a broad definition of storage, with orders totalling 151 GWh.

The company counted both utility-scale and behind-the-meter technologies in that assessment, including battery, pumped hydro and hydrogen storage. Among those technologies, Mitsubishi Power received orders for 920 MWh of fast-acting lithium-ion battery systems in the year, for storage developers including Key Capture Energy (Texas) and Hecate Grid (California).

In March 2020 IPA Intermountain Power Agency ordered Mitsubishi Power JAC gas turbine power islands that can replace conventional gas with

up to 30 per cent hydrogen fuel. IPA plans to use renewable energy to create 'green' hydrogen at its 840 MW power plant project in Delta, Utah.

Separately at the Delta site, Magnum Development selected Mitsubishi Power as its partner to produce green hydrogen, which will be stored in a salt cavern that can store 150 GWh of hydrogen.

Paul Browning, President and CEO of Mitsubishi Power Americas, said: "As power producers, developers, and utilities set targets for net zero carbon emissions, they are recognising the value of having an energy storage integrator with deep experience in all the technologies they need to seamlessly integrate power generation and energy storage of all durations."



Mitsubishi Power received orders for 920 MWh of battery storage

Chile coal closure speeds up switch towards renewables

Closure of two coal fired units in Chile has been brought forward. Ventanas 1 and Ventanas 2, both owned by US-based AES, were due to close in 2024. But the first plant was shut down recently and the second will now close in 2022, amid a drive by Chile to end carbon emissions from its grid.

President Sebastián Piñera said at a ceremony announcing the closure of the Ventanas 1 Plant in January that they would be replaced "with clean and renewable energies".

Chile signed an agreement in 2019 with major generators AES Gener, Colbun, Enel and Engie to gradually eliminate the country's coal fired power plants, which currently produce about 40 per cent of the nation's

electricity.

The country will invest in renewables instead and Spanish company Grupo Ibereólica Renovables recently started environmental permitting of a proposed 793.6 MW wind farm. The project will be named Antofagasta and construction is expected to start in mid-2022. The Spanish developer already operates one wind farm in Chile.

Meanwhile Grenergy Renovables has secured \$85.1 million from Natixis Bank to build 14 solar photovoltaic (PV) plants, totalling 130 MW, in Chile. Work is under way on the first two, called Mitchi and Condor, and all are due to go into operation this year.

Brazil's renewables expansion continues at pace

- Construction target exceeded for 2020
- Largest onshore turbines to be installed in Bahia state

Brazil added 4932 MW of renewables capacity during 2020, beating its goal of 4112.43 MW. It connected 791.2 MW of new renewables generation in December 2020 alone, according to power sector regulator Aneel.

Wind farms now account for 9.64 per cent of the country's total installed capacity, while solar represents 1.87 per cent. Large hydro retains the largest share at 58.56 per cent.

Aneel said that 20 of Brazil's 27 states put at least one new power plant in operation in 2020. Development continues at pace in many states.

Bahia state will see six new renewables projects online by mid 2022. The state's biggest new wind farm, Essentia Energia's \$434.5 million Ventos de Sao Vitor, is expected to start up by mid-2021, and reach full power a year later. It will employ 75 Siemens Gamesa 5.8-170 turbines, among the largest

onshore options.

Lars Bondo Krogsgaard, Chief Executive of Siemens Gamesa's Onshore business, said: "This is a great step forward for Brazilian renewable energy, which will help bring clean energy to many thousands more. The project will also employ market leading technology that means we can install less turbines while producing higher energy capacity." Essentia Energia also is due to start up the 474 MW Sol do Sertao solar farm in late 2021.

Also in Bahia, Brennand Energia recently announced plans to invest \$122.4 million in one solar farm and four wind farms. Civil works for the five projects have already started. Brennand Energia already has 341 MW of wind power in Sento Se, with ten operational plants and one under construction. It is analysing the potential of two other municipalities, Campo

Formoso and Juazeiro.

In Pernambuco state, European Energy and Eólica Tecnologia are building two wind farms, Ouro Branco and Quatro Ventos. Vestas has secured the 95 MW order for 21 4.2 MW turbines. Turbine delivery is planned for mid-2022 and commissioning is expected by the end of that year.

In Paraíba state, oil and gas major Royal Dutch Shell is looking to develop seven solar photovoltaic projects totalling 323 MW. The company also has plans a 130 MW solar portfolio in Minas Gerais state.

Shell's Business Development Manager for Solar Energy in Latin America, Maria Gabriela da Rocha, said recently that the company would begin talks with potential customers to sell the future output of its first solar plants in Brazil, which could start production in 2023.

Peru plans network expansion as new hydro gets go-ahead

The Peruvian Ministry of Energy and Mines has published a new Transmission Plan for the period 2021-2030, which includes 11 projects worth \$981 million.

Transmission has to be expanded to support new generation. The Ministry recently approved plans for the construction of a 392 MW hydro plant – Central Hidroeléctrica Huallaga I in the provinces of Pachitea and Huánuco

– requiring an investment of more than \$988 million. The Central Hidroeléctrica Huallaga Hydro project will include a 183 m high dam and construction is due to last four years, with operations slated to start in 2027.

Four smaller renewables projects recently entered operation at an estimated investment of \$98 million. They are the Manta hydroelectric plant (20 MW), Callao biomass thermal power

plant using solid urban waste (2.4 MW), and the Duna and Huambos wind farms, each 18.4 MW.

"Investment in renewable energy not only generates jobs and an important economic dynamism considering the situation the country is going through, it also allows us to ensure a sustainable supply for the electricity demand of Peruvians," said the head of Minem, Jaime Gálvez.



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Asia Pacific storage system costs to fall by a third

■ China has lowest all-in costs globally ■ Costs in Australia fall 34 per cent

Syed Ali

All-in front-of-the-meter (FTM) battery storage system costs in Asia Pacific markets could decline by more than 30 per cent by 2025, says Wood Mackenzie.

Storage system prices fell faster than anticipated in 2020, the biggest driver being battery price reductions. Improvements in battery energy density also contributed to lower overall balance of system (BOS) components and associated costs.

In addition, other hardware components are beginning to lose their price variance between countries. Beyond a handful of local content requirements,

many of the policies that created regional differentiation in hardware component pricing have been eroded by market forces.

Wood Mackenzie senior analyst Mitalee Gupta said: "As batteries are expected to represent a shrinking portion of all-in system costs, there will be heightened focus on BOS cost reductions moving forward."

World leader China currently sets the record for lowest all-in costs globally. The country's 2-hour duration all-in FTM system cost is expected to decline 33 per cent to \$369/kW in 2025 compared to \$554/kW last year. As a battery powerhouse, the country has benefitted from a favourable policy landscape

and domestic supply chain.

China is also the world's largest lithium iron phosphate (LFP) batteries producer and demand centre. As a result, LFP will emerge as the leading battery chemistry (globally) over the next five years. As Chinese vendors ramp up manufacturing and improve LFP technology further, costs of these batteries will decline faster.

The other leading battery chemistry, nickel manganese cobalt (NMC), dominates the rest of Asia Pacific.

A key NMC market in the region, Australia, is expected to see costs decline by 34 per cent to \$658/kW in 2025 for a 2-hour duration all-in FTM system cost compared to \$990/kW in

2020. The pace of FTM deployments in the country is expected to ramp up over the next three years, with system costs continuing to slide.

Just last month electricity generator and retailer AGL announced Wartsila and Fluence had been secured under non-exclusive framework agreements to supply up to 1000 MW of grid-scale battery storage in Australia. Also in January, Origin Energy Ltd said it will install an up to 700 MW battery in New South Wales in a bid to support its transition away from coal fired generation by 2032.

Another key NMC market, South Korea, saw a massive surge in energy storage deployments in 2018, which

led to significant reduction in system costs. The country's 2-hour duration all-in FTM system cost could decrease 29 per cent to \$579/kW in 2025, compared to \$821/kW last year. Over the next five years FTM deployments are expected to grow in South Korea, but the pace of price decline will be relatively slower than China and Australia.

Gupta said: "As the region's storage industry takes off, every component across the value chain will play a role in bringing down system costs. Fire risks and safety standards, tariffs and trade policies, and safeguarding the supply chain amidst Covid-19 uncertainty are factors that could make or break the industry."

China sets up clean energy fund

A Yuan10.02 billion (\$1.55 billion) fund set up by state-run China Energy Investment Corp (CEIC) and China Reform Holdings Corp is expected to generate about Yuan50 billion worth of financing for projects using wind, solar, hydrogen and energy storage.

China has pledged to cap its carbon emissions at peak levels in 2030 when its total wind and solar installed capacity is forecast to top 1.2 TW. In 2020 alone, China installed 71.67 GW of new wind power capacity and 48.2 GW of solar power.

The fund, whose partners include CEIC's subsidiaries Shenhua Energy Co Ltd and Guohua Energy Investment Co Ltd, as well as China Reform Assets Management Co Ltd and Orient Asset Management, will be important in helping the nation achieve its net zero goal.

In September, President Xi Jinping said China will strive to peak emissions before 2030 and achieve carbon neutrality before 2060. The key to achieving this goal is to electrify as much of the economy as possible and to ensure that almost all electricity is generated from zero-carbon resources well before 2060.

Last month Rocky Mountain Institute (RMI) and Energy Transitions Commission (ETC) released the 'China's Zero-Carbon Electricity Growth in the 2020s: A Vital Step Toward Carbon Neutrality' report, which highlights both the opportunity and urgency of meeting electricity demand growth in China almost entirely from

zero-carbon generation sources.

The report outlines a scenario for 2030 that demonstrates that zero-carbon generation is economically and technologically feasible in China. It further outlines recommendations for policies and a plan to deliver them during the 14th Five-Year Plan.

The report assesses a zero-carbon investment scenario for 2030 aligned with what is needed to decarbonise China's power sector by 2050, and assumes:

■ Electricity supply reaches 11 000 TWh by 2030, an increase of 54 per cent above current levels;

■ No new coal capacity is added beyond the 1041 GW in place in 2019, but there is a slight increase in coal generation as existing assets are used more intensely;

■ Considering the increasingly competitive economics of renewables, wind and solar capacity reach 1650 GW in 2030, contributing 28 per cent to total generation in that year; and

■ Total non-fossil fuel generation reaches 53 per cent of the total, slightly above the target of 50 per cent proposed by China's government in 2016.

According to the RMI and ETC analysis, the zero-carbon investment scenario for 2030 is economically and technologically feasible. In China, renewables and other zero-carbon generation resources are or will soon be the most cost-effective way to meet growing electricity demand, enabling the shift away from new coal plant investments.

India scraps emission compliance deadline for coal plants

India's Power Ministry has scrapped deadlines to adopt new emission limits set for coal fired power plants.

In a note to the Environment and Forest Ministry in early January, a power ministry official said the ministry remains committed to maintaining uniform ambient air quality across the country but not to a uniform set of emission norms for thermal power plants on "an unworkable time schedule" that would burden utilities and lead to an increase in power tariffs.

India initially had set a 2017 deadline for thermal power plants to comply with emissions standards by installing flue gas desulphurisation (FGD) units

that cut sulphurous oxide emissions. That was later changed to varying deadlines for different regions, ending in 2022. Even those deadlines are being scrapped.

"This could avoid immediate increase in power price in various relatively clean areas of the country (and) avoid unnecessary burden on power utilities/consumers," the power ministry official said.

He talked of a "graded action plan", whereby areas where plants are located would be graded according to the severity of pollution, with Region 1 referring to critically polluted areas, and Region 5 being the least polluted.

