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Liquid air energy storage offers large scale, long duration storage and a compelling economic case compared to batteries.



Orchestrating DERs

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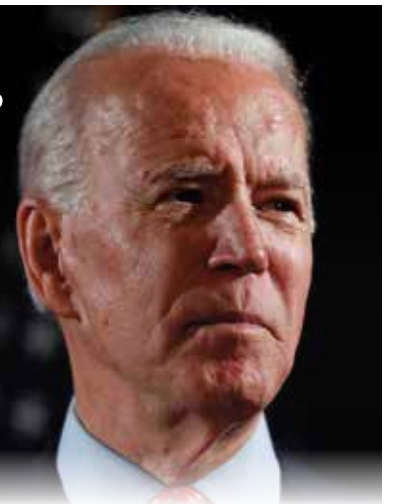
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Biden win bodes well for global climate agenda but challenges remain

The Biden administration will put clean energy at the heart of economic revival plans



President-elect Joe Biden plans to reverse many of the environmental actions of the Trump administration and bring the US back to the world climate change stage, but there may be limits to what he can achieve. **Junior Isles**

Joe Biden's victory in last month's US elections offers renewed hope in the battle against climate change, but experts argue that there will be limits on how much of his proposed energy policy he can deliver.

During his campaign, President-elect Biden proposed an energy policy that is in stark contrast to outgoing President Donald Trump. Most notably, unlike President Trump, Biden aims to bring the US more in alignment with its international counterparts in the adoption of clean, low carbon, energy as it looks to stimulate its economy while moving towards net zero carbon emissions.

This summer President-elect Biden put clean energy at the heart of his

plan to revive the US economy and stop all climate-damaging emissions from US power plants by 2035, with a goal to the country achieving net zero carbon emissions by 2050.

The 'Biden Plan To Build A Modern, Sustainable Infrastructure and An Equitable Clean Energy Future', includes \$2 trillion in funding over four years to accelerate the country's transition towards a low-carbon economy, with \$400 billion to be specifically set aside for clean energy research and development.

Experts argue, however, that with a diminished majority in the House of Representatives and a good chance the Republicans would narrowly retain the Senate, President-elect

Biden's plans are unlikely to be fully realised.

In a press commentary Fitch Solutions Sector Intelligence said: "In our view, Biden's presidency will result in considerable regulatory changes toward the sector, although major policy changes that require congressional support, such as increases in federal spending, are much less likely to advance – preventing the full realisation of Biden's agenda.

"With a divided government likely, we expect that Biden will struggle to advance a number of his more progressive proposals toward the power sector, particularly major increases in spending."

John Podesta, a former White House

chief of staff who ran the Clinton White House and advised Barack Obama, told the *Financial Times* that Biden will have to scale back clean energy ambitions.

Referring to the \$2 trillion, he said: "The number will obviously be scaled back," speculating that Biden may only be able to secure half of that. He noted, however, that while a Republican Senate would be against a sweeping spending plan, it might support smaller changes.

He said Republicans might support: the strengthening of renewable tax credits; more spending on energy and climate research and development;

Continued on Page 2

Renewables resilient to Covid but not to policy uncertainties

Renewable power is growing robustly around the world this year, contrasting with the sharp declines triggered by the Covid-19 crisis in many other parts of the energy sector such as oil, gas and coal, according to a report from the International Energy Agency.

Driven by China and the United States, new additions of renewable power capacity worldwide will increase to a record level of almost 200 GW this year, the IEA's 'Renewables 2020' report forecasts. This rise – representing almost 90 per cent of the total expansion in overall power capacity globally – is led by wind, hydropower and solar PV. Wind and solar additions are set to jump by 30 per cent in both the US and China as developers rush to take advantage of expiring incentives.

"Renewable power is defying the difficulties caused by the pandemic, showing robust growth while other

fuels struggle," said Dr Fatih Birol, the IEA's Executive Director. "The resilience and positive prospects of the sector are clearly reflected by continued strong appetite from investors – and the future looks even brighter with new capacity additions on course to set fresh records this year and next."

The IEA stressed, however, that policymakers still need to take steps to support the strong momentum behind renewables.

"Renewables are resilient to the Covid crisis but not to policy uncertainties," said Dr Birol. "Governments can tackle these issues to help bring about a sustainable recovery and accelerate clean energy transitions. In the United States, for instance, if the proposed clean electricity policies of the next US administration are implemented, they could lead to a much more rapid deployment of solar PV

and wind, contributing to a faster decarbonisation of the power sector."

A separate report by International Renewable Energy Agency (Irena) said that while a cumulative \$1.8 trillion was invested during the 2013-2018 period, the amount falls short in achieving the global climate commitments. Noting that renewable energy investment slightly declined in 2018, with modest growth through 2019, it said that in order to achieve climate goals, ambitious commitments from governments are needed, backed by supporting measures such as moving subsidies away from fossil fuels.

In its latest New Energy Outlook (NEO) 2020 BloombergNEF's (BNEF) says that despite the progress of the energy transition, and the decrease in energy demand brought by Covid-19, it still sees energy sector emissions putting the world on course

for a 3.3°C temperature increase by 2100.

Jon Moore, CEO of BNEF commented: "The next ten years will be crucial for the energy transition. There are three key things that we will need to see: accelerated deployment of wind and PV; faster consumer uptake in electric vehicles, small-scale renewables, and low-carbon heating technology, such as heat pumps; and scaled-up development and deployment of zero-carbon fuels."

Whereas NEO previously focused on the electricity sector, this year's report includes detailed chapters on industry, buildings and transport to give a full-coverage, economics-led view of the energy economy to 2050. The report also features a Climate Scenario investigating a clean electricity and hydrogen pathway aimed at holding temperatures to well below 2°C.

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funding for international climate efforts.

Advancing efforts in tackling climate change will have a significant global impact. Net zero targets in both the US and China could reduce global warming from 2.7°C by the end of the century, to about 2.3-2.4°C, according to projections from Climate Action Tracker, a research group based in Germany.

Biden's stance on climate change will be warmly welcomed by the international community, following four years of a Trump government that overturned more than 100 major environmental regulations from the Obama era.

The US, under then President Barack Obama, played a central role in developing the 2015 Paris agreement, which aims to limit global warming to well below 2°C. Trump, however, announced the US would withdraw from the Paris Climate Accord a little over a year after taking office.

That withdrawal officially took effect on November 4, the day after the US election was held. President-elect Biden, however, promised to rejoin the Paris Climate Agreement on day 1 of assuming office and aims to make the US a leader in the global climate change effort.



Boris Johnson says there is now "the real prospect" of US leadership on climate change

"I think now with President Biden in the White House in Washington, we have the real prospect of American global leadership in tackling climate change," UK Prime Minister Boris Johnson told the *Associated Press*.

"It is a big relief that the US comes back," said Laurence Tubiana, Chief Executive of the European Climate Foundation, and one of the key architects of the Paris pact. "The positive domino effect from [the] Biden presidency will be enormous," she added.

One of the challenges facing a Biden administration, however, will be to determine new climate targets. The Paris agreement would also require the US to set climate targets for 2030, much nearer than Biden is proposing.

In a move that will help push Biden's climate goals, the President-elect's administration is also expected to set up the first National Climate Council, a high-level group whose chair would direct policy across the federal government.

Although constrained at the federal level, there will be a number of other important changes a Biden government can make.

Wood Mackenzie listed several key areas. The global research and consultancy group noted: there will be a boost for offshore wind; restrictions on oil and gas development as well as new hurdles for oil and gas infrastructure projects; and support for electric vehicles.

UK 10-point plan gets a 6

The UK's 10-point plan to cut emissions and drive industrial growth has been broadly welcomed but some say it is no more than a vision that still lacks detail. **Junior Isles**

Junior Isles

While the UK's recently announced 'Ten Point Plan for a Green Industrial Revolution' has been well received across all sectors, more is needed for the country to achieve net zero emissions by 2050.

Covering clean energy, transport, nature and innovative technologies, the blueprint announced last month sets out the Prime Minister's ambitious plan for a green industrial revolution that will create and support up to 250 000 British jobs.

Yet while the plan receives high marks for vision, experts argue that it lacks detail. Chris Stark, Chief Executive of the Committee on Climate Change, the government advisory body, said the 10-point plan would help to cut emissions, but "doesn't take us all the way to net zero".

"It is a vision, it is not a plan," said

Stark. "The following 12 months is where the real hard work needs to be done... It is a vision statement that we will need to see filled in with more detail soon." The government is due to publish a much-delayed Energy White Paper before the end of the year, which could provide that detail.

The plan includes: quadrupling offshore wind capacity to 40 GW by 2030, supporting up to 60 000 jobs; working with industry aiming to generate 5 GW of low carbon hydrogen production capacity by 2030 for industry, transport, power and homes, and aiming to develop the first town heated entirely by hydrogen by the end of the decade; advancing nuclear as a clean energy source, across large scale nuclear and developing the next generation of small and advanced reactors, which could support 10 000 jobs; accelerating the transition to electric vehicles, and transforming the national

infrastructure to better support them; and developing carbon capture and storage, with a target to remove 10 million tonnes of carbon dioxide by 2030.

The government says £12 billion has been allocated to the plan but the Labour opposition party points out that at least two-thirds of that figure is recycled announcements, with just £3 billion being new commitments.

Ed Miliband, Shadow Business Secretary, said: "Only a fraction of the funding announced is new," and added, that the funding "does not remotely meet the scale of what is needed" to tackle the climate emergency.

Simon Colvin, partner and head of energy and utilities at national law firm Weightmans said: "The funding announced is only a fraction of the extra £29 billion the Institute for Public Policy Research has highlighted will be necessary every year to hit our 2050 target. It will be interesting to

see what further net zero funding is enshrined in future spending commitments, and how the government prioritises further environmental funding as it also navigates the fiscal challenges left by Covid-19."

Paul Steen, UK Head of District Energy, Ramboll, said that while the UK plan marks progress in accelerating the transition to net zero, the key challenge will be joining all of these pledges up to create a holistic strategy for the energy system of the future.

"A holistic strategy must also be applied at a technological level. For instance, heat networks and hydrogen technologies needn't be competing technologies, but instead can work in synergy if investment is directed towards clusters of opportunities. There's a role for everyone: we must work collaboratively across the industry to achieve an integrated energy system" said Steen.

Europe looks offshore for climate neutrality

To help meet the EU's goal of climate neutrality by 2050, the European Commission has presented the EU Strategy on Offshore Renewable Energy. The Strategy proposes to increase Europe's offshore wind capacity from its current level of 12 GW to at least 60 GW by 2030 and to 300 GW by 2050. The Commission aims to complement this with 40 GW of ocean energy and other emerging technologies such as floating wind and solar by 2050.

This ambitious growth will be based

on the vast potential across all of Europe's sea basins and on the global leadership position of EU companies in the sector. It will create new opportunities for industry, generate green jobs across the continent, and strengthen the EU's global leadership in offshore energy technologies.

To promote the scale-up of offshore energy capacity, the Commission will encourage cross-border cooperation between Member States on long term planning and deployment. This will require integrating offshore renewable

energy development objectives in the National Maritime Spatial Plans, which coastal states are due to submit to the Commission by March 2021. The Commission will also propose a framework under the revised TEN-E Regulation for long-term offshore grid planning, involving regulators and the Member States in each sea basin.

The Commission estimates that investment of nearly €800 billion will be needed between now and 2050 to meet its proposed objectives.

To help generate and unleash this

investment, the Commission will provide a clear and supportive legal framework. To this end, the Commission also clarified the electricity market rules in an accompanying Staff Working Document and will assess whether more specific and targeted rules are needed. The Commission will ensure that the revisions of the State aid guidelines on energy and environmental protection and of the Renewable Energy Directive will facilitate cost-effective deployment of renewable offshore energy.

Countries must focus on green stimulus packages

Countries that do not put green technologies at the heart of their stimulus packages are not only failing to address the climate challenge but are also losing out on job creation opportunities.

A new report from global technology company Wärtsilä has revealed that the G20's stimulus packages are weighted to support legacy energy systems; missing the opportunity to create jobs and accelerate the transition towards flexible, renewable-powered economies.

The report, 'Aligning Stimulus with Energy Transformation', presents modelling of scenarios where the US and the UK focus their current stimulus packages for energy on measures that accelerate the energy transition, aligning economic recovery with decarbonisation. It also provides viewpoints on a number of other G20 countries, including Germany, Australia and Brazil.

In the US, if the current stimulus pledged to support legacy fossil fuel sectors (\$72 billion) was allocated to

advance modern, flexible, high-renewable power systems, over 100 GW of new renewable energy capacity could be achieved. This would result in over 500 000 new jobs in renewable energy, 175 per cent more new jobs than if stimulus was focused on legacy, inflexible energy systems.

In the UK, the analysis identifies that current energy stimulus, if utilised to leverage private sector funds towards the energy transition, could help the nation to reach a 60 per cent renewable power system and cut power sector emissions by 58 per cent. The system would have 60 GW of renewable energy, supported by 7 GW of battery energy storage and 14 GW of flexible gas-based generation for flexibility. This would create over 120 000 jobs in the renewable energy sector alone and put the UK on track to meet its net zero emissions target by 2050.

Sushil Purohit, Energy Business President, Wärtsilä, said: "Across the G20 countries, the stimulus 'scales' are strongly weighted to support legacy

inflexible power systems, despite the agenda for rapid decarbonisation that's underway worldwide."

Speaking at the recent Sustainable Innovation Forum about the potential of a Global Green Deal similar that adopted by the EU, Rodolfo Lacy, Director of the Environment Directorate at the OECD, noted that many countries are making green recovery measures a central part of stimulus packages and said that OECD members have committed \$312 billion of public resources to green recovery. He added, however, that this was not enough and that investments must move away from technologies that generate harmful emissions.

"Some countries are implementing measures that risk having a negative environmental impact and locking [out] sustainable growth, we have to recognise that. So in a new Green Deal, we cannot for example support investments in those factories whose production activities are emitting not only greenhouse gases, but also pollutants."

In late October Rockefeller Foundation said it would commit \$1 billion over the next three years to help drive a more inclusive, green recovery from the Covid-19 pandemic. Part of this will be used to catalyse distributed renewable energy across developing countries.

It said that prior to the pandemic, half the world's population lacked access to essential health services, and more than 800 million people worldwide lacked access to electricity. "Billions more have their potential diminished by unreliable or insufficient energy access, predominantly provided by carbon-emitting fuels. The energy accessibility gap has further widened because of the pandemic," it stated.

A recent report published by Sustainable Energy For All and South Pole found that despite a trend in growing energy finance disbursements, those disbursements, totalling \$32 billion in the period 2013 to 2018, still substantially lagged commitments, which totalled \$52 billion.