Strict control of emissions will be required for plants in Region 1, while plants in Region 2 could begin to take action one year later. Currently no action is required for plants in Regions 3, 4 and 5.

Sunil Dahiya, an analyst at the Centre for Research on Energy and Clean Air, expressed shock at the power ministry's decision. "Such claims after five years of emission standards being in existence create a severe dent on the government's image," he said, urging the environment ministry to reject it.

The final decision will be left to the Supreme Court.

India takes lead on South Asia energy security

India has set up a high-level group headed by former Union power secretary Ram Vinay Shahi and tasked it with helping build a South Asia-focused energy security architecture.

Cross-border energy trade is a key part of Prime Minister Narendra Modi's neighbourhood-first policy, with plans to build energy links to check China's growing influence. India's energy diplomacy ranges from cross-border electricity trade to supplying petroleum products and setting up liquefied natural gas terminals.

The high-level group, named the South Asia Group for Energy (SAGE),

has been set up under the Ministry of External Affairs (MEA)-run think tank Research and Information System for Developing Countries (RIS).

According to a government document reviewed by *Mint*, the objective is to achieve a balanced and optimal development of energy infrastructure through mutual understanding and cooperation. SAGE will have the role of promoting, initiating and facilitating effective policy dialogue and capacity building on bilateral, sub-regional and regional basis for energy and related issues, among South Asian countries.

"The idea is to see how best we can cooperate with each other so that energy shortage is reduced. It is for the benefit of all and to ensure that climate change concerns are also adequately addressed," Shahi told *Mint*.

While India has been procuring hydropower from Bhutan, it is also supplying electricity to Bangladesh and Nepal. The plan now is to include the option of building an overhead electricity link with Sri Lanka. India has an installed power generation capacity of 373.43 GW and is trying to create a common pool for neighbouring countries.



China installed over 71 GW of new wind power capacity in 2020

Europe News

New nuclear plans forge ahead but implementation moves slowly

- Bulgaria picks Kozloduy for expansion over coming decade
- Hinkley Point C delay sets poor precedent for follow-on finance deal

Janet Wood

Bulgaria's government has approved plans to add a new reactor at its Soviet-era nuclear power plant at Kozloduy.

The seventh plant at Kozloduy will use some Russian equipment earmarked for a competing project at Belene, which will now not go ahead, along with US technology. It is hoped that the new reactor will be operational in 10 years. Kozloduy supplies a third of the country's electricity from two

Soviet-built 1000 MW units.

Recently the US nuclear industry has shown interest in neighbouring Romania, with AECOM vying to finance two more reactors at Cernavoda. The US Trade and Development Agency awarded a grant to Romania's nuclear energy authority, Societatea Nationala Nuclearelectrica, for technical assistance to support the development of small modular reactors (SMRs) in Romania.

In the UK, new nuclear continues to

take halting steps forward. EDF Energy announced in late January that Covid restrictions had helped raise costs and delay startup at Hinkley Point C, now under construction. The announcement came as the UK government opened discussions on whether to take a stake in a follow-up plant – the £20 billion Sizewell C proposed for England's east coast. The government is considering a "regulated asset base" funding model, which would see consumers pay upfront and shoulder

construction risk. Kwasi Kwarteng, the UK's new Business Secretary, said recently that it would be "far more expensive" to have an electricity system fully dependent on renewables.

Another potential follow-on plant, at Bradwell in Essex, has been granted an electricity generating licence by Ofgem. But the plant design, a Chinese-designed HPR1000 based on China General Nuclear Group's Hualong One reactor, has still to be passed by the UK's Office for Nuclear Regulation.

Other potential UK nuclear projects at the proposal stage include combining a SMR and hydrogen production in a hybrid energy project in North Wales, and an advanced modular reactor (AMR) by Costain that won innovation funding.

Meanwhile Vattenfall has shut down a second nuclear reactor at the Ringhals plant in Sweden after almost 45 years, a year after the first reactor at the site closed. Vattenfall decided to close the reactors early for economic reasons.

Poland aims to be Baltic's biggest wind player

- Offshore Wind Act passed unanimously
- Onshore wind farms win investment decisions from EBRD and RWE

Poland's Parliament adopted the country's first Offshore Wind Act in January, passing it unanimously.

"This is a historic moment and a key act not only for our energy, mostly based on fossil fuels, but also for our economy," said Kamila Tarnacka, Vice-President of Polish Wind Energy Association the (PWEA).

The Act paves the way for wind projects in the Baltic Sea, and within the next six months the regulator will allocate financial support for 5.9 GW of capacity. Projects will bid for Contracts for Difference (CfD) in competitive auctions.

Poland aims to go from zero to the biggest offshore operator in the Baltic Sea, with targets of 3.8 GW of offshore wind by 2030 and 28 GW by 2050.

WindEurope Chief Executive Giles Dickson commented: "It makes complete sense for them. Offshore wind is cheap, and they've great potential for

it". Investment has stepped up: Iberdrola has taken a 50 per cent stake in Poland's Sea Wind developer, which has a seven-project pipeline in the initial development phases.

Although in 2019 it produced over 70 per cent of electricity from coal and 10 per cent from gas or oil. Poland wants to become a low-emissions economy. The National Energy and Climate Plan (NECP) singled out offshore wind as a key technology. Poland's biggest energy companies, PGE, Enea and Tauron, signed a letter of intent on cooperation on offshore wind.

"Thanks to this agreement, together with Tauron and Enea, we can increase our chances in the process of applying for location permits for offshore wind farms and increase the possibilities of financing the development of investment projects in the field of offshore wind energy in the Baltic Sea", said

Wojciech Dąbrowski, President of the Management Board of PGE, which aims to install 6.5 GW by 2040. The company is currently selecting partners for its first projects, Baltica 2 and 3. Tauron aims for over 65 per cent renewables by 2030.

Recently three onshore wind farms have also taken a step forward. RWE has taken an investment decision for construction of Rozdrzew (17 MW). The EBRD agreed a loan of €26 million for Mława (37.4 MW) and Grajewo (14 MW). The wind farms will be built and operated by a joint venture between Helsinki based renewable fund manager Taaleri SolarWind Fund II, developer Taaleri Energia, and Masdar, the Abu Dhabi Future Energy Company. Harry Boyd-Carpenter, EBRD Director for Energy EMEA, said: "We are pleased to further support the expansion of green energy in Poland with this excellent new project".

UK EVs promise grid support with major savings



Carmaker Nissan, E.On Drive and Imperial College London say that using electric vehicles to inject power into the grid – so-called Vehicle-to-Grid (V2G) – can provide major benefits for the system. A newly-published white paper from the group calls for the introduction of incentives to accelerate widespread adoption of vehicle-to-grid (V2G) charging systems.

The white paper says V2G could save the UK system operator £410-885 million/year, as a result of offsetting capital and operational expenditure. Professor Goran Strbac, Chair in Electrical Energy Systems at Imperial College London said: "Our research has demonstrated that V2G can provide very substantial economic benefits to

the power system as well as reduce carbon emissions."

The research was part of the e4Future project, funded by the Department for Business, Energy and Industrial Strategy (BEIS) and the Office for Zero Emission Vehicles (OZEV), in partnership with Innovate UK, part of UK Research and Innovation.

Meanwhile, GB electric vehicle users are now able to offer flexibility to the system by changing their charging time using ev.energy's smart charging app. Flexibility provider Flexitricity aggregates the vehicle time-shifting response and can bid the resulting flexibility into the System Operator's market for real-time system adjustment, the Balancing Mechanism.

Transmission networks agree common offshore planning

Seven transmission system operators (TSOs) have joined the new Baltic Offshore Grid Initiative to develop common planning principles for an offshore network.

The TSOs are 50Hertz, Energinet, Fingrid, Svenska kraftnät, Elering, AST and Litgrid. Norway's Statnett will be an observer.

The agreement comes as tenders are imminent for new offshore wind farm

connections. TenneT will launch tenders for at least two in March, for offshore wind farms scheduled to begin operation in 2028 and 2029. In Germany, links will be required for BalWin1 (in operation in 2029) and BalWin2 and BalWin3 (in operation in 2030).

TenneT joined a group in 2020 developing a 2 GW, 525 kV HVDC grid connection that will more than double

the previous 900 MW HVDC standard.

Tim Meyerjürgens, TenneT Chief Operating Officer, said: "The new transmission standard supports the vision towards larger offshore wind farms and a North Sea wide Hub-and-Spoke system, combining wind power connection, coupling of energy markets through interconnection and smart integration into the main onshore grids."

Storage steps up to the big time

InterGen has been granted consent for the UK's largest battery energy storage project.

The lithium-ion battery will be part of InterGen's Gateway Energy Centre development in Essex. The £200 million project will have a capacity of at least 320 MW/640 MWh, with the potential to expand to 1.3 GWh and will provide fast reserve and balancing services.

The installation comes as new analysis from LCP's Energy Analytics team highlights the importance of storage to optimise the use of wind energy. Based on current capacity, LCP estimates an extra 20 GWh of battery storage could reduce the amount of wind power

wasted by up to 50 per cent.

Chris Matson, partner at LCP said: "Energy storage will play a crucial role in helping to decarbonise the power system, by balancing the grid in real time and backing up renewable generation."

Meanwhile, a grant from the EU's flagship Horizon 2020 research programme has set in motion the LOnG LAsTing BATtery (LOLABAT) project to develop and validate a new generation of batteries for stationary applications. The consortium of 17 European partners, including large industrial and R&D companies, SMEs, universities and research institutes, will focus on nickel-zinc technology.

Middle East ready to enter global green hydrogen race

Abu Dhabi is eyeing the opportunity to become a hydrogen hub in the Middle East and further afield. **Nadia Weekes** reports

Siemens Energy and Mubadala Investment Company (Mubadala), the state-owned global investment firm, have signed a Memorandum of Understanding (MoU) to drive investment and development of advanced technology, manufacture of equipment, and green hydrogen and synthetic fuel production in Abu Dhabi.

Mubadala has also joined forces with the Abu Dhabi National Oil Company (ADNOC) and holding company ADQ to establish the Abu Dhabi Hydrogen Alliance, with the goal of establishing the United Arab Emirates as a major green hydrogen economy.

A major natural gas player with existing global partnerships, ADNOC has plans to nearly double the around 300 000 tonnes per annum of hydrogen it produces for its downstream operations. The company will continue to develop blue hydrogen independently for domestic purposes, while the Alliance will focus on green hydrogen.

The first initiative under the Siemens agreement and the Hydrogen Alliance will be a demonstrator plant in Masdar City. The first phase will produce green hydrogen for passenger cars and buses in the Masdar City area. In parallel, a

kerosene synthesis plant will be built to convert green hydrogen into aviation fuel. The second phase of the programme will explore the production of decarbonised fuels for the maritime sector.

Siemens has also signed an agreement with the government of Egypt for the development of the country's first green hydrogen production project. Minister Mohamed Shaker sees this partnership as part of the Egyptian government's strategy to balance the country's electricity mix with renewable energies.

Egypt has been ramping up the development of clean energy through projects such as the 1.65 GW Benban solar photovoltaic complex in Aswan and wind energy installations in the Gulf of Suez. Green hydrogen would support these intermittent energy sources by making it possible to store excess electricity and discharge it later.

A report by Edison Group has found that hydrogen has a role to play in the energy transition, but not quite as big as that of ever-cheaper electricity from renewable energy alternatives.

Whilst its high energy-to-mass ratio

makes it ideal to replace coal and gas industrial processes and gaps in the power sector, hydrogen is less likely to power cars and other mass markets products, the report concludes. It also warns that the market will not become self-sufficient without government investment and policies allowing the industry to scale sufficiently.

With the share prices of many hydrogen stocks having doubled or quadrupled during 2020, there is the potential for setbacks, according to Edison. It expects applications such as materials handling and heavy duty transport – where fuel cells are a better fit than batteries – and steelmaking where hydrogen is used as a chemical reagent rather than just an energy source, to do well even without government support.

Analysis by Frost & Sullivan forecasts that global green hydrogen production will skyrocket at a compound annual growth rate of 57 per cent between 2019 and 2030. Currently, green hydrogen accounts for less than 1 per cent of the total hydrogen produced, but demand is expected to increase exponentially in the next 20 years.

Africa “unlikely” to go green before 2030

- Renewables struggle to break through
- Vast wind potential identified

Research from the University of Oxford predicts that total electricity generation across the African continent will double by 2030, with fossil fuels continuing to dominate the energy mix.

Using machine learning to analyse more than 2500 planned power plants and their chances of being successfully commissioned, the study concludes that the share of non-hydro renewables in African electricity generation is likely to remain below 10 per cent in 2030.

The research highlights regional differences in the pace of the transition to renewables, with southern Africa leading the way. South Africa alone is forecast to add almost 40 per cent of Africa's total predicted new solar capacity by 2030.

The study suggests that a decisive move towards renewable energy in Africa would require a significant shock to the current system, including large-scale cancellation of planned fossil fuel plants. It also identifies ways in which planned renewable energy projects can be designed to improve their success chances – for example, smaller size, fitting ownership structure, and availability of development finance.

According to the International Finance Corporation (IFC), a member of the World Bank Group, continental Africa possesses a stunning onshore wind potential of almost 180 000 TWh per annum, enough to satisfy the entire continent's electricity demands 250 times over.

The analysis, carried out by energy consultancy Everoze, finds that 27

countries in Africa have enough wind potential on their own to satisfy the entire continental electricity demand – estimated at 700 TWh annually.

Algeria has the highest resource with a total potential of 7700 GW. Fifteen other countries have technical wind potentials over 1000 GW including Mauritania, Mali, Egypt, Namibia, South Africa, Ethiopia and Kenya.

The analysis also finds that over one-third of Africa's wind potential is in areas with very strong winds, averaging greater than 8.5 m/s, with average capacity factors of up to 46 per cent.

Ben Backwell, CEO of the Global Wind Energy Council (GWEC) said: “There is a clear need now for governments to enact policies to take advantage of the vast resource that the report identifies and enable large scale investment in wind as a key building block for green economic recovery post Covid-19.”

The Moroccan Agency for Sustainable Energy (MASEN) and the Islamic Development Bank (IDB) recently launched a joint initiative to develop strategic renewable energy projects in Africa, notably through technical and financial support to projects in IDB member countries.

Several projects were presented at the launch of the joint initiative, including solar power plants with a cumulative capacity of 30 MW in Niger and three solar power plants with storage in Djibouti, a solar power plant and a hydroelectric project in Gabon, as well as a 50 MW solar thermal power plant in Senegal. Other projects are expected to be proposed in the coming months.

Uzbekistan to build third solar plant under 1 GW programme

A 500 MW solar farm with a battery storage component is going out for tender this month as part of the 1 GW solar programme mandated by the International Finance Corporation (IFC), Uzbekistan's Ministry of Energy has announced.

Energy Minister Alisher Sultanov said: “Following the success of Uzbek Solar 1 and high interest in Uzbek Solar 2... we are firmly on our way to new, sustainable, clean and diversified energy production in Uzbekistan.”

Meanwhile, energy company Masdar has announced financial close on the 100 MW Nur Navoi solar project, the first independent power producer (IPP) solar project in Uzbekistan to be successfully financed.

The Nur Navoi solar project was awarded to Masdar in a competitive auction. In November 2019, Masdar signed a power purchase agreement with JSC National Electric Grid of Uzbekistan and a support agreement with the government to design, finance, build, own and operate the solar plant, which is located in the Navoi region. The project is scheduled to start operations in the third quarter of 2021.

Separately, Masdar and the Uzbeki government have agreed to jointly pursue renewable energy projects. In June 2020, Masdar agreed to develop a 500 MW wind farm in the Zarafshon district, with a commercial operation date of 2024.

Russia flies the flag for small nuclear



Rosatom Group is considering building a fleet of small-capacity nuclear power plants, according to an interview on Russian television with the nuclear corporation's CEO, Alexei Likhachev.

“We are very seriously exploring the construction of a fleet of floating plants with the government,” Likhachev said. It was reported earlier that Rosatom plans to build a small plant with a RITM-200 reactor in the Ust-Yansky district village of Ust-Kuiga by 2028.

There is increased optimism worldwide on the future of small modular reactors (SMRs) after a number of nuclear markets including the US, the UK and Canada signalled support for the technology in the closing weeks of 2020.

There have recently been SMR-related developments in less obvious markets, too. NuScale Power, which has developed the first SMR to receive US Nuclear Regulatory Commission design approval, has secured

the support of the United States International Development Finance Corporation to develop plants in South Africa. The company said it intends to bid for 2.5 GW of capacity in South Africa's independent power producer programme.

But as it stands today, the only country that can claim to have a viable SMR industry is Russia, where the first such system, deployed as a floating power station aboard the Akademik Lomonosov, was commissioned in 2020.

Companies News

Investors flock to green hydrogen

- MAN Energy Solutions and Sunfire takeover electrolyser companies
- Hydrogen stock share prices surge

Junior Isles

Investment in green hydrogen is continuing at breakneck speed as companies continue to make acquisitions in the space and investors flock to snap up stocks.

In mid-January MAN Energy Solutions announced its acquisition of almost 99 per cent of the shares in H-TEC Systems, a manufacturer of PEM electrolysers based in Augsburg, Germany.

Subject to approval by the competition authorities, MAN Energy Solutions has acquired the shares of the previous majority shareholder, GP Joule, adding to the 40 per cent stake it previously took in the company in 2019. The remaining shares are currently in free float.

Dr. Uwe Lauber, Chief Executive

Officer of MAN Energy Solutions, stated: "Green hydrogen is becoming an incredibly important natural resource on our journey to becoming a climate-neutral global economy. With the acquisition of H-TEC Systems, from now on we will cover all processing steps of the hydrogen economy under the umbrella of MAN Energy Solution. By doing so, we are strategically investing in our expertise as tomorrow's provider of sustainable energy solutions and providing H-TEC Systems with complete access to our resources and sales networks at the same time. However, the current other shareholder GP Joule will remain an important sales partner."

In a separate move, Sunfire said it has taken over IHT Industrie Haute Technologie SA, a Monthey, Switzerland-

based alkaline electrolysis company. With this acquisition, the Dresden-based company continues to expand its green hydrogen portfolio to include high-pressure alkaline water electrolysis. The technology is particularly suitable for use in environments where water-steam is not readily available, such as in hydrogen mobility.

The acquisition sees Sunfire take a 100 per cent stake in IHT. The company's headquarters in Monthey will continue to play an important role in the production of the stacks, which are the main component of the high-pressure alkaline electrolysers. This year, IHT will supply and install Europe's largest single-stack alkaline pressurised electrolyser to help regulate the power grid and produce green hydrogen for a project partner in Tyrol.

Experts say an unprecedented rally in green hydrogen stocks looks set to extend as investors flock to companies that promise to produce the gas, expecting the technology to scale up over the next 10 years to justify rocketing valuations.

Share prices of companies in the industry have soared more than 500 per cent in the past year, driven by the rising adoption of zero-emission vehicles and a deadline set by many countries to go carbon-free by 2050.

"Hot money is flowing towards renewables and clean energy, and there's been a clear re-rating of valuations in the sector," said Emmanuel Cau, Head of European Equity Strategy at Barclays.

The frenzy in hydrogen-related stocks has led to some concerns about

a bubble, with companies trading at extreme prices based on expectations that their revenue will surge in future, despite worries about possible headwinds for the sector.

JP Morgan analysts, however, allayed fears about a potential bubble. The bank said in a recent note investors should take advantage of any pullback in prices and "take an unorthodox approach to valuation for the next several years".

Sean McLoughlin, HSBC EMEA Head of Industrials Research, told *Reuters* scarce value in the market, unprecedented fiscal stimulus, low cost of capital and debt and low yields in other asset classes mean the hydrogen market's valuation may be justified, though he cautioned it was at a "potentially fraught level".



In a move that reflects the growing interest in technology involving green hydrogen, South Korean industrial conglomerate SK Group has announced it will invest \$1.5 billion in US hydrogen fuel cells provider Plug Power Inc. as part of a new strategic partnership between the two.

The terms of a newly-signed deal call for a US subsidiary of SK Group to buy about 51.4 million Plug Power shares at \$29.2893 each. This purchase would give SK Group a roughly 9.9 per cent stake in the hydrogen specialist.

Subject to regulatory clearance, the transaction is expected to close this quarter.

The companies said the alliance is aimed at accelerating hydrogen as an alternative energy source in Asian markets, where, particularly in Korea, they plan to provide hydrogen fuel cell systems, hydrogen fuelling stations and electrolysers. A joint venture targeting the Korean market is also being planned.

Andy Marsh, CEO for Plug Power, said: "The current relationship with SK Group offers immediate strategic benefits to Plug Power to accelerate its expansion into Asian markets—and is intended to result in a formal joint venture (JV) by 2022. Due to the

complementary strengths in this partnership, we expect rapid growth and significant revenue generation from the joint venture that are incremental to our 2024 plan."

The government of South Korea has set a number of hydrogen-economy-related objectives for the period through 2040, including achieving more than 5 million tonnes of hydrogen per year, over 6 million fuel cell electric vehicles (EVs), 1200 refilling stations and 15 GW of fuel cell power generation. The cumulative economic value of the country's hydrogen economy is expected to reach \$40 billion by that time.

The deal highlights the increasing value of fuel cell companies. In December the combined market capitalisation of the top three fuel cell – Plug Power, Ballard Power and Bloom Energy – companies soared by 550 per cent year-on-year to \$20.8 billion, according to StockApps.com.

The increasing demand for clean energy sources and the development of environmentally-friendly urban transport systems in developed countries had been driving the impressive growth of the fuel cell industry. In the next seven years, the entire market is expected to rise by CAGR of 56 per cent and hit a \$24.8 billion value.

Total boosts green credentials through Adani

French energy major, Total, is looking to strengthen its position in the renewables sector through the acquisition of a 20 per cent stake in India's Adani Green Energy in a \$2.5 billion deal.

Adani Green Energy Ltd (AGEL) is owned by Indian tycoon Gautam Adani, who has promised to build the world's largest solar power company by 2025. Adani Green Energy already has more than 14.6 GW of contracted renewable capacity.

The transaction will help strengthen the strategic relationship between the

Adani Group and Total in India's green energy field. The partnership covers investments in liquefied natural gas terminals, gas utility business, and renewable assets across India.

"Given the size of the market, India is the right place to put into action our energy transition strategy based on two pillars: renewables and natural gas," said Total's Chief Executive Patrick Pouyanné.

Total said that the partnership with AGEL in the renewable sector in India would be a key to achieve its aim to reach 35 GW of renewable energy ca-

capacity by 2025, and adding 10 GW annually afterward.

The investment announced in January was at a nearly 40 per cent discount based on AGEL's Rs1.5 trillion (\$20 billion) market capitalisation. It also grants the French group a 50 per cent share in a 2.35 GW portfolio of solar assets and gives it a seat on the company's board.