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Nuclear players join forces as small reactor industry takes shape

■ NuScale and UKSMR partnerships formed ■ Operator joins Rolls-Royce consortium

Janet Wood

New deals announced by major players have started to reveal the outlines of a growing industry in small modular nuclear reactors (SMRs). Recently interest has been sparked in the technology because of the potential to provide low carbon power at lower capital cost than is required for large nuclear reactors.

Fluor Corporation announced in November that it had reached an agreement with Sargent & Lundy to collaborate on joint marketing and design services for the NuScale Power SMR.

Fluor will design the turbine island and balance-of-plant facilities while Sargent & Lundy will provide the design for the nuclear island.

Alan Boeckmann, Fluor's Executive Chairman, said: "This collaboration agreement with one of the most respected companies serving the nuclear power industry brings nearly 150 years of combined experience and further solidifies the opportunity to bring new carbon-free energy to the US and North America."

Sargent & Lundy Chairman, President and Chief Executive Officer Thomas R. White said: "The opportunity to team with NuScale and Fluor

for the design and construction of small modular reactor plants further extends Sargent & Lundy's history of being at the forefront of nuclear new generation design."

Meanwhile, Rolls-Royce and Exelon Generation have signed a new Memorandum of Understanding in which Exelon Generation will operate compact nuclear power stations internationally and in the UK.

Exelon will add operational experience to a consortium led by Rolls-Royce that is designing a low-cost factory-built SMR. The consortium, whose members include Assystem, Atkins, BAM Nuttall, Jacobs, Laing

O'Rourke, National Nuclear Laboratory, Nuclear Advanced Manufacturing Research Centre, Rolls-Royce and TWI.

Bryan Hanson, EVP and COO of Exelon Generation said: "We've had a very strong record of performance for 20 consecutive years, with a 2019 capacity factor of 95.7 per cent. We will leverage this experience to achieve sustainably high capacity factors for the UKSMRs."

But in Canada a federal government plan to develop SMRs has been delayed. Paul Lefebvre, Parliamentary Secretary to the Minister of natural resources, said recently: "We're still

putting the finishing touches on it," Lefebvre said. "The action plan is too important to be rushed."

Critics were quick to call on the government to halt its plans to fund the technology. But Lefebvre said that as one of the world's largest producers of uranium, Canada had to join a global market for SMRs he said could be worth between \$150 billion and \$300 billion a year by 2040.

The plan took a step forward recently when Canadian Nuclear Laboratories signed a host agreement with Ottawa-based Global First Power for a demonstration SMR at its Chalk River campus in Ontario.

Mexico opens door to China as renewables stall

China's State Power Investment Corporation (SPIC) has acquired Mexico's largest independent renewables producer, Zuma Energia. SPIC said the acquisition vehicle, China Power International Holding Limited, would be used to create "a regional sustainable development platform".

Zuma has an installed capacity of 818 MW. SPIC Chairman Qian Zhimin said Zuma would now "contribute to the operational development and investment in the countries in the region".

However, Mexican investors have warned that the country's existing energy rules in Mexico, which limit the participation of private companies and prioritise the use of fossil energy,

jeopardize compliance with the energy transition.

Three electricity auctions that allowed the private sector to enter the national energy market in renewables helped bring renewables share of generation to 24 per cent in the first seven months of 2020, according to the National Energy Centre (Cenace). But a target of 35 per cent by 2024 could recede, said Marcial Diaz, Chairman of the National Technical Committee on Energy of the Mexican Institute of Finance Executives (IMEF). He added: "Until two years ago, progress was made on clean energy and investment in the electricity sector; however, with the decisions of the current administration there is a brake."

AWEA calls on new administration to enable major wind investment

The American Wind Energy Association (AWEA) has released a new Vision for Driving a Clean Energy Transformation Plan that calls on the incoming Biden administration to take a holistic approach to achieve long-term clean energy and carbon goals.

The plan says that "meaningful clean energy targets and carbon policies" are needed to drive renewable energy deployment, but other pillars are equally important. The new administration should also reform policy in transmission, permitting, power markets and delivering renewable power to consumers.

That will include investing in the grid, the lobby group said. "America

begins this new decade with the chance to shape an affordable, thriving energy future defined by clean electricity. Our country's leaders must now move forward with bold, sensible policies to create that future, or risk leaving hundreds of thousands of new jobs and hundreds of billions in investments behind," said AWEA Chief Executive Tom Kiernan.

The sector has proved attractive to Canada-based investment fund manager, Alberta Investment Management Corporation, which recently joined forces with US-based AES Corporation. Their joint venture, sPower, will have a 12 GW development pipeline.

Investors move further into Brazil's power industry

■ Interest high ahead of Eletrobras sell-off
■ Spanish, Chinese companies drive renewables

Sovereign state and industrial power players have tightened their focus on South America, attracted by both large calls for renewable energy investment and opportunities to take a stake in existing infrastructure.

Excitement has been prompted by confirmation that the Brazilian government would sell its 42.57 per cent stake in Eletrobras by the end of 2021. Eletrobras, the largest power company in Latin America, is responsible for 30 per cent of Brazil's power generation capacity and 45 per cent of the power transmission capacity. Recent investment in South American networks also include new Colombian transmission network Caoba, set up by Cubico Sustainable Investments (Cubico), with local partner Celsia. Cubico's second Colombian investment and its first in

transmission will include 1500 km in transmission lines and 85 substations. Ricardo Díaz, Head of Americas at Cubico, said: "We are very pleased with our partnership with Celsia in Colombia; this additional transaction is clear evidence of the synergies and good fit between our companies."

Brazil has been a major target for renewables investment recently.

Spain's Iberdrola recently started construction of the 566 MW Oitis wind 'megacomplex', through its Brazilian subsidiary Neoenergia. The kick-off was three months earlier than planned, following early authorisations. It is already at work on the 471 MW Charfariz wind complex.

China's CGN, meanwhile, recently announced plans to expand its footprint in the country to 3 GW, which it expects

to do mainly by acquisition. Its existing 1.1 GW portfolio includes operational plants acquired from the UK's Actis and Italy's Enel. It is in negotiations to acquire wind and solar greenfield projects and wants to close deals immediately or by the first quarter of 2021.

The company is also planning to expand existing sites, adding 20 MW to its Santa Vitoria do Palmar wind complex, and build 600 MW of solar plants, some of them at wind farm sites.

Meanwhile, Brazil has allowed 171.9 MW of wind and solar projects to enter the national Incentive Regime for Infrastructure Development (REIDI).

REIDI, launched in 2007, grants tax incentives to companies investing in infrastructure projects within the transport, energy, sanitation and irrigation sectors.

Chile seeks leading role in 'green hydrogen'

Chilean President Sebastián Piñera has unveiled a new National Green Hydrogen Strategy that aims to make the country by 2030 the world's most efficient producer of green hydrogen in the world and a 'top three' exporter of green hydrogen to international markets.

"Due to abundant clean and renewable energy resources, Chile has the

potential to be the world's most efficient producer of green hydrogen. The National Green Hydrogen Strategy forms an essential part of our carbon neutrality plan and, most importantly, our project to develop sustainably and collaborate with sustainable development around the world. This is a long-term strategy, which will require Chileans to work together to achieve

this common goal," he said.

The government is setting up a \$50 million funding round for green hydrogen projects and making government land available. In addition, he launched two government working groups under the Ministry of Energy, to foster public and private commitments to quickly establish hydrogen consortia.

Coal use threatens China's 2060 pledge

- Demand rebounding too quickly to be met by renewables
- Leaders defer decision to stop new coal plant construction

Syed Ali

Experts argue that China's recent pledge to be carbon neutral by 2060 could be undermined by the country's continuing reliance on coal.

A new report by two environmental groups – Drawworld Environment Research Centre of Beijing and the Centre for Research on Energy and Clean Air (CREA) in Finland – notes that China has around 130 GW of redundant coal power capacity among a total coal fired capacity of more than 1000 GW but stresses that “power industry players have advocated for an expansion to 1300 GW or even higher by 2030”. This plan, it says, “contradicts” the country's carbon neutral targets.

At the general debate of the 75th session of the United Nations General Assembly in September, President Xi

Jinping promised to have CO₂ emissions peak before 2030 and achieve carbon neutrality before 2060. “China will scale-up its Intended Nationally Determined Contributions by adopting more vigorous policies and measures,” said Xi.

The country is the world's largest producer of greenhouse gases, accounting for 28 per cent of global emissions, and the rise in global emissions in 2019 was almost entirely due to China, according to the Carbon Brief website.

The joint report's authors call for China to initiate a policy process to phase-out coal fired power plants. At the same time, it says the rate of wind and solar power expansion needs to double over the next ten years to fulfill domestic targets to reduce greenhouse gas emissions.

They also said “short- and medium-term plans to decarbonise the power

sector before 2050 are essential” to achieve China's carbon neutrality objective. The Drawworld and CREA report says that power system planning of the 14th Five-year Plan should include a clear signal to at least double the annual rate of renewable energy installations, to more than 100 GW annually.

China's situation is complicated by its dependence on coal-powered industries to drive economic recovery. Environmentalists have therefore warned that governments must pursue climate-friendly stimulus measures in order to kick-start growth, or risk a post-pandemic rise in greenhouse gas emissions.

Yang Muyi, an analyst at Ember, a climate think-tank said, however, that electricity demand was rebounding too quickly to be met by renewables. Research led by Yang revealed that a 5.8 per cent year-on-year rise in

electricity demand from May to October was “simply too fast for new wind, solar, hydro and nuclear investment to keep pace”.

China is consequently continuing to burn coal and will account for 53 per cent of global coal-generated power this year.

Despite mounting environmental pressure, at the end of October at a key Communist Party meeting, China's leaders deferred a decision on stopping construction of new coal fired power plants.

Official statements issued at the close of the meeting made only general references to the troublesome problem that may challenge Xi's promise. The phrasing suggests that the central government may spend the next several months trying to persuade or force local authorities to cancel the controversial coal projects before the 14th Five-Year Plan for 2021-2025 is

finalised in March.

Meanwhile, in mid-November China announced that its long-awaited nationwide emissions trading scheme (ETS) will cover a total of 2267 power plants in its first phase, according to government consultation papers.

Coal and gas fired power plants with annual carbon dioxide emissions of at least 26 000 tonnes are included in the first phase of the scheme, according to documents released for public feedback by the Ministry of Ecology and Environment.

Experts said President Xi's announcement has injected more urgency into the market construction process.

“The Ministry of Ecology and Environment will try to rush through these new measures so as to get all things up and running as quickly as possible,” said Shawn He, a Beijing-based lawyer who advises firms on carbon compliance.

Philippines makes decisive shift on coal

The Philippines has banned new coal fired power plants in a move that appears to mark a decisive shift to a greener more flexible power generation mix.

In late October the Department of Energy (DOE) declared a moratorium on new coal projects, while allowing foreign investors to fully own geothermal plant projects in the country. The decision to halt the endorsements of greenfield coal fired stations came after its recent assessment showed the need for a shift to a “more flexible” power supply mix.

“This would help build a more sustainable power system that will be resilient in the face of structural changes in demand and will be flexible enough to accommodate the entry of new, cleaner, and indigenous technological innovations,” explained Energy Secretary Alfonso G. Cusi.

Cusi said the DOE is committed to accelerating the development of the Philippines' resources, while “pushing for the transition from fossil fuel-based technology utilisation to cleaner energy sources to ensure more sustainable growth for the country”.

The DOE is currently updating its

Philippine Energy Plan for the next two decades.

However, the ban on endorsing new coal fired power plants will not affect those that were already given prior endorsements, said Energy Undersecretary Felix William B. Fuentebella.

“We need to prepare for the influx of RE (renewable energy) under the recent policies issued by the DoE. Hence, the need for more flexibility,” he said.

As of August, there are 3436 MW of committed coal-fired power projects in Luzon, including the big projects of Meralco Powergen Corp. and GNPowder Dinginin Ltd. Co., a joint venture of the Ayala and Aboitiz groups.

The DoE has also endorsed 135 MW of coal fired generation in Visayas, and 420 MW of such projects in Mindanao.

Also, there are almost 10 000 MW indicative coal fired power plant projects across the country, some of which may not receive government endorsements. “That one we need to sort out,” Fuentebella said.

The ban will remain in effect until such time that the country needs additional baseload power, according to the DOE official.

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The Philippines is looking to build a more sustainable power system



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Japan emissions targets seen as overly ambitious

- Renewables auctions undersubscribed, land acquisition problems
- Shift away from thermal power generation contingent on nuclear restarts

Syed Ali

Japan is unlikely to reach its newly established net zero emission targets due to its dependence on fossil fuels for power generation and limited success in restarting nuclear power capacity, according to Fitch Solutions Sector Intelligence.

In late October, Prime Minister Yoshihide Suga set out a pledge for Japan to be carbon neutral by 2050. This follows similar pledges made by China and South Korea in recent months.

In a recent statement, however, Fitch Solutions said: "Although the targets point to a strong upside risk to our non-hydro renewables growth

forecasts, we remain cautious in our outlook because of undersubscribed auctions, land acquisition issues and cost concerns. We will wait for more concrete announcements and projects developments before factoring stronger renewables growth into our forecasts.

"We are maintaining our forecasts for Japan's power sector at present, as we do not expect that the country will achieve its newly-established net-zero emission targets."

As part of its new pledge, the Japanese government will reduce coal fired generation, boost innovations in next-generation solar cells and carbon recycling, and promote renewable

energy. The Ministry of Economy, Trade and Industry (METI) is also looking to promote hydrogen and battery storage technologies, with more information expected by the end of 2020.

Fitch Solutions notes, however, that "it is unclear how the government intends to achieve these plans as details remain vague". The government is due to publish a revised energy plan in June 2021, and may look to revise its 2030 power mix targets.

Japan's ability to shift away from thermal generation will remain contingent on their ability to restart their nuclear power plants, says Fitch Solutions. "Despite an ongoing firm

commitment by the government to push for nuclear restarts, the nuclear sector faces significant headwinds stemming from substantial public opposition, a lack of support from many local and regional governors and the high costs of safety upgrades," it said.

Several reactors that were already online were forced to suspend their operations in 2020 as they missed the Nuclear Regulation Authority deadlines for the installation of counter-terrorism measures. The Ikata 3 nuclear reactor was also temporarily suspended due to ongoing court injunctions over safety concerns.

Fitch forecast a total of only 14 nuclear reactors to be online by the

end of 2029, taking the share of nuclear power in the Japanese power mix to 8.3 per cent by the end of its forecast period.

■ In November the government announced that projects with a combined capacity of 368.8 MW have won Japan's sixth tender for solar photovoltaic (PV) power. The tender, the bids in which were capped at Yen12 (\$0.114)/kWh, targeted solar projects bigger than 250 kW and sought to award a combined volume of 750 MW. The average price of the proposals stood at Yen11.48/kWh, below the one achieved in the previous tender rounds. The lowest price offered was Yen10/kWh.