India has set out ambitious targets for renewables and gas, with the goal of installing 175 GW of generating capacity based on renewable energy sources by 2022.

Mainstream sells majority stake to Aker Horizons

Energy entrepreneur Eddie O'Connor and his management team have sold a 75 per cent equity stake in Mainstream Renewable Power to Norwegian group Aker Horizons in a deal that will enable a rapid acceleration of Mainstream's global expansion plans.

The deal, which values Mainstream at €1 billion will help Mainstream achieve its goal of bringing 5.5 GW of wind and solar assets to financial close by 2023.

The company, founded by O'Connor in 2008, has significant interests across Latin America, Asia-Pacific and Africa, as well as in the global offshore wind sector, with over 1.2 GW

of major capital projects currently under construction. Mainstream has a major market presence in Chile, Africa, and Vietnam, as well as assets in development in other countries including the Philippines, Australia, and Colombia. The company will remain focused on delivering its ~10 GW global development pipeline and growing its portfolio in existing as well as new markets, with the full backing of the Aker ASA group.

Under the terms of the agreement, the company will continue to operate as Mainstream, led by its CEO Mary Quaney and supported by its established and experienced leadership

team. O'Connor will remain as Chairman, retaining a significant minority interest in the business and all existing shareholders will have the opportunity to reinvest alongside him ahead of a planned IPO of Mainstream within the next two to three years.

O'Connor commented: "This partnership is the crucial next step in the vision we set out for Mainstream in 2008 to lead the global transition to renewable energy and rid the world of CO₂ emissions. It means we can widen our scope for entry into new markets and further deepen and expand our leadership position in existing ones..."

10 | Tenders, Bids & Contracts

Americas

Solar-thermal will power gold mine operation

Aggreko has signed a contract with Gold Fields, a mining operator, to provide a total of 25.9 MW hybrid solar and thermal power supply system to the Salares Norte open pit mine in Chile. The system will provide power for the whole mine, which is at an altitude of 4500 m in the Andes, and 190 km from the nearest town.

The system comprises high-altitude performance diesel gensets and Aggreko solar power units. Each genset will deliver 772 kW and will incorporate spinning reserve and cold reserve units to manage peaks in demand. The integrated solar units will provide 9.9 MW.

The system will deliver power across all five of the mine's distribution points.

Pablo Varela, Latin America Managing Director for Aggreko, said: "Our customers are increasingly looking for more flexible power solutions which can reliably support operations while reducing carbon emissions and lowering costs."

He added: "Hybrid products, such as the one we are deploying for Salares Norte, enable a reliable and flexible power supply while reducing carbon emissions."

IEA to build 300 MW Illinois wind park

White Construction, a unit of Infrastructure and Energy Alternatives (IEA) has won a \$100 million wind farm construction contract from Apex Clean Energy. The contract is to construct the 300 MW Lincoln Land wind project in Morgan County, Illinois, USA. Operation is scheduled for late 2021.

Apex Clean Energy will manage the construction process. IEA will be responsible for all EPC work, including building project roads, improvement of nearby public road infrastructure, installation of collection systems, foundations, and substations. It will also be responsible for installing the 107 GE wind turbines that will power the wind farm.

Social media giant Facebook has contracted for 170 MW of output from Lincoln Land, and McDonald's Corporation will take 126 MW of the total capacity under a PPA struck in December 2020.

Leeward picks GE wind turbines

Leeward Renewable Energy has selected wind turbines from GE Renewable Energy for 235 MW of wind farm projects in Guadalupe County, New Mexico, USA. GE Renewable Energy will supply 2.x-127 and 2.3-116 wind turbines, with 86 turbines in total being supplied.

The turbines will be used to re-power the 90 MW Aragonne wind farm and for the new 145 MW Aragonne Mesa wind park that will be built at the same location. GE's new turbines will replace the existing 90 machines at the Aragonne plant. Repowering and construction of the Aragonne Mesa element of the projects are scheduled to be completed later in 2021.

Arizona Public Service Company (APS) has bought electricity from the 90 MW Aragonne wind park since its commissioning in 2006. In November 2020, it signed a 20-year PPA for electricity from the output of a 200 MW portion from the overall capacity of the two projects.

Sumitomo Electric cable for Alaska

Sumitomo Electric Industries has won a contract from Southeast Alaska Power Agency (SEAPA) for the Stikine Crossing Submarine Cable Replacement Project.

The transmission line project is to remove one existing 138 kV oil-filled submarine power cable and install an environmentally friendly 69 kV XLPE submarine cable with ancillary equipment for a system in the Stikine crossing (approximately 5100 m) between Vank and Woronkofski Islands, near Wrangell, Alaska, USA.

Asia-Pacific

Glow Energy selects AFRY as owner's engineer

Glow Energy, a subsidiary of Global Power Synergy Public Company (GPSC) has awarded AFRY with an owner's engineer services assignment for the 200 MW Glow Energy Phase 2 Cogeneration Plant Replacement Project in Rayong, Thailand.

The project consists of the demolition of the existing cogeneration plant and construction of two new gas fired cogeneration blocks, each consisting of two gas turbines, two HRSGs, and the balance-of-plant equipment. The plant will provide electricity and steam to industrial users in Map Ta Phut Industrial Estate, as well as electricity to the national power grid.

AFRY's role includes assistance in project management, design review, site supervision services, quality assurances, and control and commissioning supervision. The overall schedule for AFRY's services is 28 months.

GE HA turbines for Tongyeong

GE has secured an order to supply over 1 GW of power generation equipment for Tongyeong combined cycle power plant in South Korea. GE will supply two 7HA.02 gas turbines, one STF-D600 steam turbine, two HRSGs, and three H65 generators. In addition to the equipment, GE signed an 18-year services agreement to provide maintenance services for the 7HA.02 gas turbines and generators.

The new plant will be located at Anjeong Industrial Park in Tongyeong City. Construction is scheduled to start in 2021 by Hanwha Engineering & Construction, with commercial operations expected to start in 2024.

Chris Khang, President and CEO of GE Korea, said: "We are pleased to work for Tongyeong combined cycle power plant project to support South Korea's growing energy demand in the most efficient and cost-effective way as possible. Gas power will play a critical role in facilitating South Korea's transition to a lower carbon future."

"Natural gas fired combined cycle power plants are the lowest emitting fossil fuel power plants, whether measured based on CO₂, SO_x, NO_x, particulate matter, or mercury. Our H-class gas turbines are highly fuel flexible and able to operate on a variety of fuels, including blends of hydrogen and natural gas to offer Tongyeong Eco Power multiple pathways to achieve lower or near-zero carbon operations, if needed in future."

Europe

Mott MacDonald to design hydrogen mega project

Mott MacDonald has been appointed by the North₂ Consortium 1 as its

technical integration and optimisation contractor for the North₂ project. North₂ is a flagship project for large-scale green hydrogen production and the largest hydrogen project in Europe. Mott MacDonald will develop conceptual designs that will be carried forward to a final investment decision.

The project aims to develop an international hydrogen market through large-scale production, storage, and transport of green hydrogen.

Mott MacDonald will collate, evaluate, and develop the potential technical solutions required to realise the project. It will also provide cost, scheduling, and risk management services.

New offshore wind farms will generate the power, and could grow in capacity from 1 GW in 2027, to 4 GW by 2030, and to over 10 GW in 2040. The consortium aims to produce 1 million tons of green hydrogen per year by 2040.

The project is set to complete a feasibility study by mid-2021, with project development scheduled to start in the second half of 2021.

Siemens gas engines for UK peaking plants

Conrad Energy has signed two contracts with Siemens over the supply of containerised gas engines for two new peaking power plants in Wrexham and Bilston in the UK. This is in addition to a contract received earlier in 2020 for a plant in Sittingbourne. The new plants will feed energy into the National Grid during peak demand.

Under the contracts, Siemens will supply seven SGE-56SL 1 MW containerised gas engines. Siemens will also provide full design of these gas engines to Conrad Energy.

Steve Conry, Operations Director at Conrad Energy, said: "With Siemens, we have an expert partner at our side who has proven willing to always go the extra mile. The team has efficiently responded to all our requirements and provided sound technology advice, which was instrumental in helping us identify and create an optimal solution for the new plants we are building."

The Sittingbourne peaking plant is scheduled to be completed in February 2021 with the Wrexham and Bilston containers due for delivery from Siemens' factory in Spain in March 2021.

Loma de los Pinos to use GE wind turbines

GE Renewable Energy will supply wind turbines to the Spanish renewable power retailer Capital Energy for its 39 MW Loma de los Pinos wind farm project in Andalusia, Spain. Capital Energy said that it has closed a contract with GE to purchase seven wind turbines and signed an agreement for the provision of monitoring and maintenance services for 20 years.

GE will supply 5.5 MW Cypress wind turbines, each 158 m in rotor diameter and with a hub height of 101 m. Capital Energy said that the turbines will arrive at the Loma de los Pinos site in October 2021.

The company plans to invest €36 million in the project. Construction started in December 2020 and is expected to last for a year.

Framatome and Rosatom I&C for Hanhikivi

Framatome and Rosatom Automated Control Systems (RASU), a subsidiary of Rosatom, signed a contract in January to provide technical support in design and integration of the I&C system for the Hanhikivi 1 nuclear power plant in Finland.

Under the terms of the contract, Framatome will provide consulting support for I&C system integration and design in the construction project based on a VVER-1200 reactor. RASU will review design documentation and act as I&C technical leader for Hanhikivi 1.

International

Voith equips Ethiopian hydropower plant

Voith Hydro has enhanced the Ethiopian hydropower plant Gilgel Gibe II for the plant owner, Ethiopian Electric Power (EEP). The enhancement consists of the installation of state-of-the-art digital solutions. This follows the signing of a comprehensive two-year service and maintenance contract for the plant.

The intelligent applications can be used for maintenance planning and execution, as well as reporting and spare parts management. On-Care.Asset will significantly reduce O&M costs and ensure high system availability, and OnCall.Video will ensure that Voith experts are available around the clock. In addition, Voith Hydro will offer spare parts and employee training.

Mark Claessen, Regional Market Director of Voith Hydro, said: "This contract further enhances the relationship between Voith Hydro and Ethiopian Electric Power and demonstrates the benefits digital solutions can bring."

The plant is located 300 km southwest of the capital Addis Ababa. Voith has already supplied four Pelton turbines, generators, and the electrical and mechanical equipment for Gilgel Gibe II in 2010.

AGL Energy orders Wärtsilä grid-scale storage

AGL Energy of Australia has selected Wärtsilä as one of two suppliers for their grid-scale energy storage plans of up to 1000 MW.

Wärtsilä has signed a non-exclusive five-year Large Scale Storage System Frame Agreement to supply energy storage projects in partnership with AGL. This will reduce tender timeframes for individual projects, enabling faster project schedules and commercial operation.

In 2020, AGL announced plans to develop energy storage installations near the Loy Yang A power station (200 MW) in Victoria, Liddell power station (150 MW) and Broken Hill (50 MW) in New South Wales, and Torrens Island (250 MW) in South Australia. The grid-scale energy storage plans will play a key role in Australian energy industry's transition from traditional fossil fuels towards cleaner energy.

L&T wins Saudi transmission line contracts

The Saudi Electricity Company has awarded Larsen & Toubro (L&T) contracts for the construction of 380 kV double-circuit overhead transmission lines between Rafha, Qaisumah, and Arar in Saudi Arabia.

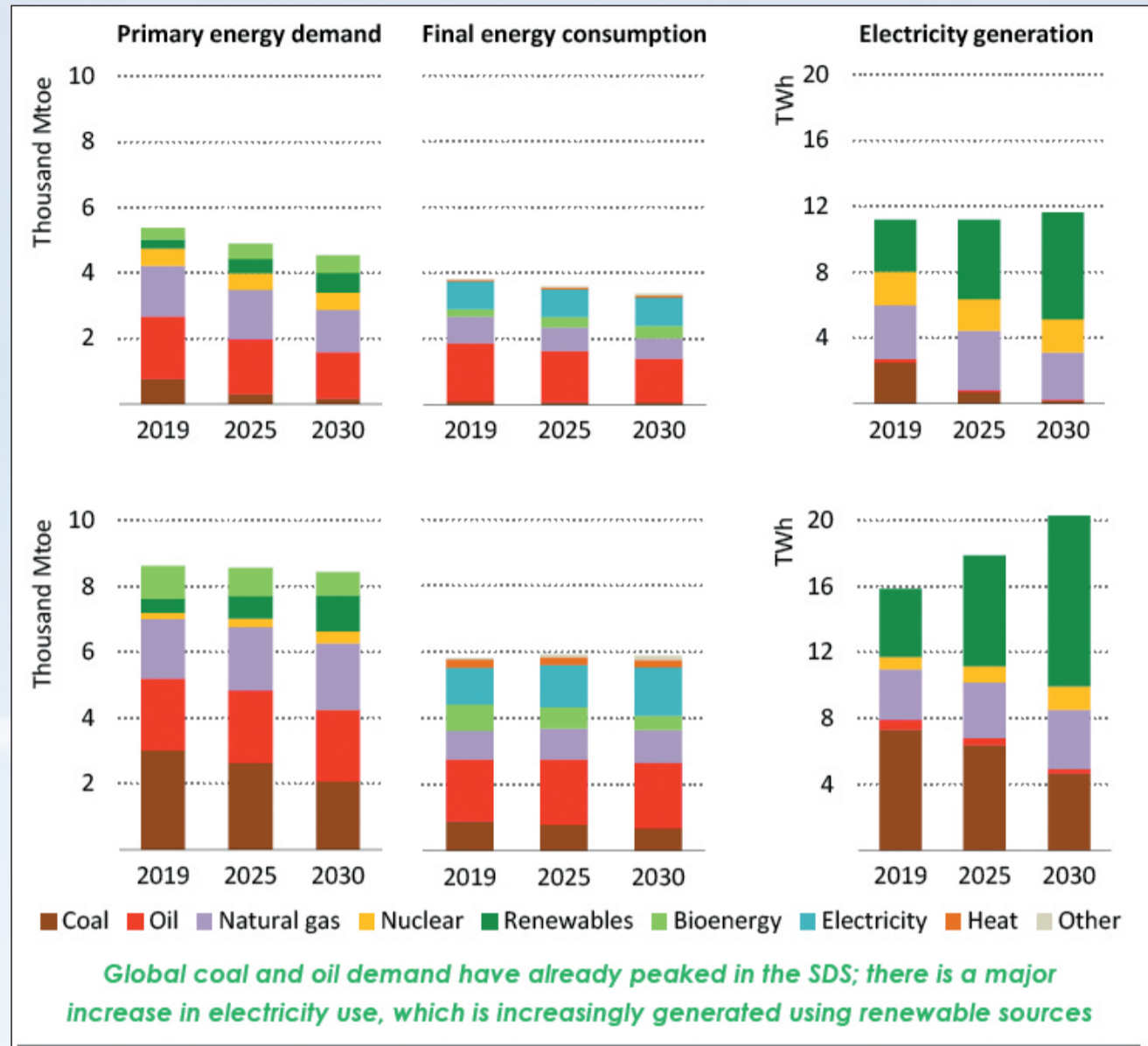
L&T will design and build the line between the Rafha bulk supply point (BSP) and the Qaisumah BSP, as well as two lines from the Arar BSP to the Rafha BSP. The line between Rafha and Qaisumah will be around 327 km long, and those between Arar and Rafha will be around 335 km long.

L&T's responsibilities include design, engineering, materials procurement, quality management, installation, construction, testing, and commissioning. Project completion is scheduled for within 24 months.



Energy sector transformation in advanced economies (top) and emerging market and developing economies (bottom)

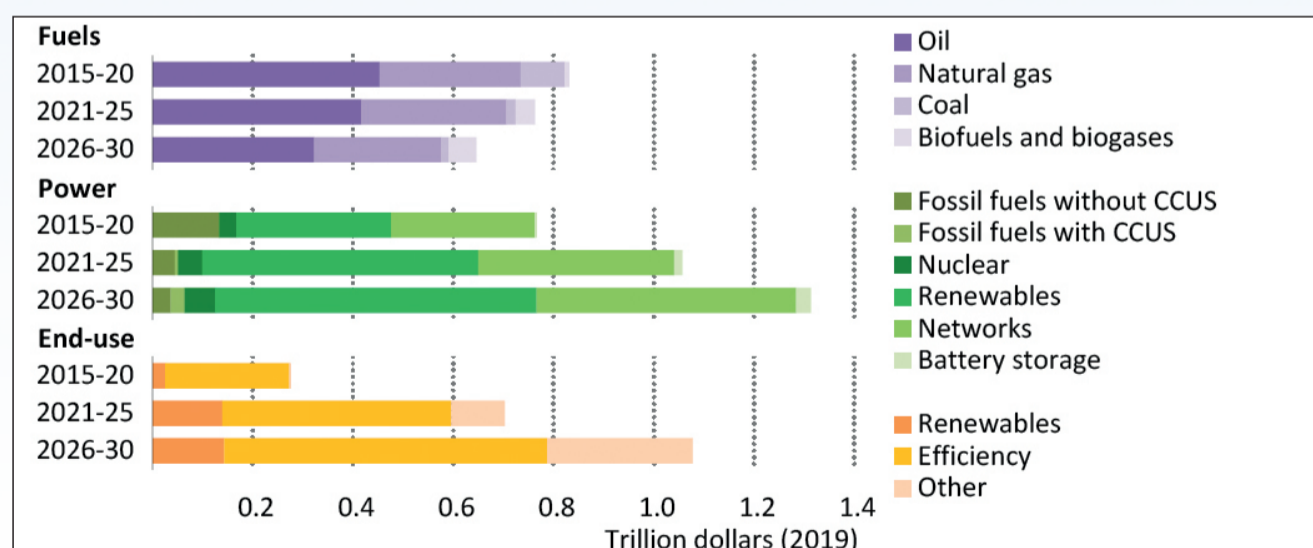
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 website: www.iea.org



Notes: Mtoe = million tonnes of oil equivalent; TWh = terawatt-hours.

World Energy Outlook 2020, © IEA/OECD, Figure 3.1, page 104

Average annual energy investment in the Sustainable Development Scenario



Investment in fuels and power is marked by a major reallocation of capital towards renewables and electricity networks; demand-side investment increases substantially

Note: Other end-use includes CCUS in industry, spending to meet the incremental cost of EVs and investment in private EV charging infrastructure.

World Energy Outlook 2020, © IEA/OECD, Figure 3.17, page 115

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Hydrogen

Abu Dhabi advances hydrogen, ammonia future

- Agreement with Japan on ammonia production
- Companies join forces to expand hydrogen production

Gary Lakes

Abu Dhabi is taking a number of steps to develop its capacity for the future use of hydrogen and ammonia. It has recently signed an agreement with Japan regarding blue ammonia production and UAE companies have joined together to pursue the expansion of hydrogen output.

Earlier in January the Abu Dhabi National Oil Company (Adnoc) signed a memorandum of cooperation (MOC) with Japan's Ministry of Economy, Trade and Industry (METI) that will focus on the production and export of fuel ammonia to Japan as well as technology for recycling carbon. Together the two organisations intend to advance the use of ammonia and hydrogen as carbon neutral fuels.

The MOC is part of Japan's recent announcement that it intends to establish a global supply chain for blue ammonia, which is produced by the use of natural gas. Late last year, Japan received its first shipment of blue

ammonia from Saudi Arabia. The deal with Adnoc is part of Japan's Green Growth Strategy for 2050 Carbon Neutral.

In November last year, Abu Dhabi's Crown Prince Shaikh Mohammed bin Zayid called for Adnoc to explore making the UAE a leader in the production of hydrogen. As part of that effort, Adnoc merged its downstream operations with its trading division to create the Downstream Industry, Marketing and Trading Directorate.

The agreement with METI "is another significant development for the UAE as we continue to explore the potential of new fuels that can help us produce more energy with fewer emissions," UAE Minister for Industry and Advanced Technology Dr. Sultan al-Jaber said in a statement released by Adnoc.

Japan's global supply chain for ammonia will include not only the Middle East, but also North America and Australia. The country estimates that its demand for blue ammonia will rise to

500 000 t by the late 2020s and reach 3 million t annually by 2030. Japan expects that by 2050, 10 per cent of its energy mix will be ammonia and hydrogen. Global ammonia production is currently around 200 million t and is generally used for fertiliser.

The formation of the Abu Dhabi Hydrogen Alliance is another indication that the UAE is serious about establishing itself in the expanding hydrogen market. Adnoc, Mubadala Investment Company and ADQ signed a memorandum of understanding (MOU) in mid-January agreeing to collaborate in the production of blue and green hydrogen, produced from renewable sources, for international markets.

The Alliance is to develop a roadmap to accelerate the UAE's adoption and use of hydrogen in major sectors such as utilities, mobility and industry, through their respective operating companies and with international partners, the *Emirates News Agency (WAM)* said in a report. The three companies are to also align their approach

to international markets for projects developed by the Alliance so as to position Abu Dhabi as a reliable and secure supplier of hydrogen and its carriers to customers around the world as demand grows, the report said.

Commenting on the importance of the Alliance to UAE business, Dr. Jaber said: "While we explore green hydrogen opportunities through the Alliance, Adnoc will place special emphasis on pursuing blue hydrogen projects by expanding on its existing hydrogen capacity, leveraging its significant gas reserves and best-in-class infrastructure, as well as its extensive customer relationships to help advance the hydrogen industry, both domestically and internationally."

Meanwhile, Siemens Energy has announced plans to build a solar-powered green hydrogen plant in Masdar City, located in the Emirate of Abu Dhabi. Phase one of the project will concentrate on green hydrogen for passenger cars. At the same time, a kerosene synthesis plant will be built

to convert most of the green hydrogen to aviation fuel. Phase two involves the decarbonisation of fuels for the maritime sector.

The project will be the first undertaken by Siemens with the Hydrogen Alliance. It will involve Masdar, Abu Dhabi Department of Energy, Etihad Airways, Lufthansa, Marubeni Corporation and Khalifa University.

Moreover, Saudi Arabia is also launching a green ammonia project at its NEOM modern city on the Red Sea in partnership with ACWA Power and New York-listed Air Products. The facility will use hydrogen produced by electrolyzers connected to 4 GW of solar and wind power to produce 1.2 million tons of green ammonia annually. The plant is to become operational in 2025.

Saudi Arabia is producing blue ammonia at its Ibn Sina petrochemical plant, which is operated by SABIC. The CO₂ captured in the process is reinjected at the Uthmaniyah field for enhanced oil recovery.

Gas

Nord Stream II runs into new political headwinds

The future of Nord Stream II is in question following the arrest of political activist Alexei Navalny and potential US sanctions against Europe.

Gary Lakes

Work on completing the 1200 km Nord Stream II pipeline through the Baltic Sea stands the chance of being delayed again indefinitely as European Parliamentarians take a stand against Russia for its recent arrest of political activist Alexei Navalny, and the new US administration of President Joe Biden stands prepared to impose sanctions against European companies involved in the \$11 billion project.