Pakistan could ease debt by adopting wind and solar

Calculations by the World Bank indicate that Pakistan could significantly reduce its national debt by increasing the amount of wind and solar in its electricity mix. **Syed Ali**

Pakistan could save an estimated \$5 billion in power costs over the next 20 years, if it implements a major expansion of variable renewable energy (VRE) such as solar and wind power, according to the World Bank (WB).

The study – 'Variable Renewable Energy Integration and Planning Study' – noted that Pakistan's power sector is heavily impacted by circular debt, creating a financial bottleneck for producers due to non-payments.

In order to overcome the crisis, the government has prioritised domestic hydrocarbon production while increasing natural gas imports.

According to the study, many sources of fossil fuel generation are no longer competitive and should be retired or their use significantly reduced. This includes domestic and imported coal, which is not economical over the next 10 years compared to VRE.

The WB suggests that Pakistan could alleviate many of its problems through a major expansion of VRE, to a share of at least 30 per cent of total capacity by 2030. It stated that at least 6700 MW of wind and 17 500 MW of solar PV should be added by 2030 to achieve the government targets in a least cost way.

This would help lower the cost of power, achieve greater energy security, and reduce greenhouse gas (GHG) emissions. In an optimal scenario, a major scale-up of VRE would save

Pakistan would realise the predicted \$5 billion savings, mainly through reduced fuel consumption.

This is a reduction of \$0.002 for every kWh consumed in Pakistan over the next 20 years, representing a 1-2 per cent reduction if total costs of \$0.10-\$0.15 per kWh are assumed.

Even allowing for the relatively short development and construction times associated with solar PV and wind projects, competitive bidding for new VRE capacity and associated investments in the transmission system should start immediately, if Pakistan hopes to reap the cost, energy security, and environmental benefits says the study.

"We understand that for achieving the renewable energy targets set through Alternative and Renewable Energy Policy 2019, we need to make sufficient investments in the transmission system, including modern automation and control systems and a reliable forecasting system," said Dr Khawaja Riffat Hassan, Managing Director, National Transmission and Despatch Company.

■ Work has now been completed on Pakistan's first high voltage direct current (HVDC) transmission project connecting Murtyari and Lahore. The 878 km line is the longest transmission line in the country and, at 660 kV, boasts the highest voltage level in Pakistan.



Australia goes even bigger on batteries

Australia is again turning to large battery storage with a project that will again demonstrate the ability of batteries to stabilise grids that are seeing a growing influx of variable renewable energy sources such as wind and solar.

Last month Neoen, the French renewable energy company and Tesla announced that they are partnering to build one of the world's largest lithium-ion batteries in the country. Neoen has secured the contract to provide system integrity services to the electricity grid and will deliver the 300 MW battery, which uses Tesla's megapack technology.

If built as planned, the battery will have a generating capacity of 300 MW and a storage capacity of 450 MWh – more than twice the size of the battery at Hornsdale, South Australia, which was the biggest in the world when it began operating in 2017. The Hornsdale installation initially had an output of 100 MW before it was upgraded to 150 MW last year.

The battery will be located near Moorabool Terminal Station and would be installed by the end of next year. It will be used to modernise and stabilise the energy grid in Victoria, as ageing coal fired power stations became less reliable and the state in-

creased its reliance on wind and solar power. The Andrews government aims to source 40 per cent of the state's electricity from renewable energy by 2025, and 50 per cent by 2030.

The battery will help overcome the intermittent nature of solar and wind power by providing reserve capacity to the grid when the sun is not shining or wind conditions are sub-optimal.

The market operator's Chief Executive, Audrey Zibelman, said Neoen's proposal was "a significantly more cost competitive and attractive market response than other recent major battery developments in Australia". A portion of the battery's capacity will be reserved to increase electricity supply over an interconnector cable between Victoria and New South Wales.

"By securing one of the biggest batteries in the world, Victoria is taking a decisive step away from coal fired power and embracing new technologies that will unlock more renewable energy than ever before," said Lily D'Ambrosio, Victoria's Environment Minister.

She said consumers would pay for the use of the battery through their power bills, but suggested it would lead to a reduction in wholesale energy prices so that Victorians were

charged less for electricity.

Independent analysis found that Victorians would receive \$2 in benefits for every \$1 invested in the battery, she said. Energy consultancy Aurecon found the Hornsdale Power Reserve saved consumers \$116 million in 2019.

The news highlights a global trend in large-scale lithium-ion batteries that are being built or planned around the world, as utilities install more renewable generation infrastructure to cut greenhouse gas emissions.

In May, Vistra Corp announced plans to add an extra 400 MWh battery to complement a 1200 MWh battery under construction in California, USA. Florida Power & Light plans to build a 409 MW battery and solar plant in the state by 2021.

■ The 500 MW Wambo Wind Farm project has secured planning approval from the Queensland state government. The project, located in southwest Queensland, 20 km northeast of Jandowae, will comprise up to 110 wind turbines and a 50 MW/200MWh battery storage and associated infrastructure. The project is being jointly developed by Cubico Sustainable Investments (Cubico) and Renewable Energy Partners.

Europe News



Urgent need for system flexibility prompts response from industry

■ Storage and flexibility a focus for new developments ■ Intelligent control opens door to aggregation

Janet Wood

Government auctions must begin to incentivise flexible power and promote storage, according to new research from Wood Mackenzie, which warned that Europe's growing investment in non-dispatchable renewables required more investment in storage alongside to provide flexibility.

The company pointed to recent experience of negative prices in GB and Italy as evidence of the need. "Energy storage will be at the forefront of meeting this challenge, as the technology can provide much needed flexibility with zero carbon emissions, while keeping power prices more stable and affordable for the end consumer," said

Rory McCarthy, Wood Mackenzie Principal Analyst.

Wood Mackenzie says that policy-makers are underestimating the flexibility challenge ahead and warns that Europe's diverse market-based system is less likely to bring forward consistent storage investment than integrated utilities like those in China.

However some countries have now begun to tackle structural barriers to storage. UK energy regulator Ofgem recently redefined storage in its operating rules so it does not incur 'double costs' to use the system on charge and discharge cycles and required licensees to provide accurate information on their electricity storage.

Energy law expert Ronan Lambe of

Pinsent Masons said: "Investors are likely to welcome the clear definition of 'electricity storage' provided by Ofgem and re-iteration of its previous 'future-proofing' policy of including a non-exhaustive list of technologies which should be considered as electricity storage."

Meanwhile enterprises have responded to the need for flexibility with a variety of recent initiatives launched that take advantage of storage in different market niches. Among them:

■ Engie and Kiwi Power have joined forces in the Netherlands to aggregate mobile battery boxes of 600 kW/660 kWh to offer up to 3 MW of primary frequency response to system operator TenneT. The mobile storage is used

for short term demand like construction sites or events and offered to the local FCR market between times.

■ 'Intelligent energy' platform Kaluza and Bosch, supplier of charging services and embedded vehicle technology, recently demonstrated EVs being smart charged to meet the needs of the local grid via direct connection with a digital platform. With their combined digital architecture, an electric vehicle was remotely controlled to charge at times when it was cheapest and greenest. Kaluza meanwhile has drawn on predictions of 2 million smart heating systems and 11 million EV chargers in UK homes by 2030 to forecast that intelligent technology could provide as much as

25 TWh of flexible charging capacity annually.

■ Low voltage network operator UK Power Networks is seeking 250 MW of flexible capacity at more than 130 sites in a new tender totalling £50 million (\$65 million). For the first time it included extra-high voltage sites.

■ At the European Marine Energy Centre in Orkney, Scotland Invinity Energy Systems 1.8 MWh flow battery will be used with tidal turbines to produce continuous green hydrogen. The vanadium flow batteries are a form of heavy duty, stationary energy storage, which are deployed in high-utilisation, industrial applications. The project is expected to go live next year.

Wave and tidal projects get ready to expand

New initiatives on so-called 'ocean energy' – mostly wave and tidal projects – are now hoping to follow the offshore wind industry into a huge step up to large-scale operation.

A new project funded by the European Maritime and Fisheries Fund aims to ensure market readiness of the WaveRoller technology, and develop

a scalable business and service model to support future wave farms of up to 200 GW. The three-year project will see Finland's AW-Energy develop processes to deliver the world's first large-scale wave farm, with up to 24 WaveRoller units.

The EU-funded Ocean DEMO project has also made recommendations

to support 12 offshore renewable energy developers on their path to commercialisation. The project will accelerate ocean energy's transition from single prototype to multi-device farms by providing free access to European test centres.

Lisa Fitzpatrick, Ocean DEMO Project Leader, said: "The level of interest

we've seen for Ocean DEMO's third call is extremely encouraging."

Meanwhile the UK's Offshore Renewable Energy (ORE) Catapult is urging offshore wind farms to sign up to a data collection platform that aims to reduce subsea cable failures, which are the single biggest insurance cost for the industry. It can take an average

of two months to repair a failed power cable, costing more than £10 million (\$13 million) in costs and lost power generation.

'Electrode' will track trends in cable failure and service downtime, as well as the effectiveness of current methods of monitoring, detection and response.

Wind and solar retain investor interest despite financial rethink

■ New auction rules in Spain
■ France cuts back on returns

Investor interest in wind and solar has remained steady despite recent and planned changes in its financial framework in several European countries.

Some changes have been wholly positive. The UK recently decided to reopen its 'contract for difference' support scheme to onshore wind, a move that could see it grow its installed onshore wind capacity to 30 GW by the end of 2029 from the current 13.6 GW, according to RenewableUK.

The UK has also recently seen its largest commercial rooftop solar array, Custom Solar UK's 6.5 MW installation at the Port of Hull.

In Spain, meanwhile, new renewable auction rules are due to be used for the first time this year that will have a "pay as bid" model, replacing the 2013

model that awarded a return on investment on top of market revenue. The new framework will allow hybridisation of technologies, expansion or modification of existing plants and energy storage installation. The auction will offer contracts for up to 3.1 GW of new renewables capacity.

Bidders may include Copenhagen Infrastructure Partners, which has reached an agreement with Forestalia to develop a portfolio of 27 wind farms totalling 1 GW in Teruel province.

The most contentious change was in France, which recently confirmed plans to revise its feed-in tariffs, including retrospective cuts on PV projects installed between 2006 and 2010. Opponents argued that the change would damage investor confidence.

Nevertheless other PV projects remain popular, and recently minerals company Lhoist joined with renewables company Total Quadran, to co-develop more than 83 MW of PV at 11 Lhoist sites in France.

At four Lhoist sites the power will be directly used on-site. This is now often seen as the most financially beneficial way of using local power generation and it is also a factor at the largest new PV plant in Northern Europe. This will be a 300 MW site to be developed by European Energy in the municipality of Aabenraa, Denmark. Its customers will include local data centres.

Elsewhere in southern Europe EDP Renovveis has joined forces with El-laktor to develop up to 900 MW of onshore wind.

Vendors circle UK's growing nuclear gap

An announcement from EDF that it will close its Hinkley Point B nuclear power plant in 2021 has added urgency to discussions over how the UK will replace its nuclear fleet and revived interest in new-build that had seemed stalled after recent reverses.

Potential new-build was hit when Toshiba abandoned plans to build Westinghouse's AP1000 reactor in Cumbria and most recently when Hitachi announced it would abandon plans for an ABWR in Wylfa, Wales. But recent reports suggest that a US consortium could see the AP1000, which has been licensed by UK regulators, built at the Wylfa site – widely seen as among the best sites for new-build. The project is said to have US support.

Dan Brouillette, US Energy Secretary, was quoted as saying that his government was very interested in "the potential in the UK and the Horizon project". A deal would depend on the UK government introducing a new funding model for large nuclear projects.

Wylfa is also among the sites being eyed by Rolls-Royce to host the company's Small Modular Reactor (SMR). The 440 MW design has sparked interest from utilities as far apart as CEZ in the Czech Republic, which recently signed a Memorandum of Understanding with Rolls-Royce, and the USA. The SMR consortium received £18 million in government funding for the design and argues that it should build 16 reactors to gain series-built experience and cut costs. But the proposal has run into resistance from the UK's anti-nuclear lobby. Prof Andrew Stirling, Professor of Science & Technology Policy at Science Policy Research Unit warned that, "the kinds of SMRs currently envisaged by Rolls-Royce, are not only commercially untested, but not yet even built as pilots".

EU climate chief Frans Timmermans was also lukewarm on the technology. As he confirmed recently that the EU regarded nuclear energy as low carbon, he warned, about the life-cycle costs, "which means that you will be stuck with it for a long, long, long time".

Latvia steps towards grid synchronisation with neighbours

Although a newly commissioned transmission line running between two power plants in the country's capital, Riga, is just 12 km long, it represents a key step in synchronising the Baltic electricity networks with the rest of Europe.

The transmission line links Riga's thermal power plant (CHP-2) to its hydro power plant and the Salaspils substation. It will increase the security of electricity supply and transit capacity of the Latvian transmission network.

Varis Boks, Chairman of the Board of Latvian system operator Augstsprieguma Tikls (AST), said electricity transmission lines like this one, which was part-funded by the EU's Connecting Europe Facility, will improve electricity transmission capacity in Latvia,

and will allow the company to make full use of the linked electricity markets and supply cheaper electricity to Latvian consumers from neighbouring countries.

"It will reinforce the internal 330 kV transmission network and ensure a

stable and reliable operation of the Estonia-Latvia third interconnection, one of the key cross-border infrastructure projects in the region," explained Dirk Becker, Director of the Innovation and Networks Executive Agency (INEA).



Race for hydrogen gathers pace

- Hydrogen production set to double within ten years
- Technology and policy both needed to make progress

The world is shifting towards a hydrogen-based economy due to concerns over increasing carbon emissions, energy security and climate change, according to a report by Frost & Sullivan.

Global hydrogen production is forecast to more than double, reaching 168 million tonnes by 2030 from 71 million tonnes in 2020, with revenue expected to reach \$420 billion in 2030, the 'Growth Opportunities in the Hydrogen Market for the Global Power Sector' report finds.

"For the hydrogen economy to become a reality, decisive government actions are required in four key areas," said Frost & Sullivan's analyst Swagath Navin Manohar.

Support for R&D activities, incentives for infrastructure development, a clear roadmap and decarbonisation policies are the four elements that will enable hydrogen to become an important tool in catalysing the transition towards sustainable energy economy, he said.

The report names a number of countries including China, Japan, the US and Europe's larger nations as likely leading players in the hydrogen economy. But other countries are keen to get involved, too.

Speaking at the G20 Riyadh Summit

in late November, Saudi Aramco's Chief Technology Officer, Ahmad Al-Khowaiter, said that energy needed to become more sustainable.

"The question is not if we reduce our emissions, but how," he said, making the case for hydrogen to be used to make conventional hydrocarbon fuels sustainable.

"It could allow us to recycle CO₂ through synthetic fuels, and crucially, if we combine it with carbon capture, we can remove the CO₂ associated with the hydrogen production process," he said.

Aramco has recently completed a low CO₂ ammonia supply chain demonstration. Natural gas was converted to hydrogen, then to ammonia with the resulting CO₂ being captured and sequestered in Aramco's enhanced oil recovery project.

The blue ammonia "was shipped from Saudi Arabia to our partners in Japan, where it is now being used in zero-carbon power generation. This is just one example of what is possible under a circular carbon economy approach," Al-Khowaiter explained.

Meanwhile, Russia and Japan are considering cooperating on hydrogen, according to an interview in Japan's *Nikkei* with Russian Deputy Energy Minister Pavel Sorokin.

He said that Russia was committed to producing two million tonnes of hydrogen from natural gas – of which Russia has vast reserves – under its energy strategy to 2035. If this proves to be a commercial success, "potential production and exports will be significantly greater".

State companies Gazprom, Rosatom and Rostec, alongside the Academy of Sciences and other organisations, are working on developing technologies and doing market research for hydrogen production and exports, Sorokin said.

Russia has plans "to sign a document on cooperation at the government level... [and] with two or three Japanese companies," he added.

In the shorter term, Russia's hydrogen energy development plan to 2024, which was signed off in October, provides for the development of a regulatory framework, state support for scientific research and projects to create production facilities.

The government has plans to run trials for low-carbon production of hydrogen in the oil and gas industry and at nuclear power plants, developing gas turbines that run on a mixture of methane and hydrogen, and using hydrogen in motor vehicles and railway transport.

Belarus nuclear plant alarms Baltic neighbours

Lithuania and Latvia have raised safety and national security concerns over the newly inaugurated Astravyets nuclear power plant in neighbouring Belarus, according to local press reports.

Within minutes of the facility being connected to the grid, Lithuania's transmission system operator Litgrid said it had ceased all power trading with Belarus.

Latvia also said it had blocked imports of energy generated at the plant and vowed not to purchase Russian electricity if Moscow was unable to prove imports did not originate from the Belarusian plant.

The Astravyets project has proved divisive within the country, which suffered severe damage from the 1986 Chernobyl nuclear disaster.

Within days of the plant's official inauguration, news of an incident emerged. The Belarusian energy ministry confirmed "the need to replace individual electrical engineering measuring equipment" at the facility, but did not indicate the reasons for this step, nor whether power generation had to be discontinued.

The facility is located some 50 km from the Lithuanian capital, Vilnius. It was built by the Russian state firm Rosatom and financed by Moscow with a \$10 billion loan.

Power generation at the Astravyets plant started in October, with the capacity quickly ramped up from 250 MW to 400 MW. The pilot operation stage is expected to start in December, with commercial operation scheduled for the first quarter of 2021.

The Rosatom-designed and built Gen III+ power unit, equipped with a VVER-1200 reactor, marks Belarus' entry into nuclear energy and the first Gen III+ nuclear power plant using Russian technologies outside of Russia. Rosatom has ambitions to export this technology to other countries.

Lithuanian President Gitanas Nausėda said that joint effort was needed to prevent power from unsafe third-country nuclear power plants entering the EU market.

The Lithuanian, Latvian and Estonian power systems will be physically disconnected from Belarus and Russia in 2025 when their power grids are synchronised with western Europe.



Nuclear concerns: the Astravyets project has proved divisive

Rich countries urged to support global clean energy drive



In need of support: Poorer countries facing desperate challenges may be forced to use cheap coal to aid their recovery

Poorer countries will fail to move away from fossil fuels unless the world's leading economies support them, a report by Christian Aid has found.

Despite rhetoric about the importance of a green recovery, more than \$500 billion worldwide is being given to carbon-intensive businesses, according to the Whose Green Recovery report.

The danger is that, left without support, poorer nations facing desperate challenges may be forced to use cheap coal to aid their recovery. This could thwart the climate gains made in rich-

er countries and destabilise the Paris Agreement ahead of the crucial COP26 summit in Glasgow next year, the report warns.

Christian Aid calls for a truly global green recovery featuring debt cancellation, fossil fuel subsidy removal and greater investment in renewable energy.

The report recommends that donor countries allocate at least 50 per cent of their climate finance support in poorer countries to adaptation and commit to a new global adaptation finance goal.

Middle East embraces lower-carbon vision

Greener energy goals sweep the region's fossil fuel hotbeds as they pledge to transition to renewable energy generation.

Nadia Weekes reports

Middle East countries have produced a flurry of national plans to lower carbon emissions and improve their countries' energy systems.

Under its Vision 2030 plan, Saudi Arabia aims to reduce the energy sector's carbon footprint by moving away from the use of liquid fuels towards renewable energy and natural gas. It also wants to increase the electricity network's security and reliability through better interconnection with neighbouring countries.

In order to attract investment, the kingdom will establish a revenue requirement mechanism for service providers and a tariff balancing system to compensate for the difference between cost of supply and tariff income.

In the United Arab Emirates (UAE), Prime Minister Sheikh Mohammed bin Rashid Al Maktoum has set a goal for the country to increase its renewable energy share to 75 per cent by 2050.

An estimated AED600 billion (\$163 billion) will be spent under the UAE Energy Strategy 2050 to meet growing

energy demand while achieving sustainability goals.

A green hydrogen project in cooperation with Siemens and Saudi Arabia is under way to produce hydrogen gas using solar power at the MBR Solar Park.

The UAE is also supporting the construction and operation of new solar farms in Sudan, under a memorandum of understanding between the two governments.

Israel has launched a national plan for energy efficiency and dealing with the climate crisis for the decade to 2030.

It pledges to reduce energy consumption and greenhouse gas emissions by promoting the transition to renewable energy production and the use of electrical technologies to replace fossil fuels.

The plan is estimated to result in a reduction of 7.5 per cent (6 million tonnes) of greenhouse gas emissions per year.

Electricity generation from renewable energy is expected to reach 30 per cent by 2030, from the current 17 per

cent. This will be funded through a 2-3 per cent increase in power tariffs, but should eventually lead to a reduction in electricity costs.

In Iran, the government has announced it will add more than 220 MW of renewable power – through a combination of solar, wind and hydroelectric – by March 2021.

Natural gas accounts for 90 per cent of the country's energy generation, but Iran is aiming to add 5 GW of renewable energy capacity over the next five years, with small-scale solar photovoltaic plants at the heart of the growth strategy.

Elsewhere in the region, Siemens Energy has signed a multi-phase agreement with Afghanistan to establish the country as an energy hub in central Asia by developing a modern and sustainable power system that incorporates the massive potential of renewable energy generation.

Currently, Afghanistan relies heavily on neighbouring countries for its electricity, and less than a third of its 37 million people have access to it.

A cool approach to energy storage

Liquid air energy storage has all the benefits of large scale, long duration storage technologies but can be sited anywhere. And when used to provide ancillary services it offers a compelling economic case when compared to batteries. **Junior Isles**

The inexorable growth of wind and solar in the power generation mix is presenting challenges to electricity system operators around the world. Although crucial to reducing global carbon emissions, their variable nature calls for the integration of other technologies into the system that can rapidly compensate for the sudden loss of power in the grid that can occur when there is no wind or sun.

Such technologies include fast-start gas turbines peaking units, reciprocating engines and flexible gas fired combined cycle plants. These, fossil fuelled plants, however, only add to the climate change challenge.

Energy storage, and in particular battery storage, has therefore been increasingly attracting the attention of grid operators and power providers. Batteries, however, do not provide large scale, long duration storage – and the long duration commercial storage technologies that do exist, such as pumped hydropower and

compressed air energy storage (CAES) are limited by geography.

A more recent development offers another alternative. Liquid air energy storage (LAES), a cryogenic energy storage technology developed by Highview Power (HVP), is now seeing the first large scale commercial installations.

Crucial to the commercial rollout, was a deal signed in February between HVP and Sumitomo Heavy Industries Ltd (SHI) to build projects globally. As part of this partnership, SHI has invested \$46 million in HPV, signifying SHI's move into the clean energy storage market. SHI's fully-owned daughter company Sumitomo SHI FW (SFW) will become SHI's technology centre and hub for the CRYO-Battery business, thereby expanding the technology's geographical footprint in Europe, Asia, and Americas.

Commenting on the move into an area for a company that has historically focused on circulating fluidised

bed (CFB) boilers, Robert Giglio, Senior Vice President of Strategic Business Development, SFW, said: "We wanted to do more to help the world decarbonise and become more sustainable and saw energy storage as a key to sustaining the growth of renewables, both on and off the grid."

"We spent a lot of time looking at energy storage technologies and saw markets moving strongly in the battery direction. We felt that batteries still have a long way to go to serve the broad growing range of energy storage markets around the world. For shifting a lot of energy over long periods, battery cost and size need to come down much further than forecasted. But even still, a number of other shortcomings need to be solved like their relative short life, capacity decay related with cycling, overheating problems and most importantly what to do with gigatons of spent batteries."

"As we add more and more [variable]

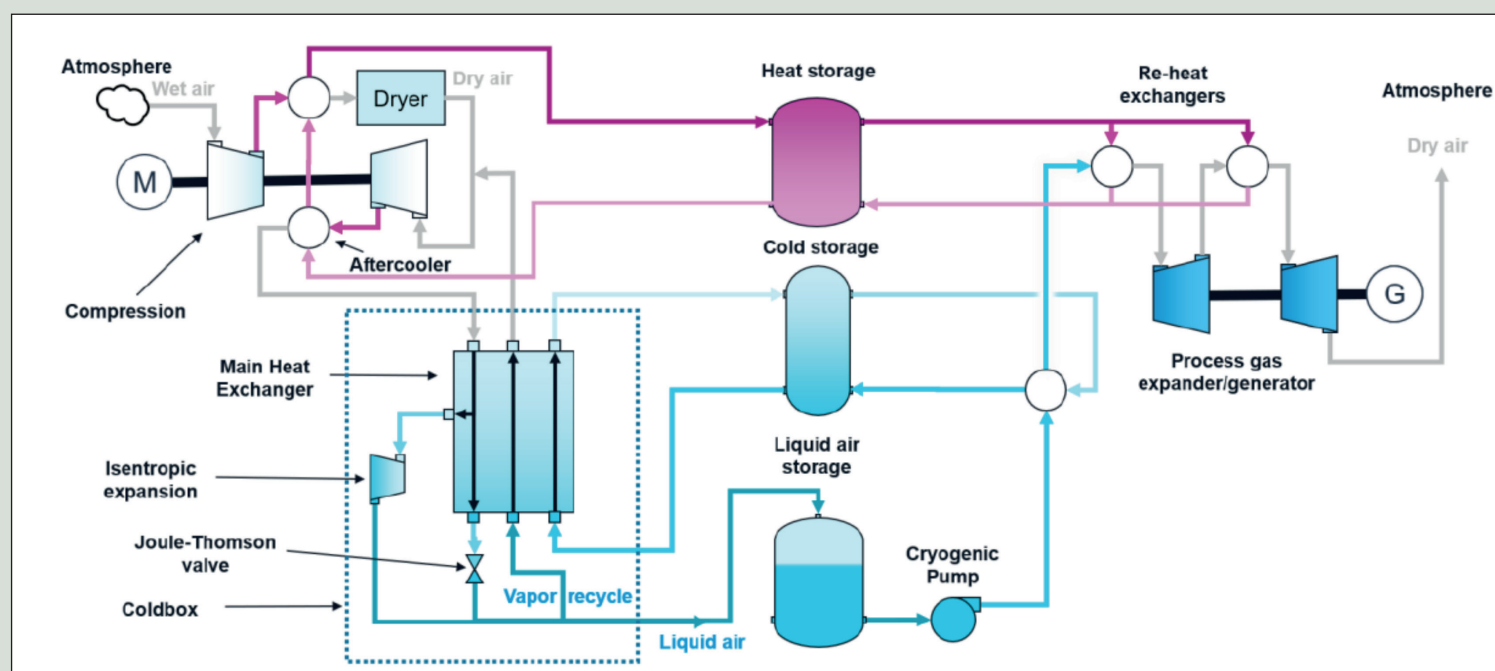
renewables to the grid, the need for longer duration energy storage will grow, and batteries get very costly and large when you try to make them deliver power for, say, 10 hours. And even with the cost of batteries coming down, we don't think it's enough to replace pumped hydro, which is the dominant energy storage technology in terms of global capacity... but like compressed air energy storage, it is site limited. You can't put these large scale plants where you need them on the grid."

"When we first looked at HVP's liquid air technology called CRYO-Battery, we realised there was nothing that comes close to it. And one of the most attractive features for us, is it has the lowest cradle-to-grave environmental impact."

The origins of HVP's CRYO-Battery technology, date back as far as 2001. That was the year British inventor Peter Dearman developed and patented the Dearman Engine. Although there have been numerous attempts over the last century to exploit liquid air, Dearman's breakthrough came with the realisation that liquid air could be vaporised inside an engine cylinder using heat supplied by a thermal fluid mixture such as water and glycol, eliminating the need for the bulky and inefficient external heat exchangers of traditional cryogenic engines.

It was not until 2006, however, that the possibilities for Dearman's technology in the power sector began to take shape when HPV began to develop its cryogenic technology. Working with the University of Leeds, HPV developed a series of efficiency enhancements to the liquid air cycle by integrating the production and expansion processes to make use of waste heat and cold, so making the concept of a grid scale energy storage system economically viable.

But it was a concept that was perhaps ahead of its time. Fifteen years ago, with very little penetration of wind and solar, there was no real demand for this kind of storage. This has now changed. As more variable renewables come on line, the ability to



Liquid air energy storage process detail

Special Technology Supplement

store electricity is becoming increasingly important. Further, with the loss of baseload thermal generation, technologies that can provide grid stabilisation are an important tool in the grid operator's toolkit.

Liquid air is like pumped hydro – it offers long duration storage as well as large megawatts but most importantly can be located anywhere. It is for this reason that some call it “pumped hydro in a box”. And like pumped hydro, running costs are very low. Further, with the ability to ease congestion and help stabilise the grid, it is the kind of infrastructure asset that can provide owners with multiple revenues streams.

Like a battery plant, each CRYO-Battery block consists of a ‘charging station’, ‘storage’ and a ‘discharging station’. But crucially each section can be sized independently.

Charging is provided by a liquefaction system, which uses off-peak or excess electricity from the grid to produce liquid air. This predominantly comprises heat exchangers, expanders and compressors to clean, dry and chill air from the atmosphere to its liquid state, shrinking its volume by a factor of 700. The liquid air is stored in insulated tanks at low pressure, essentially acting as battery cells capable of storing energy for hours, days or until the energy is required. When power is needed the liquid air is pumped to high pressure, evaporated through heat exchangers and then expanded through a turbine to drive a generator.

The turbine is not the traditional industrial or aeroderivative gas turbine that is commonly used in the power industry. It is a process gas expander-type turbine that has no combustor or compressor, and exhausts clean dry air. These simple machines, which run on low temperature clean gases (below 200°C), are widely used in the chemical process industry for capturing energy from compressed gas streams.