Nord Stream II, which is 90 per cent complete with less than 200 km of pipeline to be laid in German and Danish waters, will have the capacity to transport of 55 billion cubic metres per year (bcm/year) of Russian gas, matching that of Nord Stream I, which was commissioned in 2012. Both phases of the pipeline have been controversial since Gazprom first proposed their construction more than a decade ago for political and environmental reasons.

The underwater pipelines – both of which are dual pipelines with a total

combined capacity of 110 bcm/year – through the Baltic are meant to bypass Moscow's troublesome neighbours Ukraine, Poland and the Baltic States, and deprive them of transit revenues and access to Russia gas supplies on their way to Central Europe.

The pipelines run from the Russian cities of Vyborg and Ust-Luga respectively, following the same route to the northern German city of Greifswald, from where gas will be distributed into German and European networks.

In early January, during the last days of the Trump presidency, the Department of State warned European companies they would face US sanctions if they involve themselves with the completion of the pipeline. Work on the pipeline restarted in December after permits to proceed were secured from the Danish government.

Germany has supported the project from the start on the grounds that the gas will be needed as coal and nuclear energy are phased out, yet despite the European Union's expressed desire to reduce its dependence on Russian gas,

which supplies a quarter to a third of European demand, Germany is keen that Nord Stream II sees completion.

While Berlin supports the Nord Stream project as being solely a commercial undertaking, the pipeline continues to be caught in politics. The arrest of Moscow's main opposition figure Alexei Navalny on his return to Russia from Germany, where he was recovering from an alleged attempt in Russia to poison him with a military grade chemical agent, prompted European Parliamentarians to demand that Nord Stream II be scrapped in retaliation.

A non-binding resolution passed by the European Parliament on January 21st called for an immediate stop to work on the pipeline once and for all and for the EU to significantly strengthen its restrictive measures regarding Russia.

"Following years of deteriorating relations, MEPs stress the importance of critically reviewing cooperation with Russia in various foreign policy platforms and on projects such as Nord

Stream II," the parliament's press office said in a statement. "They call on the EU to immediately stop the completion of the controversial pipeline," the statement added.

The resolution had the backing of 581 votes in favour, 50 against and 44 abstentions. European environmental groups continue to register their opposition to the pipeline system.

Sanctions against Nord Stream II were imposed by the US in late 2019 through the Protecting Europe's Energy Security Act and new sanctions are looming as a result of the National Defence Authorization Act 2020, which was passed by Congress in December despite President Trump's veto. European companies have complained that the threat of US sanctions on European companies for working with Gazprom on the project is a violation of European sovereignty.

But the new administration of President Biden is likely to proceed with pursuing this course. During his confirmation hearing in the Senate, the new US Secretary of State Anthony

Blinken said the US is determined to stop Nord Stream II. The US argues that the 110 bcm/year system will hold too much leverage over Europe and threaten the security of the EU and thus NATO members. US LNG exporters are also keen to capture a significant segment of the European LNG market for their burgeoning industry.

German Chancellor Angela Merkel continues to support the pipeline and has said discussions with Washington about the project are needed. Speaking in Berlin in late January, Merkel said Germany and the US need to discuss "which economic relations in the gas sector are possible with Russia and which aren't," adding that her support for Nord Stream II has not changed.

Merkel said that sanctions against European firms are not acceptable and pointed out that the US itself has trade relations with Russia in the oil sector. "We need to put all this on the table and discuss whether we won't have any more trade with Russia in the gas sector, what degree of dependence is acceptable," she said.

Energy communities gather momentum in Europe

Although energy communities has been an industry buzzword for years, only recently have regulation, technology and functioning use and business cases provided a solid foundation for mass adoption. Nevertheless, challenges still remain. GreenCom Networks' **Christian Feisst** explains.



Feisst: The Brunnthäl showcase perfectly illustrates that communities are appealing but need explanation and promotion

Energy communities have been around for some time now. The first was launched in the 1980s, when citizens in Denmark joined forces to finance wind turbines. Still, energy communities remained a rare phenomenon. Later, municipalities brought back and started operating the distribution grid to set up local energy communities.

Today, we see a wide range of energy community concepts – from public-owned to privately held; from island solutions to communities relying heavily on the grid – the most popular ones arguably being marketing-driven, nationwide communities selling the idea of a large-scale peer-to-peer energy exchange based on a shared energy tariff. And whereas the first communities were mostly communities producing electricity from wind or solar, many of today's communities offer a connection between producers and pure consumers creating benefits for both.

So far, regulation has not helped much. However, with the recent Clean Energy Package (CEP), the EU gives energy communities and citizens a clear EU legislation status. The CEP grants: the right not to bear disproportionately high burdens or costs for the use of self-generated energy; the right to access, directly or through a third-party, the relevant energy markets; the right to participate in public electricity trading and the mutual exchange of renewable energy. In short, energy communities may produce, consume, store, share and sell renewable energy with ease.

Although the CEP needs to be implemented in all EU countries, we already see the first applications in Austria, Spain, Italy, and Greece. In Spain, for example, the local energy community may extend self-consumption to a group of people beyond single owners opening up new possibilities.

On the technology and business side, significant improvements push

the energy community closer to true peer-to-peer sharing while at the same time enabling business cases appealing to end-customers and providers alike.

Firstly, the growing number of smart meters installed in private homes provides crucial visibility behind the meter. And with Germany finally starting the residential rollout, most of Europe will be covered during the next years. Secondly, gateways that connect distributed assets like solar inverters, batteries, heat pumps or wall boxes are becoming cheaper and more capable every year, making real-time control, in theory, a plug-and-play task for the end customer without putting the business case in peril. In the end, a good gateway can be as simple as an Amazon Alexa device.

The third technology element, however, remains a challenge. To successfully run an energy community, a central platform must control decentralised energy assets, offer optimisation, visualisation and, ideally, foster energy sharing. After all, although definitions of what makes an energy community vary widely, the most basic and all-unifying function seems to be "to share energy".

In theory, all of the above is clear and possible but the challenges arise in real-life implementations. Therefore, GreenCom Networks built up an end-to-end energy community showcase, based in Brunnthäl, south of Munich. The community is built on several building blocks:

- A joint energy tariff: Electricity consumers and prosumers share energy in the community – this means there must be real-time matching of production and consumption for all members. To simplify things, all members use the same energy tariff, provided by GreenCom Networks.

- Integration of decentralised assets: To help keep consumption and generation in balance, the community integrates all kinds of different de-

centralised energy assets such as solar PV systems, battery storage, electric cars, heat pumps or even micro-CHP units. On the technical side, this requires an extensive interface driver library for all integrated assets kept up to date and the collection and harmonising of vast amounts of data in real-time.

- *Optimisation on house and community level:* To decrease costs and emissions, the community energy flows' management aims to increase self-consumption on the household and community level. Here, machine-learning-based optimisation, including weather forecasts and market signals, helps smoothen energy flows in the community. In real terms, this means charging EVs sequentially rather than all at once or balancing house temperatures and heat pump activity within a set frame to maximise the use of solar PV generated electricity.

- *Fostering customer engagement:* In GreenCom's showcase community, two were used to promote customer engagement. First, everything happening in the community is shown live: energy flows in the household and community can be seen via a web or mobile app as well as consumption, production, or reports – whatever happens in the community is instantly visible. Even billing is calculated every minute and fed into a precise monthly digital bill, no down-payment with corrections at the end of the year. Second, for each kilowatt-hour produced and consumed in the community, members receive an attractive bonus. The producer gets a premium on the regular feed-in tariff and the consumer receives a discount on the regular electricity price leading to a strong incentive for action and participation.

Although GreenCom's showcase successfully proves the technical and commercial viability of the energy community concept, it also revealed two challenges in establishing energy communities.

Firstly, people want to be a part of the great transition, and sharing energy is tangible and attractive. However, a lot of explaining is still needed on the marketing side, and numerous doubts must be scattered – after all, energy communities as a concept remains mostly unknown.

Secondly, although the Brunnthäl community's IT infrastructure is highly scalable, the hardware setup in houses varies widely. Space in the fuse-box may be limited, internet connectivity in the cellar may or may not be stable, and the local area network may pose challenges for stable connectivity. Here, extra effort in harmonising the hardware works wonders.

When considering the implementation of energy communities, it is worth mentioning initiatives like UP-STAIRS, a EU-funded Horizon 2020 project. Throughout Europe, many energy communities already

exist, most of them initiated by individuals or groups of individuals who strongly believe in the concept of joint estate and sharing principles. To reach a much broader audience and build up significantly more energy communities, UP-STAIRS aims to boost energy communities by helping citizens plan and establish such communities. UP-STAIRS is establishing a one-stop-shop solution providing information, advice, capacity building, energy auditing, financing, and implementation of energy efficiency and energy conservation solutions, as well as monitoring of impacts and benefits.

With this approach, the UP-STAIRS project will push for an effective and accelerated growth of sustainable energy communities. The necessary service model framework will be made available through local authorities to drive the uptake of energy efficiency and energy conservation measures in residential communities.

So, is the foundation for mass adoption of energy communities set? Almost.

Now, the CEP regulations must be converted into national law. There is a chance that some country regulations will undermine EU-efforts – for example, the German EEG Novelle shortcomings compared to EU regulations. On the hardware side, prices of gateways, smart meters and decentralised assets are bound to fall further, paving the way even further. Regarding IT-connectivity, control and optimisation, however, it remains doubtful if regular energy industry players can provide these functionalities themselves. Here, partnering will offer a feasible and scalable solution.

Considering business cases and challenges of establishing an end-to-end community, the Brunnthäl community provides valuable insights: the energy community is working. The chosen bonus scheme motivates customers to produce and consume energy simultaneously and increases self-consumption rates. However, today, the applied bonus scheme helps stabilise the grid but is not financed by the grid operator.

Furthermore, the Brunnthäl showcase perfectly illustrates that while communities are appealing, they still require reasonable explanation and promotion efforts. And although connected and controlled decentralised assets provide an excellent base for optimised energy flows, the devil may be in the detail for some houses' setup.

Projects like UP-STAIRS will help solve some of the challenges by informing, consulting, and supporting a framework and proven tools. And most likely, at the 50th anniversary of the first European energy community in Denmark, it will be one among thousands.

Christian Feisst is founder and CEO of GreenCom Networks.

App showing live energy flows in a household of the Brunnthäl Energy Community.
Photo: GreenCom Networks





Taking solar to the next level

Solar power is one of the key technologies central to achieving the EU's net zero carbon ambitions. But with today's solar cells reaching their limits in terms of practically achievable efficiency, further innovation is needed. The Graphene Flagship's Patrik Johansson believes graphene-based technology could be the answer.

Johansson: Although PSCs have shown excellent performance at lab-scale, their efficiency declines quickly as the module size increases. Their stability is also problematic – this is where graphene comes in



By 2050, the European Union (EU) aims to be climate neutral. In pursuit of this goal, the first half of 2020 saw renewables – including solar, hydro, wind and bioenergy – produce more electricity than fossil fuels in the EU. To continue this trajectory, more efficient renewable power generation will be necessary.

With solar becoming the fastest growing zero carbon technology, there is great interest in how the efficiency of solar generation can be improved. The Graphene Flagship believes graphene and related materials (GRMs) could be the answer to enabling a new generation of solar technologies.

Current mainstream solar cell technology has, for a couple of decades, been based on silicon, mainly due to its relative abundance in the Earth's crust.