Notably, HPV has managed to more than double the efficiency of the overall efficiency of the plant from 25 per cent to above 55 per cent by adding a thermal store and a proprietary cold store. Here, waste cold from reheating the air before entering the turbine is captured by the cold store so it can be later recycled to enhance liquefaction efficiency. Similarly, heat generated from compression during recharge is captured by the thermal store.

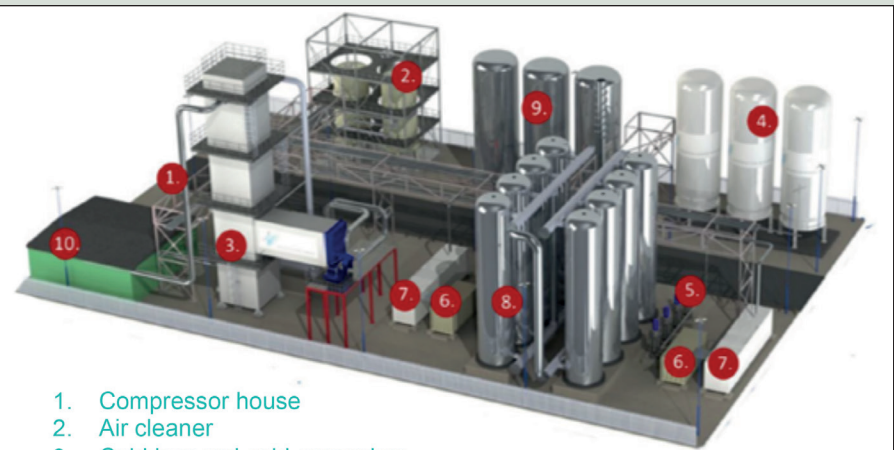
The design is flexible enough to integrate nearby external waste heat and cold energy sources, such as from a gas turbine peaker plant's hot exhaust gas, LNG regasification waste cold, or hot gas from a steel furnace, to boost the efficiency of the LAES plant to as high as 80 per cent.

Such a plant can have a number of applications. While there is no silver bullet in terms of energy storage solutions – they are all needed to even-out power, reduce grid congestion, provide synchronous inertia for stability, control voltage and frequency to support the expansion of wind and solar – LAES ticks all of the boxes.

Generally, the optimum spots for energy storage plants will depend on grid design and the distribution of generating plants and loads unique to each grid. The technology selected depends on which offers the best economic and functional capability according to the services, range of capacity and energy discharge duration needed.

Flywheel and super-capacitor technologies are best suited for small scale (up to 1 MW storage applications requiring instantaneous response. However, size, cost and safety issues grow along with the scale, making them unsuitable for larger

- Indicative footprints for 6h systems:
 - 20 MW: 0.5 acres
 - 200 MW: 4 acres
- Layout can be configured to the available space and shape of the plot
- Equipment can be selected according to height requirements (vertical/horizontal tanks)



1. Compressor house
2. Air cleaner
3. Cold box and cold expanders
4. Liquid air storage
5. Cryo pumps
6. Containerized power turbine and generator (2 x 10 MW)
7. Heat exchanger containers
8. High grade cold stores
9. Hot water storage
10. Electrical intake and switch-house

scale applications.

Li-ion battery technologies have become the default choice for energy storage plants in the small to medium size range (up to 100 MW, under 4 hours of duration) driven mainly by their high siting flexibility and growing supply chain from the electric vehicle (EV) sector. Beyond this scale, however, their cost and size become uncompetitive compared to the larger scale options (pumped hydro, compressed and liquid air).

Also, at any scale, the main drawback of battery technologies is that they continuously lose capacity each time they charge and discharge. This imposes a significant limitation on the revenues that a Li-ion battery can realise in energy peak shifting and energy arbitrage markets. At the same time, it drives up plant life cycle cost since the battery modules need to be replaced every 8-12 years, and oversized to account for their continuous capacity decay. The need to dispose or recycle spent battery modules is potentially the ultimate limiting factor for the growth of batteries. Giglio says this is a major concern.

“Every 10 years or so, you have to replace the modules, which is 90 per cent of the plant itself. And then what do you do with them? You can hope that we find a practical and economic way for them to be recycled but you can't predict how a market is going to handle a waste stream like that. That could be our next environmental catastrophe and it's a big concern for us.”

For the largest scale, i.e. gigawatts of power capacity over 8 hours, pumped hydro has been the dominant choice. In fact, pumped hydro represents 93 per cent of all energy storage plants operating in the world today on a megawatt capacity basis and 99 per cent on a megawatt-hour capacity basis. At this scale, response time is not as important (5 min or longer), since the common application for these large plants is shifting energy from a few hours to days, providing capacity and operating reserve margin to the grid. Their biggest drawback, however, is they must be built where there are large natural bodies of water. The construction of the prerequisite dams also has an impact on the local population and wildlife.

CAES is the other gigawatt scale technology but like pumped hydro, is limited by geography. CAES plants need to be located above large, underground salt and limestone caverns, aquifers or depleted oil and gas reservoirs.

LAES has none of the drawbacks of batteries, pumped hydro, CAES or

flywheels. It has the gigawatt scalability of pumped hydro with the advantage of being flexibly located across the grid with its only site requirement being a grid connection. With normal maintenance, a LAES plant maintains its original energy storage capacity and round-trip efficiency over a long 30-year plant life without the need to replace major plant components. At the end of its life, recycling of LAES plant components and restoring or repurposing the site does not pose any significant long lasting environmental or site cost liabilities.

In addition to its large, long-term storage capability, the CRYOBattery can also provide grid balancing, and ancillary services such as inertia, black-start, frequency response and voltage support. While not in the seconds range of Li-ion batteries, power can be delivered to the grid in under 5 minutes. In synchronised mode (generator spinning at grid frequency), a LAES plant can deliver power in less than a minute from the time of receiving the signal to providing energy to the grid.

Another key benefit is the CRYO-Battery can also provide synchronous inertia to the grid, like rotating turbines at thermal or nuclear power plants. Inertia stabilises grid frequency and voltage during inevitable disruptions to the grid – something that has been disappearing as coal and gas thermal plants are displaced by solar and wind.

The CRYOBattery is an extremely flexible asset. Unlike other batteries, which can only be charged and then discharged, it can charge and discharge at the same time. This means it can provide both storage and system services at the same time, in the same second or it can be shifted in time. System services can be provided without storage, or storage without system services, or both can be done at different power outputs. Synchronous inertia can even be provided to the grid without providing any real or reactive power.

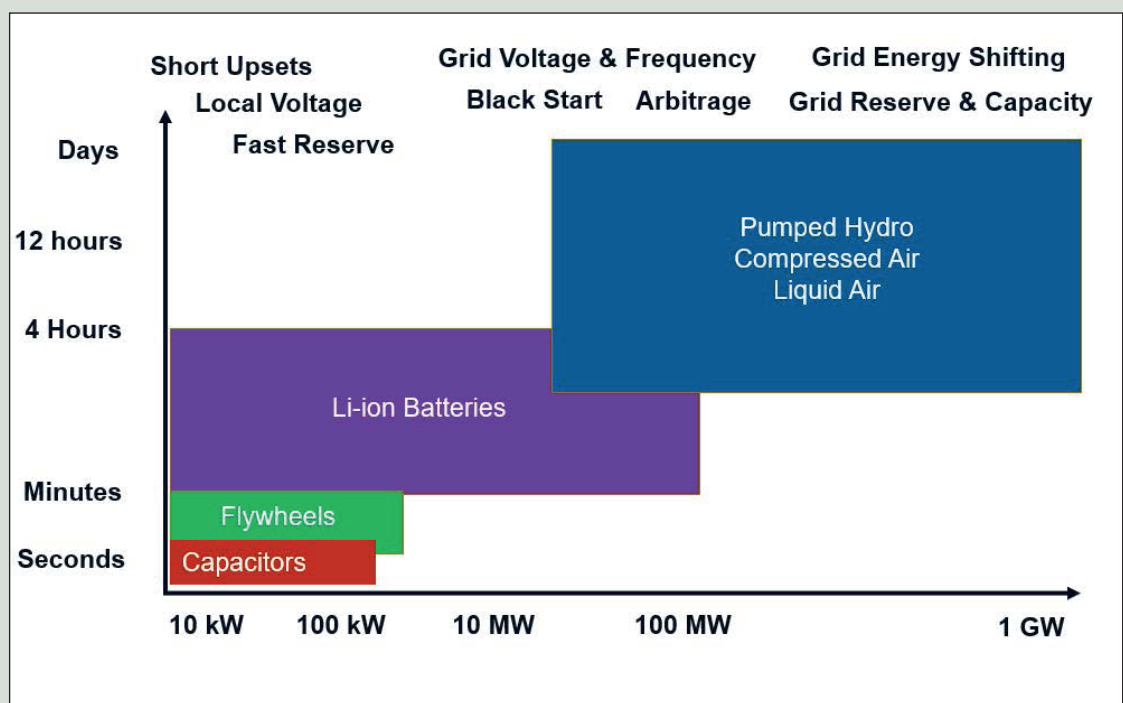
Further, for the same storage capacity, a LAES plant can be built on a site 5-10 times smaller than that needed for a Li-ion energy storage plant and can achieve a much lower levelised cost of storage (LCOS), due to its full discharge flexibility, long plant life and low O&M cost. SFW conducted a LCOS comparison between a LAES and Li-ion energy storage at a 400 MWh (50 MW x 8 hour) capacity.

The results from the analysis reveal that the need to oversize the battery modules to offset their capacity degradation (4-8 per cent/year), significantly drives up the cost of the Li-ion plant.

More importantly, the analysis showed that the cost of replacing the battery modules every 8-12 years (depending on the number of charge/discharge cycles) was the overwhelming factor driving up the LCOS of the Li-ion plant in the form of major plant maintenance cost.

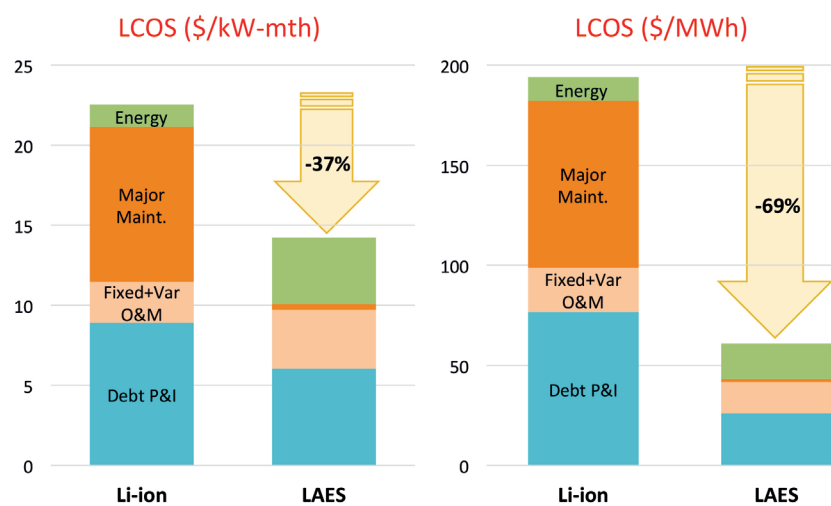
Liquid air plant layout and footprint

Scale and fit for energy storage technologies



Special Technology Supplement

- On a monthly basis, liquid air plant has 37% lower LCOS than Li-ion
 - Avoids expensive 10-year battery replacement and disposal/recycling cost
 - Avoids expensive cost of oversizing battery capacity to offset annual degradation
- On an energy basis, liquid air plant savings grows to 69%
 - Li-ion plant is unable to fully discharge its energy each day due to 50% depth of discharge (DOD) limit



Case study of a 50 MW x 8 hour energy storage plant showing levelised cost of storage for liquid air versus Li-ion.

Note: Plants allowed to fully discharge each day and capture \$50/MWh energy price differential

Together, these two factors result in a 37 per cent higher LCOS for the Li-ion plant as compared to the LAES plant on a monthly fixed cost basis (\$/month per kilowatt of plant capacity).

On a discharge energy basis (\$/MWh of energy discharged by the plant), the LCOS of the Li-ion plant grew to a much larger 69 per cent above that of the LAES plant. This is because the Li-ion plant could not

higher plant round trip (charge-store-discharge) efficiency (RTE) of the Li-ion plant (85 per cent vs. 55 per cent for LAES) coupled with the future decline in Li-ion battery cost (both accounted for in the analysis) are not great enough to offset short life and cycling limitations of the Li-ion battery.

SFW's analysis notes that RTE has a strong financial impact when charging (buying) and discharging (selling)

the empty missing money bar in the chart).

Whereas, the LAES plant can achieve the 12 per cent investor return due to its much lower revenue need and ability to fully discharge its energy each day. These factors have a much greater impact to project economics than does RTE.

The energy revenue component is simply not large enough for the RTE to change this outcome. This is due to the limited peak-off-peak energy price range and duration available in all markets today. Li-ion plants are further disadvantaged by their charge/discharge cycling limitation, preventing them from fully capturing the available arbitrage in energy prices, no matter its range.

The strong economic case for LAES is now being recognised by power plant owners. On November 6th, Carlton Power broke ground at its 50 MW storage facility (with a minimum of 250 MWh) at the Trafford Energy Park, Carrington, just outside of Manchester, United Kingdom. It will be one of Europe's largest energy storage complex and marks the first commercial installation of the CRYOBattery.

Carlton Power has been permitted to build a gas fired combined cycle plant at Trafford, which would operate according to demands from National Grid. However, the impact of increasing wind on the grid could make its operating regime increasingly expensive for National Grid. The storage project would help control these costs.

When National Grid calls on a gas fired plant to provide grid support

services, it is forced to curtail wind power. So it ends up paying twice – for the wind it does not use and for the gas plant needed to balance the grid. Bringing in storage will help Carlton Power to maximise the value of its existing assets and provide National Grid with ancillary services such as reactive power and voltage support.

HPV says the facility will provide five and potentially six hours of storage (250-300 MWh) but notes that it can be expanded, with very little extra investment, just by adding more storage tanks. The 50 MW/250 MWh block at the Carrington facility represents a total investment of about £85 million.

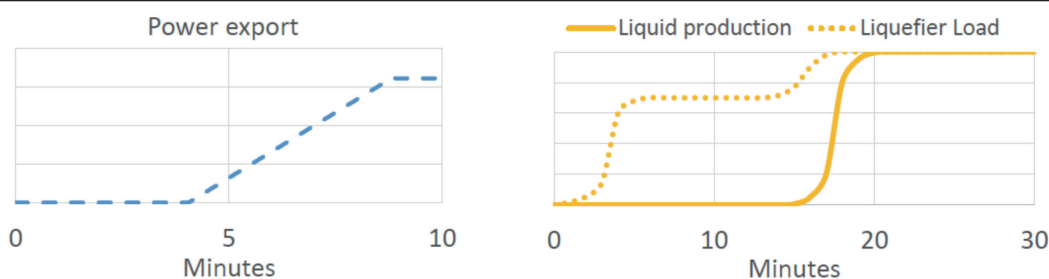
Part of this will come from the SHI cash injection. Giglio said: "The money is being used to help develop the Carrington project as well as other projects in the US and in Scotland. We are helping HPV get these first projects off the ground by contributing this financial support as well as directly supporting the projects with design and engineering services."

Looking forward, SFW plans to pursue projects independently under a licencing agreement it has with HPV, taking an EPC role.

Giglio is excited by the prospects. He says the company will be chasing projects that "have scale". He said: "These will be projects that go beyond the 0-4 hours duration window. Here batteries have the best economics and functionality but outside that window, you need something else. We believe that the long duration energy storage market will open up over time and that market will be anywhere between 50 MW and 500 MW plant size, but for the near-term it will probably stay around the 50-150 MW pure power capacity and the 8-10 hour range."

"The market currently doesn't offer much value for energy shifting. But at some point, once renewables get to high levels – 50, 60, 70 per cent penetration – the market will have to value energy shifting services. And you will be paid handsomely for shifting solar power from the middle of the day to the evening."

Giglio concluded: "Many studies and surveys show the energy storage market having a growth factor of 10x with steep curves of announced projects over the next five years. Our goal is to offer the market an alternative to Li-ion, pumped hydro or compressed air energy storage solutions. It's up to us to find the best fit for liquid air energy storage and bring its full value to the market."



Mode of Operation	Time to export	Ramp rate
Standard	< 5 minutes	20% P _n / min
Spingen	< 30 seconds	5% P _n / sec

Mode of Operation	Time to load	Ramp rate	Time to liquid production
Standard	< 5 minutes	20% P _n / min	10 - 20 minutes from cold

Power response performance. A LAES plant is capable of dispatch faster than a classic peaking unit

fully discharge its capacity daily, falling short of capturing the maximum revenue available from the fixed 50 \$/MWh energy arbitrage assumed in the analysis. The Li-ion plant's daily charge/discharge cycles were limited to a 50 per cent depth of charge (200 MWh of total 400 MWh capacity) to maintain a reasonable battery module replacement frequency of 10 years based on National Renewable Energy Laboratory's System Advisor Modelling.

If the Li-ion plant was fully discharged each day to capture the full energy arbitrage revenue, the increase in battery module replacement cost would have resulted in a higher LCOS for the plant. In contrast, the LAES plant was fully discharged daily and captured the full energy arbitrage without a significant impact on plant maintenance cost or life.

One important note about this analysis is that the cost to dispose or recycle the spent Li-ion battery modules was not included as part of the battery replacement cost. So, the LCOS for the Li-ion plant could be significantly higher than shown in the analysis. Battery recycling and disposal costs are not known today since the cost for landfilling or recycling large Li-ion batteries is in a very early stage.

This comparison also shows that over a 30-year period, the much

energy to the grid but is seldom a significant factor in ES project viability.

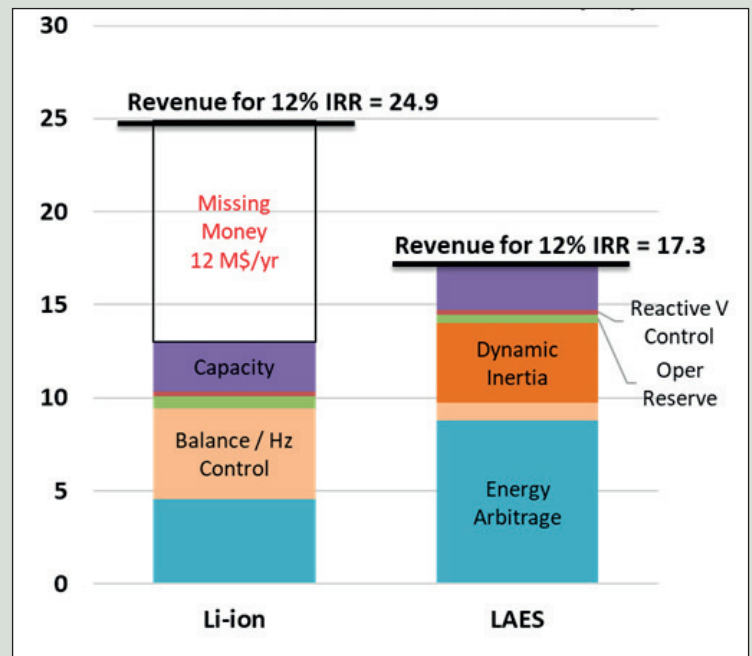
Giglio commented: "LAES is not the most efficient process but when we started studying the economics, we saw that efficiency plays a very minor role in the economic success of a project because most of these plants, at least for the next 10 years, will be used for ancillary services such as providing synchronous inertia, voltage control and frequency control, where efficiency is not really a factor."

Today, in all markets, the revenue that an energy storage plant can realise from energy price arbitrage (high-low energy price range) falls well short of that needed to support the capital investment and operating cost of an energy storage plant. To be economically feasible today, energy storage facilities need revenue from non-energy ancillary services in addition to energy related revenue.

SFW's analysis further shows the revenue that these same storage facilities could realise from such services offered in the Southern California Edison CAISO market.

Even though, the Li-ion plant has a much higher RTE than a LAES plant (85 per cent vs. 55 per cent), it is unable to generate enough revenue from the market to provide a 12 per cent return to investors (as shown by

Example of levelised annual revenue (in million \$) for an energy storage plant in CAISO SCE power pool



Energy Storage Gets a Boost.

Sumitomo Heavy Industries and Highview Power combine efforts to provide large-scale, long-term renewable energy solution.

Liquid air energy storage technology delivers clean, reliable and cost-efficient long-duration energy storage to enable a 100% renewable energy future.

- Flexible siting at point of need
- Compact Foot print
- Competitive cost of storage
- 30+ year plant life
- No capacity degradation over plant life
- Utilizes industry proven equipment
- All recyclable plant components
- No emissions



Siemens completes solid spin-off year

- Orders show slight increase despite Covid
- Plan to exit greenfield coal plant business

Junior Isles

Newly listed company, Siemens Energy has reported “a solid operating performance” for fiscal year 2020 and achieved its guidance.

The company spun-off from Siemens as a separate business entity earlier this year, increased new orders 1 per cent from the prior year, to €34 billion – amid a challenging macro-economic environment which was dominated by the Covid-19 pandemic. Though the company’s revenue in fiscal year 2020 was down 5 per cent from the prior year, to €27.5 billion, the decrease was still within the projected target range of 2-5 per cent.

Dr. Christian Bruch, CEO of

Siemens Energy AG, said: “I am proud how our Siemens Energy team managed the macroeconomic challenges, successfully executed the spin-off of our company while further streamlining our portfolio. We have fully achieved our fiscal year 2020 guidance and confirm our outlook for fiscal year 2021.”

In its outlook for fiscal 2021, the Gas and Power segment is expected to show nominal revenue performance within a target range of between 2 per cent and 11 per cent. Nominal revenue growth for the Siemens Gamesa Renewable Energy (SGRE) segment is expected to be between 3 and 12 per cent, driven by the order backlog to date and stable performance in the

Service and Product business.

Notably, the company said it will no longer participate in new tenders for greenfield coal fired power plants. It said its exit from coal will be “step-by-step” and it would continue to execute retrofits and honour service contracts.

“Siemens Energy will still meet the existing commitments for coal fired power plant projects, including binding offers,” the company stated.

The company said it will also “adjust” its aero-derivative gas turbine portfolio, where portfolio-related impairments and write-downs totalled €956 million. It said there has been a major change in the future prospects for gas turbines that are not used for

combined heat and power (CHP). The company no longer sees a big role for rapid start machines to complement variable renewables.

“These small gas turbines don’t have the highest efficiency, although they can start-up quickly,” said Dr Bruch in a press call. “But we have decided that this is a market that will not return. There are other solutions such as storage [for complementing renewables] and we believe this market will be impaired.”

It said, however that it will “continue to offer bridging technologies like gas fired plants and components for efficient CHP, waste heat and biomass co-firing projects and also continue its CO₂-reducing service and

solutions business”.

These technologies include sector coupling to drive the energy transition, and thus support the reduction of global warming, with power-to-X solutions and green hydrogen as the main elements, the company said.

Meanwhile SGRE reported record order intake of €14 736 million (+15.6 y/y), as momentum for wind energy grows. Service was reported as the fastest-growing division in FY20, supported by the assets acquired from Servion. Order intake increased by 53 per cent y/y to 4152 MW during the year.

■ In November SGRE announced that Marc Becker is to return as CEO of its offshore business.

Vestas takes control of MHI Vestas as it targets offshore wind

Vestas is to take control of MHI Vestas in a move aimed at improving its position in the offshore wind market.

In late October, Vestas Wind Systems and Mitsubishi Heavy Industries signed an agreement through which Vestas will acquire MHI’s shares in the MHI Vestas Offshore Wind joint venture.

In exchange, Vestas will issue roughly 5.05 million shares to Mitsubishi. The latter, through MHI Holding Denmark ApS, will hold a 2.5 per cent stake in Vestas and occupy a seat on the Danish company’s board.

With this move, Vestas aims to be-

come a leading player in offshore wind by 2025. “Vestas is the leader in on-shore wind, but to accelerate the energy transition and achieve our vision we must play a larger role in offshore wind,” said CEO Henrik Andersen.

A new offshore wind turbine platform will also be introduced to improve efficiency and drive the levelised cost of energy further down, the Danish turbine maker said.

Vestas and MHI also plan on collaborating in green hydrogen, as well as setting up a joint venture in Japan to secure accelerated growth for on-shore and offshore wind energy.

Companies eye new European battery business

Technology giant Panasonic, energy company Equinor and industrial group Hydro are looking to explore possibilities for establishing a sustainable and cost-competitive European battery business.

The companies last month signed a Memorandum of Understanding (MoU) to form a strategic partnership to work together to assess the market for lithium-ion batteries in Europe, and mature the business case for a green battery business located in Norway. The companies say the initiative is based on Panasonic’s technology and targets the European market for electric vehicles and stationary battery applications.

“The creation of this world-class battery partnership demonstrates Equinor’s ambition to become a broad energy company. We believe that battery storage will play an increasingly important role in bringing energy systems to net zero emissions. By pooling our different areas of energy

expertise, our companies will seek to create a battery business that is profitable, scalable and sustainable,” said Al Cook, Executive Vice President of Global Strategy & Business Development in Equinor.

Arvid Moss, Executive Vice President of Energy and Corporate Development in Hydro, added: “We believe the combined strengths of Panasonic, Equinor and Hydro represent an attractive starting point for exploring the possibilities for a profitable and sustainable battery business in Norway, where we have a strong foothold, renewable power base and close proximity to the European market.”

Mototsugu Sato, Executive Vice President of Panasonic, which supplies batteries for the automotive sector, says the collaboration “combines Panasonic’s position as an innovative technology company and leader in lithium-ion batteries, with the deep industrial experience of Equinor and Hydro”.

Clean energy drives investment from utilities and O&G majors

Electric utilities and international oil and gas majors are continuing to pour money into low carbon technologies.

Presenting its five-year investment plan at the start of November, Spanish energy group Iberdrola committed to spending €75 billion (\$88.7 billion) to boost its renewables, grids and utility business.

The company said it will be taking advantage of the prospects “created by the energy revolution facing the world’s major economies”, expecting to grow net profit by 6-7 per cent per year to some €5 billion in 2025.

The renewables spending spree will enable the group to reach 60 GW of total installed capacity by mid-decade, up from 32 GW in 2019. Beyond 2025, Iberdrola is looking to have

95 GW of installed renewable energy capacity by 2030.

Also at the start of November, Norwegian-based multinational energy company Equinor said it plans to expand its acquisition of wind acreage and will continue to leverage its position in offshore wind.

Announcing its 2050 net zero plans, the company said it will establish renewables as a separate reporting segment from the first quarter of next year.

Equinor said renewables will be a significant growth area as it develops into a broad energy company, with previously set ambitions for profitable growth within renewables and expected production capacity of 4-6 GW by 2026 and 12-16 GW by 2035.

The plans follow news that Equinor, along with bp, Eni, National Grid, Shell and Total have formed a new partnership, known as the Northern Endurance Partnership (NEP), to develop offshore carbon dioxide (CO₂) transport and storage infrastructure in the UK North Sea, with bp as operator.

Carbon capture and storage is seen as a crucial technology for decarbonising industry and the oil & gas sector. Notably, in November Total signed a strategic framework agreement with the Abu Dhabi National Oil Company (ADNOC), to explore joint research, development and deployment partnership opportunities to reduce CO₂ emissions, improve energy efficiency and the use of renewable energy for oil and gas operations.

More coal plant exits

Toshiba and Samsung last month joined GE, and more recently Siemens, in the growing number of engineering companies planning to exit the coal fired power plant sector.

Toshiba said it will stop taking orders for new coal fired power plants as it makes a wider push to embrace renewable energy, including parts for offshore wind power facilities and research and development for next-generation solar batteries.

It says, however that it will still complete ongoing work on 11 coal fired projects. The engineering-to-technology giant will continue to manufacture steam turbines and offer maintenance services for existing coal power plants, and work on the construction of plants that have already

been ordered, spokesman Takashi Ebina said.

“Given a global trend toward decarbonisation, we need to change our stance on the coal-power business,” he said.

Toshiba plans to invest \$1.5 billion in renewable energy for its operations for the fiscal year ending March 2023, and also aims to halve carbon dioxide emissions by 2030. The company aims to increase annual sales from its renewable energy business to ¥650-billion by March 2031, compared to about ¥190-billion in the most recent full year.

The news came as Samsung, South Korea’s largest conglomerate, pledged to stop all investment in new coal projects. Samsung Group’s financial units

said such investments include those via bonds or insurance underwriting.

According to the *Financial Times*, research suggests that Samsung Life Insurance and Samsung Fire & Marine Insurance, South Korea’s largest property and life insurers, respectively, financed \$14 billion of such projects over the past decade and had about Won2.5tn (\$2.2 billion) in outstanding investments in coal projects. The two companies said they had stopped direct financing of new coal projects since June 2018.

The move follows a similar announcement last month by Samsung C&T, the group’s construction affiliate, to cease new investments in coal projects, including power plant construction and coal trading.

10 | Tenders, Bids & Contracts

Americas

Nordex to supply Texas turbines

The Nordex Group has won an order for 63 N149/4.0-4.5 wind turbines from its Delta4000 series for a 302 MW project in Texas, USA. The project and the customer were not disclosed.

Nordex Group will start installing the turbines in summer 2021. The turbines will be supplied in a 4.8 MW operating mode, resulting in a total capacity for the wind farm of 302.4 MW.