However, the silicon-based solar cell technology is reaching the limit of its economic and practical efficiency. The laws of physics limit their maximum efficiency to about 32 per cent, and even reaching that level has so far proven either unachievable or not cost-effective. As a result, scientists have spent decades trying to come up with alternatives.

Perovskite solar cells (PSCs) are widely predicted to offer a solution, promising much better performance than their silicon counterparts. Progress in PSCs means that they are primed to become an affordable and flexible solar cell option for smart, low-intensity applications. This is because PSCs are less complex to produce, are made with cheaper materials and, due to their flexibility, can be used in locations where traditional silicon-based solar cells cannot.

In lab settings, PSCs are made by depositing chemicals by spraying or painting them onto a surface. This easy application onto substrates opens perovskite's potential in markets wanting flexible and lightweight solar generation options.

Although PSCs have shown excellent performance at lab-scale, their efficiency declines quickly as the module size increases. Their stability is also problematic. The longest lifetime reported is about one year, which is much shorter than the 25 years expected from commercialised technologies. This is where graphene comes in.

The Graphene Flagship is Europe's biggest collaborative research initiative. Funded by the European Commission, the Graphene Flagship has the aim of bringing graphene technologies out of labs and into society within ten years – including technologies to support and advance renewable energy generation.

Since the Graphene Flagship's launch in 2013, the applications of GRMs in solar energy generation have been a strategic priority. In the current phase of the initiative, there are several projects and working groups doing research and innovation within the field of solar energy generation.

The Graphene Flagship spearhead project GRAPES aims to make cost-effective, stable graphene-enabled perovskite-based solar panels. Alongside the Graphene Flagship, the industrial partners GreatCell Solar, BeDimensional and Siemens, introduce GRM-based layered technologies to boost the performance and stability of PSCs to new record levels. The end goal is to use the graphene-enabled PSCs in functional panels, tested in the field.

As one example, the collaboration between research institutions and industrial partners has yielded a GRM-based ink, which is layered over PSCs to give them drastically increased stability. This was achieved by anchoring the GRM molybdenum disulphide (MoS_2) to reduced graphene oxide. This allowed for both materials' properties to be applied and the ink not only increased the stability but also the performance of the PSC.

Due to their flexibility, PSCs can be applied to nearly any surface and produce electricity. Stable PSCs could therefore change the way we power our homes and devices, as every available surface could be made to generate electricity.

Another Graphene Flagship partner involved in GRAPES is Enel Green Power SPA, Italy. Enel Green Power holds the world record power conversion efficiency (PCE) for a silicon hetero-junction cell, 24.63 per cent, but believes graphene will help it beat that number.

By using GRMs as interlayers in tandem cells that combine PSCs and silicon cells, Enel Green Power and Graphene Flagship partners have reached record stability and efficiency, demonstrating a PCE increase of 9 per cent for GRM-based perovskite-silicon tandem cells, as opposed to tandem cells without GRMs.

As well as taking advantage of the transparency and stability of graphene in the interlayers of the solar cell, a highly conductive graphene-based paste will be used in the back contact

and metal front grid, replacing expensive and finite metals such as silver.

Taking tandem cells even further, Graphene Flagship researchers at the University of Rome Tor Vergata, the Istituto Italiano di Tecnologia (IIT) and its spin-off, Graphene Flagship Associate Member, BeDimensional, in cooperation with ENEA have successfully combined graphene with tandem perovskite-silicon solar cells to achieve efficiencies of up to 26.3 per cent.

Graphene will also help the production of large-area solar cells. A paper published in *Joule* during 2020, a reference journal in the field of energy research, sets out a new manufacturing method envisioned by Graphene Flagship researchers that promises reduced manufacturing costs, leading the way to the production of large-area solar panels.

The benefits of the new approach to manufacturing graphene-enabled tandem solar cells are two-fold. Firstly, it can be applied to enhance all the different types of PSCs currently available, even those processed at high temperatures. More importantly, graphene can be incorporated using widespread manufacturing methods – key to further industrial adoption.

Francesco Bonaccorso, co-author of the paper and co-founder of Graphene Flagship spin-off BeDimensional, commented: "This innovative approach, proposed in the context of the Graphene Flagship, is the first step toward the development of tandem solar cells delivering a higher efficiency than the limit of single junction silicon devices. Layered materials will be pivotal in reaching this target."

Emmanuel Kymakis, Graphene Flagship Energy Generation Work Package Leader, added: "There are some compatibility issues that have to be tackled before the full exploitation of the perovskite-silicon tandem solar cell concept. This pioneering work demonstrates that the integration of GRMs inks with on-demand morphology and tuneable opto-electronic properties in a tandem structure, can lead to high-throughput industrial manufacturing. Graphene and related materials improve the performance, stability and scalability of these devices."

"The stacked silicon-perovskite configuration will act as the foundation

of the new Graphene Flagship Spearhead Project GRAPES," Kymakis continued. "During the project, a pilot line fabrication of graphene-based perovskite-silicon tandem solar cells will take place, paving the way towards breaking the 30 per cent efficiency barrier and a significant decrease on the levelised cost of energy."

GRAPES will play an essential role in improving Europe's uptake of solar energy projects and meeting its environmental targets, particularly by improving the stability and efficiency of solar cell technology when deployed on a large scale.

Alongside GRAPES, the Graphene Flagship has built and launched the world's first graphene-based perovskite solar farm. Located in Crete, the farm has been fully operating since June 2020, with promising early results.

The project is a collaboration between the University of Rome Tor Vergata, the Hellenic Mediterranean University, the University of Cambridge, the Istituto Italiano di Tecnologia (IIT) and GreatCell Solar. It consists of nine graphene-perovskite panels with a total area of 4.5 m² and a total output of approximately 261 Wp. The project aims to enable the commercialisation of graphene-perovskite solar cells.

Each solar module incorporates technology developed through the GRAPES project, relying on GRMs to help increase the module's performance and stability. The panel's active layer is a mixed triple cation lead halide perovskite.

A full year of operation of the solar farm will be needed before full results can be published, but with strong early results in terms of power generation, and competitive manufacturing costs, the system represents a significant further improvement for solar cells.

For the EU to meet its goal of becoming climate neutral by 2050, advances in renewable energy generation must be made. Thankfully, innovations in photovoltaics, such as graphene-based perovskite-silicon tandem solar cells, offer great promise, bringing Europe closer to a brighter, more sustainable future.

Patrik Johansson is Vice Director of the Graphene Flagship.

The Graphene Flagship

Funded by the European Commission, the Graphene Flagship aims to secure a major role for Europe in the ongoing technological revolution. It gathers nearly 170 academic and industrial partners from 21 countries, all exploring different aspects of graphene and related materials.

Bringing diverse competencies together, the Graphene Flagship facilitates cooperation between its partners, accelerating the timeline for industry acceptance of graphene technologies.

The Commission's Future Emerging Technologies (FET) Flagships enable research projects on an unprecedented scale. With €1 billion budgets, the Graphene Flagship, Human Brain Project and Quantum Flagship serve as technology accelerators, helping Europe to compete in global markets on research and innovation.

Technology Focus

Liquid metal battery storage looks hot

A novel battery technology is to be demonstrated at a data centre to be built in the desert of Reno, Nevada, USA. The battery holds the promise of low-cost, compact storage, capable of cycling without degradation. **Junior Isles reports.**

According to the International Energy Agency data centres consumed around 250 TWh in 2019, accounting for about 1 per cent of global energy demand. That figure is predicted to rise to 270 TWh in 2022. Ensuring these buildings are powered by clean renewable energy sources going forward will therefore be crucial in avoiding what is fast becoming a major source of carbon emissions. But the goal to have these facilities powered by wind and solar calls for the deployment of energy storage to store and supply energy when the wind is not blowing and the sun is not shining.

US company TerraScale recently announced a project that will see it build a data centre near Reno, Nevada, that will be powered by solar energy and use a novel battery that, among other things, is designed to be cheaper than lithium-ion batteries and not degrade over time.

TerraScale is a global clean infrastructure design and development firm that works with partners to design, engineer, build and operate large scale, sustainable data centres and digital infrastructure projects.

Commenting on the main project driver, Mark Schonberg, President, TerraScale, said: "Most data centres in the US are powered by the traditional utilities, which means their electricity is a mixed bag. Providing 100 per cent carbon-free energy is not a problem but getting to 100 per cent renewables is a challenge. We want to make green energy real and tangible to our customers."

The company is taking its first step to achieving this at Energos Reno – a 3700 acre mixed-use development near Reno – where it intends to develop a data centre with 500 MW of on-site renewable power generation within ten years to power an inside-the-fence microgrid.

The original plan was to use geothermal energy to power the data centre. However, the length of time it would take to develop a geothermal project led the company to kick-off with solar.

"There's a lot of geothermal energy

there and from a data centre perspective, geothermal is perfect because it's 24/7, 365. But the construction time is protracted. We are still working toward using geothermal but that would be part of Phase 2 of the project," said Schonberg. "In the first phase of the project, we will therefore start with 20 MW of electricity, primarily solar, with the capability to expand up to 100 MW for the data centre in Phase 2. Once we've successfully leased out the 20 MW to our clients, that will be the trigger for the second phase."

The campus will be built in 20 MW chunks, with "doors opening" in spring 2022. The next phase, which will be four more 20 MW blocks of primarily solar, is likely to start in the summer of 2023.

"We will build the renewables infrastructure to support each building. All of our buildings for the data centres are in 20 MW segments, so we will execute the renewable power build at the same time. We will get to 100 MW probably around 2027," noted Schonberg.

At installations such as data centres, having back up power in different forms is critical and that includes a robust battery system, says Schonberg. This is especially important for intermittent renewables. "If you're going to have a large renewable energy source, it needs to run through your battery system. It allows you to flip between power sources. If I'm running off solar energy and at some point cloud rolls in, my battery back-up kicks in and gives me time to switch over to whatever my secondary power source is. Batteries are an intrinsic part of your plan."

This led TerraScale to partner with another US company called Ambri to demonstrate a new type of battery, known as a liquid metal battery at the Reno site.

"With our pilots, we are looking at testing new technology. The thing that drove us to look at Ambri is the fact that, unlike Li-ion and Li-sulphur batteries, they are 100 per cent recyclable, are completely safe from a fire risk perspective and have a

small footprint. This is important to us because as we go forward, data centres will get smaller and will be increasingly located in buildings in urban areas."

It is expected that the new battery system, which could ultimately provide 250 MWh of storage, will have a number of advantages over existing batteries, including low cost, smaller footprint, safer operation and negligible degradation. According to Ambri, capital cost of the battery will be 25-50 per cent less than the cost of a comparable Li-ion battery for a project that is cycled once per day and has a 20-year lifespan.

Development of the battery began in the lab of Professor Donald Sadoway Massachusetts Institute of Technology (MIT) and Ambri was formed in 2010, when the project achieved significant technical breakthroughs. From the outset, the team's goal was to develop a completely new type of battery technology instead of trying to improve existing battery technology. It therefore decided to look at other technologies within electro-chemical industries.

Adam Briggs, Ambri's Chief Commercial Officer, explained: "They looked at industries like aluminium smelting and the ways in which very low cost materials could possibly be used in order to generate and store electricity. They eliminated materials that were very expensive or not readily available around the world and stuck with those that are already in the ground... start with dirt. If you want something to be dirt-cheap, start with dirt."

The team decided that operating the battery at high temperature was the key to using these low-cost materials. Briggs notes that for stationary batteries, operating at high temperatures is not a concern.