With this latest order from the USA the Nordex Group can look back on 3.7 GW in turbines sold in the state of Texas alone.

It follows an earlier order in late October for 50 N155/4.X turbines of the Delta4000 series at a 240 MW wind farm, again in Texas. The project will also start up in 2021.

CGN orders 83 MW wind turbines in Brazil

CGN Energy's wind expansion project in Brazil's Piauí state has awarded a contract for 82.8 MW of wind turbines to Goldwind of China. Goldwind will supply 18 units of its GW155 model turbines.

Delivery is due to start in early 2021. This project will bring Goldwind's total installed capacity in Brazil to almost 500 MW.

Asia-Pacific

MAN signs O&M contract in Cambodia

MAN PrimeServ has signed a five-year O&M service agreement for a new 200 MW power plant near Phnom Penh, Cambodia. The contract was signed with SchneiTec of Cambodia, which is responsible for the C7 power plant owned by utility Electricite Du Cambodge (EDC) and constructed by MAN Energy Solutions.

The plant is powered by 11 MAN 18V51/60DF engines. The five-year agreement covers the supply of OEM spare parts, specialist services, and digital solutions. MAN PrimeServ will partner with SchneiTec to ensure efficient planning of maintenance services during the plant's lifecycle.

SchneiTec and EDC will utilise MAN's digital service solution PrimeServ Assist, which supports the efficient operation of power plants. Engine operation will be remotely monitored 24/7.

Guangdong Energy orders 9HA.02 GTs

The Guangdong Energy group has placed an order with GE for three 9HA.02 gas turbines for the 2400 MW Dongguan Ningzhou power plant. The project is the first H-class gas turbine planned by local government after policy reform in the Greater Bay Area (Guangdong-Hong Kong-Macau), focused on the coal-to-gas energy transition.

The power plant will become one of the largest gas power plants in China's mainland. GE will partner with Harbin Electric, which will provide steam turbine, generator, and balance of plant equipment. Ningzhou power plant is expected to be operational in 2022.

Yang Dan, President of GE Gas Power China, said: "GE's H-Class combined cycle power plant has unmatched efficiency available at greater than 64 per cent net combined cycle efficiency, higher than any other OEM or competing tech-

nology today. In addition, our HA turbines, being fuel flexible, have the capability to transition from gas to hydrogen."

Doosan wins 216 MW Nepali hydro contract

Doosan Heavy Industries and Construction has signed a \$350 million contract with Nepal Water and Energy Development Company (NWEDC) for the construction of the 216 MW Upper Trishuli 1 Hydropower plant in Nepal, 70 km north of Kathmandu. Under the terms of the contract, Doosan will manufacture and supply main components including turbines and power generators along with construction of the power plant.

Doosan stated that the project will be completed about five years after the start of construction. Construction is due to start in 2022.

NWEDC is a special purpose firm, which has Korea South-East Power Company, Korea Overseas Infrastructure & Urban Development Corporation and International Financial Corporation as stakeholders.

Vestas turbines for la Bang 1

Vestas has won an order for a 50 MW wind farm in Vietnam with local developer la Bang Wind Power, owned by the Vietnam-based renewable power producer Gia Lai Electricity Joint Stock Company (GEC). This is Vestas' second project with GEC.

The contract includes the supply and supervision of the installation of 12 V150-4.2 MW wind turbines delivered in different power ratings to optimise energy production for the site wind profile. The contract also includes a 10-year service agreement.

The la Bang 1 wind power project will be in Gua Lai province in the Central Highlands of Vietnam. The project is scheduled to be commissioned in the third quarter of 2021.

Europe

UK issues tender for offshore transmission licences

UK energy market regulator Ofgem has announced it is holding a tender for the offshore transmission licenses for the 900 MW Moray East and 857 MW Triton Knoll offshore wind farms. The competitive round was, at the time of writing, scheduled to open on November 30, 2020.

Bidders will compete to become Offshore Transmission Owners of the transmission assets for the two wind parks, with assets worth over £1.3 billion.

Moray East will consist of 100 MHI Vestas 9.5 MW turbines located 22 km off the Caithness coast in northern Scotland, and is scheduled to start operations in 2022. Triton Knoll will be installed 32 km off the Lincolnshire coast, consisting of 90 MHI Vestas 9.5 MW turbines. The wind farm is scheduled for commissioning in the first quarter of 2021.

GE to equip Lithuanian wind farms

GE Renewable Energy has been awarded a contract by European Energy to provide its Cypress onshore wind turbines for 121 MW of wind projects in Lithuania. GE Renewable Energy will supply 22 turbines in 5.5 MW mode for three wind farms about 80 km north of Vilnius. The turbines will be mounted on 151 m towers. GE

will provide servicing of the units for 25 years.

Turbine installation is scheduled for the second half of 2021.

Vestas turbines for Sandy Knowe project

The Italian energy company ERG has awarded Vestas Wind Systems a contract to supply 50 MW of wind turbines for the Sandy Knowe wind park in Scotland. Vestas will deliver 14 of its V112-3.45 MW wind turbines in 3.6 MW power optimised mode, delivery starting in the third quarter of 2021. The wind farm is scheduled for commissioning by the end of 2021. The contract also includes a 20-year service agreement.

ERG announced in early November that it had secured approval to increase the capacity of the Sandy Knowe wind farm to 92 MW.

Altrad to decommission six nuclear plants

Altrad has won a four-year contract from Magnox Limited to provide support services across six sites undergoing decommissioning in the UK.

The contract, which started in October, covers six sites owned by the UK Nuclear Decommissioning Authority (NDA): Chapelcross, Dungeness A, Hinkley Point A, Hunterston A, Trawsfynydd, and Wylfa nuclear power stations. Altrad said the contract builds on a successful 15-year strategic relationship with Magnox, during which time Altrad has delivered a range of services including access, asbestos removal, thermal insulation, environmental cleaning, corrosion protection, cladding, and minor civil work.

Altrad is working on several other UK nuclear contracts, including at Sellafield, across the EDF nuclear fleet, at Hinkley Point C, and at Capenhurst.

EDF wins French solar tender

EDF Renewables has secured 105 MW of solar PV projects in a tender in France launched by the French Energy Regulatory Commission. EDF Renewables will build 12 solar plants in the Auvergne-Rhône-Alpes, Bourgogne-Franche-Comté, Centre-Val de Loire, Grand Est, Nouvelle-Aquitaine and Pays de la Loire regions.

Construction on these facilities is scheduled to begin in 2021.

In addition, EDF ENR has secured a 9.4 MW solar project.

Polenergia orders Vestas turbines for Kostomloty

Vestas Wind Systems has won a contract to supply turbines for a 27 MW wind farm in Poland being developed by the energy group Polenergia.

The Kostomloty project is the fifth collaboration between Polenergia and Vestas. The project will consist of nine V136-3.45 wind turbines. The machines will be in 3.0 MW power optimised mode on 122 m towers, and will be covered by a 30-year service agreement. The Kostomloty wind farm will be located in the Lower Silesian Voivodeship in southwestern Poland.

Commissioning is expected to start in the first quarter of 2022. Once fully online, the wind farm will generate an estimated 87 GWh per year.

Hydrogen-capable Siemens GTs for Leipzig

A contract for two gas turbine packages for the Leipzig Süd district heating plant in Germany has been awarded

to Siemens Energy. The plant is expected to operate with 30-50 per cent hydrogen a few years after the start of commercial operation, with a long-term goal of operating the plant on 100 per cent hydrogen. Commissioning is scheduled for the end of 2022.

The new plant will be built on Stadtwerke Leipzig's existing site on Bornaische Strasse and produce electricity and district heat for the city. It will have an electrical capacity of 125 MW and a thermal capacity of 163 MW, with a maximum fuel efficiency of 93 per cent.

The order covers the supply of two SGT-800 gas turbines, each with a maximum efficiency of 41 per cent. The turbines are expected to be fired with natural gas, starting in late 2022, and be successively converted to the combustion of increasing proportions of hydrogen. The long-term goal is to operate the plant on 100 per cent green hydrogen, which can be produced from wind or solar energy by electrolysis.

International

Hybrid microgrid with flow batteries for Africa

Abengoa is to build the first large-scale hybrid microgrid with flow batteries in Africa.

The company will be responsible for the engineering, supply and construction of the plant, which integrates an energy storage system using vanadium redox flow batteries with a capacity of 1 MW/4 MWh, with a 3.5 MW solar photovoltaic plant. This will be located at Vametco Alloys mine, owned by Bushveld Minerals in the northwest province of South Africa and will allow it to increase its energy autonomy.

Elsewedy Electric wins transmission contracts

Elsewedy Electric has won three EPC contracts, valued at \$54 million, for Egyptian Electricity Transmission for power transmission works in Egypt. The first contract is for an overhead transmission line connecting the Toshka 4 substation to the grid. The \$9.5 million contract will be carried out four months after acceptance of the bid.

The second contract of \$26.2 million is for construction of Toshka substation, and this will be carried out over a 10-month period. The third contract, valued at \$18.4 million, includes construction of the West Port Said substation, with work to take one year.

Solar venture in Angola

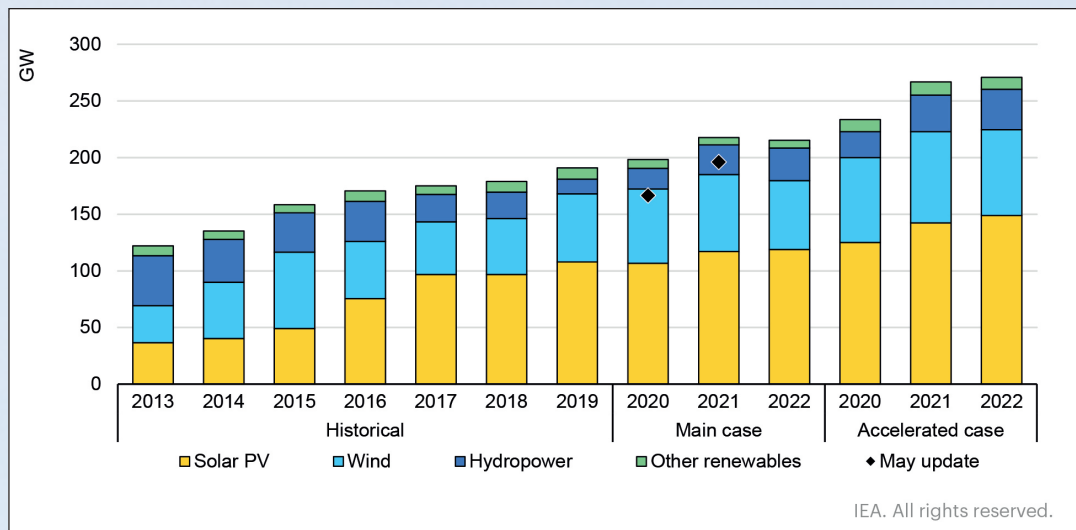
Hitachi ABB Power grids has won a major order from M Couto Alves (MCA), part of the EPC conglomerate, to support sub-Saharan Africa's largest solar venture in Angola. This work is on behalf of Angola's Ministry of Energy and Water, to supply the main electrical infrastructure to connect the solar power project to Angola's transmission network. The project will be developed by a consortium consisting of Sun Africa, a US renewable energy company, and MCA.

The contract includes design, main power equipment supply, testing and commissioning.

Niklas Persson, Managing Director of Hitachi ABB Power Grids' Grid Integration business units, said: "This is one of the largest and most significant PV projects ever delivered. We are contributing pioneering technology to enable MCA to integrate more renewables and electrify rural areas while maintaining a stable network. Our role is to develop the project from idea to energisation."



Renewable electricity net capacity additions by technology 2013-22, main and accelerated case



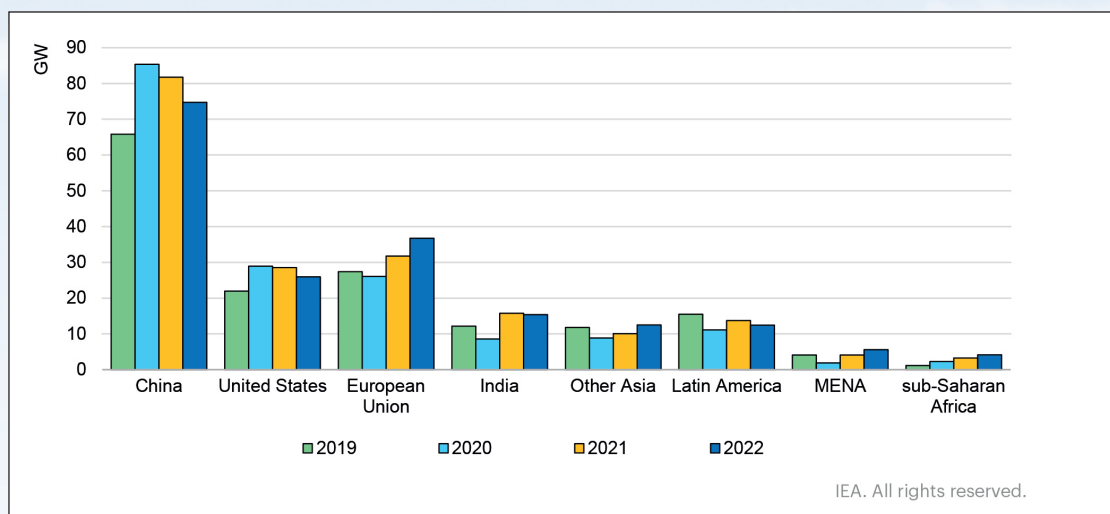
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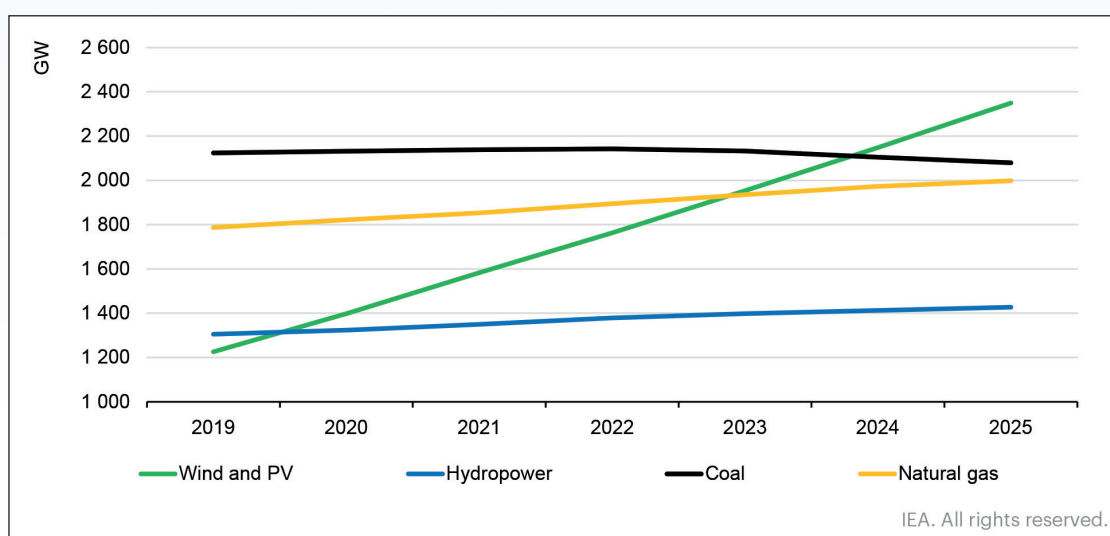
Renewables 2020: Analysis and forecast to 2025, Figure 2.1, page 29.
IEA. All rights reserved.