The liquid metal battery is comprised of a liquid calcium alloy anode, a molten salt electrolyte and a cathode comprised of solid particles of antimony, whereby the active materials in the cells reversibly alloy and de-alloy while charging and discharging.

Briggs explained: "When you elevate the temperature of those materials they readily form alloys and de-alloy relatively easily without any catalyst. The calcium anode melts into a liquid, as does the calcium chloride electrolyte, which is a relatively common material, to create a battery where the constituents are either salts or metals melted into liquids. Those liquids can move around without being constrained by separators that are normally included for safety reasons."

An important advantage of the materials used, says Briggs, is that they cannot generate gas under any circumstances. This means that unlike other batteries there is no venting of gas which, if flammable, as is the case with Li-ion batteries can pose a fire hazard.

"The batteries operate at 500°C and can be overcharged for extended periods of time, short-circuited or over-discharged without generating gas or resulting in an unsafe increase in

temperature," said Briggs.

A unique aspect of a high temperature battery is that, if used daily, it stays at its operating temperature regardless of ambient temperature without any need for electricity for cooling or heating. This makes it well suited to hot environments like the Nevada desert.

Noting the significance of this, Briggs said: "It's almost as efficient as Li-ion but doesn't need any auxiliary power to keep it cool. This is one of the reasons TerraScale chose it."

Another important feature is that, unlike Li-ion batteries, it does not degrade with usage. Because the materials easily alloy and de-alloy when they are being charged and discharged and are liquids, they do not have the same degradation mechanism that many of today's batteries have.

This says, Briggs, brings a significant economic benefit compared to Li-ion batteries. He notes that not only do the batteries last longer, there is also no need to install more capacity than is actually needed in order to compensate for the degradation over time.

"People usually don't factor this in when comparing different battery chemistries... you have to guarantee it will deliver a certain amount of energy every day for 20 years," he said. "So our battery will not only cost less upfront, it will last longer and have a lower operating cost over its life relative to Li-ion."

The footprint is also impressive. Commercial-scale systems will come in 10 ft x 10 ft shipping containers that contain electric heaters that will be connected to the grid on the day of commissioning to heat the system up. The battery is then available for use and will generate its own heat going forward.

"You would really want to use it in applications where it is going to be charged and discharged at least once every other day. This will keep it warm without any extra energy to heat it back up," said Briggs.

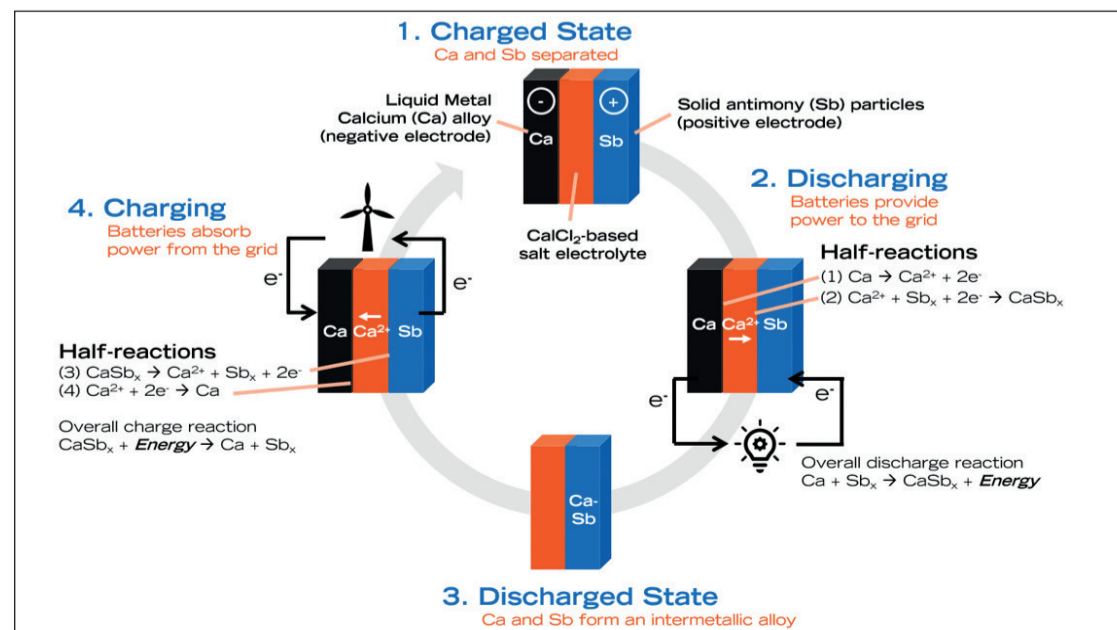
This is perfect for pairing with solar and the general requirement for shifting energy daily from the daytime when it is generated to the evening when demand is at its peak.

The first systems will go into the field as 40 kWh trial systems to demonstrate their effectiveness and operation. The pilot battery for TerraScale, which will be one of these trial systems, will be installed late this year. Briggs says a larger 1 MWh commercial-scale trial system will be installed next year. "For our early customers, like TerraScale, we will install that in late 2022."

Volume production will then start in 2023, at which time Ambri will build battery systems that are available in 1 MWh blocks and have discharge rates of 4 hours or longer.

Schonberg said its pilot will help TerraScale "flush out things like, what is the cost point". He concluded: "Here's a small battery company with a phenomenal battery but now has to commercialise it... we are looking at allowing them to prototype it."

Flow schematic of the Ambri liquid metal battery





Junior Isles

Spring cleaning

New US President Joe Biden has begun the task of some urgent spring cleaning, literally. Just hours after his inauguration, the Democrat leader signed no fewer than 17 Executive Orders, among the first of which was one to rejoin the Paris Climate Agreement as promised in his campaign. Yet signing orders is the easy part.

In rejoining the global effort to curb the accelerated heating of the planet, President Biden has brought renewed hope that the world can move more aggressively in curbing greenhouse gas emissions.

Biden's move was immediately welcomed by the US' small vulnerable neighbours. Following the signing, the Organisation of Eastern Caribbean States (OECS) said it "ignited great

expectation among Small Island Developing States (SIDS)".

The organisation noted that the governments of the OECS and the wider Caribbean have all heavily invested in prolonged diplomatic advocacy, drawing attention to the grave dangers and the damaging impact of climate change throughout the world but particularly in the region. "We have consistently called on the largest contributors to climate change to commit to urgent climate action such as carbon reduction targets and investment in new technologies that can safeguard lives and livelihoods," it said in a statement.

Director General of the OECS Dr Didacus Jules applauded President Biden for signalling that climate change, along with tackling the Covid

pandemic, has now been elevated to the top of the US domestic agenda.

In signing an order that promises "... to reduce greenhouse gas emissions; to bolster resilience to the impacts of climate change..." notably the President moved to take executive action to limit methane pollution from new and existing oil and gas operations.

Methane is a powerful greenhouse gas and the second largest contributor to climate change. Air pollution and climate change expert at the University of York, Dr Johan C.I. Kuylenstierna, noted: "Prior to the pandemic, methane emissions were growing rapidly. To achieve the Paris agreement, countries need to change this trajectory, with rapid reductions in emissions."

The week after taking office, on a day dubbed "climate day at the White House", Biden signed a slew of Executive Orders to address climate change including orders to freeze new oil and gas leases on public lands and double offshore wind energy by 2030. "We have already waited too long," Biden told reporters. "And we can't wait any longer."

But while these moves are important and set the tone of the new government going forward, it is only a beginning.

The International Renewable Energy Agency (Irena) hailed the US decision to rejoin the Paris Climate Accord as a "crucial" step forward in the fight against climate change. "Coming from a superpower, one of the big emitters in the world, this is really crucial and it's very important," said Francesco La Camera, Irena's Director-General. "I think it will make a difference."

The Biden administration plans to make the US a 100 per cent clean energy economy with net zero emissions by 2050. The administration also plans to decarbonise the US power sector by 2035, tapping into renewable energy solutions and technology that can be deployed at scale and compete with fossil fuels on cost.

Getting there, however, will be no mean feat. "The commitments are very high, and very difficult to get," La Camera said. "I hope they will fulfil their commitment."

With a pretty much even split in the Senate, Biden will still need the support of some Republicans in order to pass legislation. He will also have his hands full with tackling the pandemic and stimulating the economy. Some therefore believe that the quick moves have happened but nothing significant will happen for a while.

But with the US keen to re-assert its leadership on the world climate stage, it will need to show concrete progress in legislation, especially with COP26 fast approaching in Glasgow, UK, in November. The UK has already enshrined its net zero 2050 target in law.

With strong climate credentials, the US would be better placed to use climate policy as a tool to leverage foreign policy. Speaking during a panel at the recent online annual Global Energy Forum held by the Atlantic Council, Meghan O'Sullivan, Director of the Harvard Kennedy School's Geopolitics of Energy project, said: "The Biden administration and Secretary Kerry are talking about infusing climate into every foreign-policy interaction."

It will certainly be interesting to see how climate plays a part in the fractious relationship between the US and China. Certainly, the two superpowers will have to work together if the world is to have any chance of meeting the Paris goal of limiting global temperature increase to 2°C above pre-industrial levels.

Gavin Thompson, Vice Chairman, at research and consultancy group Wood Mackenzie, said: "We can expect both collaboration and competition on tackling climate change," noting that the US will have to "collaborate with China, particularly to bring others on-board". He added: "But at the same time, China and the US will increasingly compete to be the global leader in tackling climate change, with both seeking to expand control over low/zero carbon technology."

Speaking in another panel session at the Atlantic Council event, David McKinley, a Republican for West Virginia, who is a Member of the Climate Solutions Caucus in the US House of Representatives, claimed that whatever the US does, it would make no difference to climate change unless the "the rest of the world buy into their responsibility on climate change".

This was to some degree echoed by new US Climate Envoy John Kerry at a White House news conference held during the House "climate day". He said: "He [Mr Biden] knows Paris alone is not enough. Not when almost 90 per cent of all of the planet's global emissions come from outside of US borders. We could go to zero tomorrow and the problem isn't solved."

Singling out China and India McKinley argued that the Obama administration had "let them off the hook". He said: "If you look at the language of the Paris Accord, it was quite frankly just playful theatre... the language says developing nations should continue enhancing their mitigation efforts and are encouraged to move over time to economy emission reductions. That's not *shall*, that's not *must*..."

Kathy Castor, the other member of the same panel discussion largely agreed but noted that the US essentially lead from the front. Castor is a Democrat from Florida and Chair of the House Select Committee on the Climate Crisis. She is part of the Committee that unveiled the 500-page climate crisis action plan last summer.

"We have a lot of work to do internationally," she said. "[but] we cannot expect other countries to meet their nationally determined commitments and targets unless we're part of it and we're walking the walk as well."

It is clear the world needs a unified and global approach to the climate problem but Biden can do much to raise spirits. He is setting about it the right way and appears to be getting his House in order.

Many of the key architects of the Obama Clean Power Plan have been assigned key administration jobs. Gina McCarthy, the former EPA administrator, will be at the White House as national climate adviser; Janet McCabe, who ran the EPA's air office, has been nominated for deputy administrator; and Joe Goffman, an adviser who wrote much of the CPP, is a member of the EPA transition team.

Notably President Biden has given his science advisor, who is Director of the White House Office of Science and Technology Policy, a seat in his Cabinet. It is a move that is unprecedented in the history of White House science policy.

Biden's January spring clean and roll-back of the Trump administration's most egregious acts against the environment are perhaps a little early in terms of season but they could not have come soon enough. Now we can all look forward to a brighter spring with bluer skies as we move towards COP26 with renewed vigour.