Renewable electricity net capacity additions by country/region 2019-22, main case



Renewables 2020: Analysis and forecast to 2025, Figure 2.2, page 31.
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Total installed power capacity by fuel and technology 2019-25, main case



Renewables 2020: Analysis and forecast to 2025. Figure 2.4, page 33.
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Hydrogen

US launches hydrogen programme while UK outlines 'green revolution'

- US DOE sets out plan to provide framework for hydrogen RD&D
- UK aims to generate 5 GW of green hydrogen capacity by 2030

Gary Lakes

The United States and United Kingdom both took steps during November to advance changes in their respective energy sectors that will lead to cleaner energy production and address some of the problems of climate change. The two programmes are in time expected to have a profound impact on the economies of both countries as the transition to renewables and net zero emissions by 2050 picks up speed.

There is a considerable amount to be done though, first of which is to develop the technologies that will bring the cost of hydrogen production down. There are also strong arguments being made for 'green hydrogen', which is produced by renewable energy sources, although the fossil fuel and nuclear energy sectors maintain that they are also in the game.

The US Department of Energy (DOE) in mid-November released a

Hydrogen Program Plan that appears to be quite progressive in its approach to America's energy future. The plan is designed to provide a strategic framework for the DOE's hydrogen research, development and demonstration (RD&D) activities.

While the office of President-Elect Joe Biden has yet to layout its energy policies, Biden has stated that he will work to implement programmes to combat climate change. In that regard, the Hydrogen Program is likely to serve as a platform for the Biden administration.

Private companies and government agencies have long researched hydrogen as an alternative to fossil fuels and during the last year as the coronavirus has upset the oil and gas industries in dramatic ways, hydrogen seems to have burst onto the scene as a viable alternative.

A statement released by the DOE said the programme is a coordinated departmental effort to advance the affordable

production, transport, storage, and use of hydrogen across different sectors of the economy. It involves participation from the Offices of Energy Efficiency and Renewable Energy, Fossil Energy, Nuclear Energy, Electricity, Science, and the Advanced Research Projects Agency-Energy.

"Hydrogen is an exciting fuel source that has the potential to integrate our nation's energy resources, but to fully recognise its potential across the economy, we need to lower costs and see a significant increase in hydrogen supply and demand," Dan Brouillette, US Secretary of Energy, said.

The DOE is funding RD&D efforts that will provide the basis for near- to long-term production, delivery, storage, and use of hydrogen derived from diverse domestic energy sources. These include addressing challenges through activities to:

- Reduce costs and improve the performance and durability of hydrogen production, delivery, storage, and

conversion systems

- Address technological, regulatory, and market barriers that both limit the integration of hydrogen with conventional energy systems and reduce opportunities for exporting hydrogen

- Explore opportunities for achieving large-scale adoption and use by aggregating disparate sources of hydrogen supply and demand

- Develop and validate integrated energy systems utilising hydrogen

- Demonstrate the value proposition for new and innovative uses of hydrogen.

In the UK, Prime Minister Boris Johnson laid out a 10-point plan designed to create a green industrial revolution that would create 250 000 jobs. The plan covers clean energy, transport, nature and innovative technologies that will enable the UK to move to net zero carbon emissions by 2050. Its announcement comes in the run-up to the COP26 climate summit in Glasgow in 2021.

The plan calls for the government to invest £12 billion (\$16 billion) to create and support 250 000 green jobs and encourage private sector investment three times that by 2030.

One of the 10 points of the plan covers hydrogen, whereby the UK government will work with industry aiming to generate 5 GW of low carbon hydrogen production capacity by 2030 for industry, transport, power and homes, aiming to develop the first town heated entirely by hydrogen by the end of the decade.

Up to £500 million (\$665 million) is to be invested in hydrogen with funding going to trialling homes using hydrogen for heating and cooking, starting with a Hydrogen Neighbourhood in 2023 and expanding to a Hydrogen Village by 2025. By the end of the decade, a Hydrogen Town, including tens of thousands of homes, is to be up and running. Some £240 million in funding is to be invested in new hydrogen production facilities.

Gas

Iraq reliance on Iranian energy will continue as hurdle for Biden administration

With Joe Biden preparing to take over the Oval Office, the world is speculating on how the US will approach energy in the Middle East and in particular Iran.

Gary Lakes

With President-Elect Joe Biden preparing to enter office in January, the world can expect to see a big change in US foreign policy. Little has been said by the Office of the President-Elect about how it intends to proceed with foreign policy, but judging by the appointments of well-known professionals to important offices that Biden has made, engagement and diplomacy are expected to be key drivers for the new US administration.

As ever, the Middle East will command considerable attention, especially for America's ongoing involvement in Iraq and its antagonistic relations with Iran. Already questions are being asked about whether Biden will attempt to re-enter the Iran Nuclear Accord, from which President Donald Trump withdrew the US in 2018 and subsequently re-imposed sanctions on Iran.

Numerous countries and companies were forced to end their business dealings with Iran in November 2018 when the sanctions came back into effect. But business continues between Iran and

Iraq, which has come to rely on Iran for imports of natural gas and electricity. Despite Iraq's huge gas reserves, decades of war and financial collapse have left it unable to harness the huge volume of associated gas it produces for power generation. The country is flaring up to 18 billion m³ (bcm) annually, according to the World Bank, more than enough to provide the country with sufficient electricity supplies.

For its part, the Trump administration continues to press Iraq to reduce its reliance on Iranian supplies, but, knowing that a halt to the energy supplies that Iran provides for southern Iraq would only deepen the country's economic problems and social unrest, Washington has chosen to provide Iraq with waivers to sanctions that enable it to continue to pay for Iranian energy supplies.

The US State Department on November 20th granted its latest 45-day sanctions waiver to Iraq in late November, which will carry it through until the end of December. Whether the Trump administration will issue another at the end of the year, so near to the inauguration of Biden, remains a question. How

the Biden administration will deal with the question of Iranian sanctions, especially in the case of Iraq, is an even bigger question.

In the meantime, US companies continue working with Baghdad on plans that will enable it to supply its own electricity at some point in the future. Last August, during a visit to Washington by Iraqi Prime Minister Mustafa Al-Kadhimi and the ministers of oil and electricity, several major US power sector and oil and gas companies signed contracts worth \$8 billion that are designed to expand Iraq energy infrastructure.

Iraq is importing 1.2-1.5 GW from Iran daily, plus 38 million m³ of gas per day under a two-year contract that Baghdad and Tehran signed in June this year. But while in Washington, US officials discussed with Kadhimi the possibility of Iraq improving its relations with Saudi Arabia and linking up with the Saudi Arabian power grid through Kuwait. Talks moving in that direction have been under way for several months.

In Washington, Baker Hughes agreed with the Iraqi Ministry of Oil to further

collaborate on flare gas-to-power projects and the deployment of services and equipment.

General Electric signed three deals worth \$1.2 billion with the Ministry of Electricity that will boost reliable access to electricity. One includes GE's existing generator maintenance programme, another the addition of combined cycle units at Dhi Qar and Samawah power plants, and collaboration on strengthening Iraq's power grid and interconnections with other countries.

Stellar Energy and the Ministry of Electricity signed an agreement whereby Stellar will provide FEED for the advancement of turbine inlet air chilling technology in more than 30 turbines, allowing a boost in generation efficiency by 30 per cent.

These projects would depend on using Iraq's own gas.

Meanwhile, some discussion has taken place between Baghdad and the Kurdistan Regional Government (KRG), which governs Iraqi Kurdistan, on the use of Kurdish gas for Iraqi power generation. Unfortunately, differences between the two sides have

made this option slow going.

Last month, during a virtual conference organised by the US-Iraq Business Council, a US energy official urged Baghdad to make use of the natural gas being produced in the semi-autonomous region.

US Deputy Secretary of Energy Mark Menezes said the more that Kurdistan develops its gas resources and the closer it gets to being a regional energy hub, the less dependent Iraq will be on Iranian gas imports. For the KRG's part, Prime Minister Masrour Barzani said Kurdistan is ready to export gas to the rest of Iraq. He told the virtual conference that the KRG is working to become a regional energy hub with gas production and storage and export gas to the rest of Iraq and other countries. The KRG is already exporting electricity to other parts of Iraq, Barzani said.

Prying Iraq away from Iran's influence will not be an easy thing to do. Many Shia Muslim Iraqis want close ties with Tehran. Needless to say, the region will continue to be a worry for the US and other countries concerned with Iran's influence in the Middle East.

Conducting an orchestra of DERs

The growing amount of renewables and distributed energy resources (DERs) on the grid is presenting unprecedented challenges for today's grid operators. GE Digital's Jim Walsh explains why a single, coordinated, view of the distribution and transmission grids is needed if utilities are to maintain reliability efficiently.

Junior Isles

Walsh: Variable renewable energy sources such as solar are posing challenges for grid operators



Managing a constantly changing electricity network is no easy task. And the job is not getting any easier. With the proliferation of variable renewables at the transmission level and distributed energy resources (DERs) at the distribution level, such as electric vehicles, heat pumps, batteries, and energy from prosumers, utilities more than have their hands full.

It is a new world that Jim Walsh, General Manager, Grid Software Solutions, GE Digital, says is becoming increasingly complex and calls for greater renewable and DER awareness for utilities and a much more "orchestrated" approach across their full information technology (IT)/operational technology (OT) network.

"The world of the grid operator is becoming more challenging by the day. They are seeing more change in the last five years than they have in the previous 125. Renewables penetration is fundamentally changing everything that they thought they knew about how to seamlessly operate an electric grid," he said. "When we talk about orchestration, we are describing the integration of all the different electron sources, and management of supply and demand in a much more seamless way."

Existing grids have been built to handle consistent power flows in one direction. Today, there are many intermittent generating sources – many of which are embedded in the distribution grid – and consumers can also produce and feed power back into the grid.

Transmission system operators (TSOs) perform a balancing act between grid supply and demand every day. Meanwhile, distribution system operators (DSOs) work to ensure quality and continuity of service to end-users. Utilities and regulators expect this to be done flawlessly. But renewables and DERs are creating unprecedented challenges for the electric grid. In some geographies, there is now more energy being fed directly at the distribution level than there is at the transmission level.

But while utilities are coping with this high degree of complexity, all while maintaining reliability, Walsh says it is causing a fair degree of inefficiency. What utility leaders need, he says, is an end-to-end solution to coordinate how they model, monitor, forecast, and ultimately control and dispatch these new renewables and DERs across all internal and external systems and stakeholders.

"When reliability is a constant and the grid itself is becoming more dynamic, what you will see suffer in the short term is efficiency," said Walsh. "Operators tell us that out of 100 electrons that get



Variable renewable energy sources such as solar are posing challenges for grid operators

created, only 50 are consumed. So we are trying to help them bring these disparate energy sources together. And that's where you hear us starting to talk about this notion of orchestration, which is having the ability to model, monitor forecast and ultimately control the dispatch of these new renewables and DERs. That's where we believe you will achieve this balance between reliability and efficiency."

These resources are disrupting utility business models and operations at the most fundamental level. At the transmission level, the challenges are linked to installed capacity, balancing, reserves, stability, lack of inertia, and lack of visibility to what is happening at the distribution level.

Here, the challenges include hidden loads, backfeeds, and voltage issues. Hidden load refers to the share of consumption covered by embedded generation, which is therefore not directly visible to the grid operator whose traditional operation systems only manage "net load", i.e. the net flow on the power lines.

However, accurate visibility of the two components of the net load (native consumption and embedded generation) is essential to many core distribution grid management processes. When a fault occurs, for example, ensuring that a faulty feeder is de-energised is paramount for the safety of workers in charge of the repair. As such, operators must be aware of every single PV rooftop and fully comprehend its connection/disconnection status.

GE Digital makes the point that DERs cannot be marginalised. As distribution level challenges aggregate up to the interface with the transmission level, DERs are pushing TSOs and DSOs to coordinate. Clearly it is more of an issue in regions where there is higher renewable penetration. Utilities in states like California and countries like Germany and the UK have therefore been forced to adapt faster. These have subsequently been the places where GE Digital says it has been doing most of its work.

Walsh argues that some utilities and TSOs may not yet be experiencing significant impacts on energy flows and voltages profiles but cannot wait for the day they start to experience those impacts. And there is a growing backlog of devices on the grid that utilities are unaware of.

Every single system in grid asset

and operations management needs to be involved in the management of renewables and DERs. Certainly Geospatial Information Systems (GIS), Advanced Distribution Management Systems (ADMS), Advanced Energy Management Systems (AEMS) and Advanced Market Management Systems (AMMS) all have a role to play. But Walsh explains that the grid cannot be operated through a number of different silo-type bespoke solutions.

"There has to be one integrated platform, so there is one view of the network; one version of the truth," said Walsh.

While there has been innovation around renewables and DER management, including solutions that, for example, take weather into account, Walsh says today's siloed solutions "come up short". GE Digital has therefore been looking to bring the capabilities of these systems together in an integrated way on a common platform that leverages a common data model. "This is the next level of efficiency and capability that utilities are looking for," said Walsh.

The other thing he says is missing, is the ability to recognise when new DERs are added to the grid. With no formal registration process for adding DERs to the grid in many jurisdictions, he says self-recognition is an advance that will be "really important" in the next couple of years.

Walsh noted: "We are looking at ways to provide more automated capabilities to our utility customers, so they don't have to be as dependent on the registration process."

In an effort to help DSOs and TSOs "connect some of the dots", GE Digital has been building "DER-enabled" capability into its products and started working with network operators on specific projects. For example, in December 2018 it worked with Dutch DSO Stedin in creating a network capability called T-Forecast. This connected the DSO with the TSO so they had consistent updates in terms of demand coming from the DSO.

"This is just one example of where those silos can be connected with a common view that gets updated in more real-time so that the TSOs are better positioned to plan and the DSO or DNO is in a much better position to receive. We are seeing that [kind of] digital linkage across all the different silos," said Walsh.

According to Walsh, much of the ongoing innovation is taking place on the distribution grid – where microgrids, rooftop solar panels, etc., are becoming more commonplace. He stresses, however, that the DSOs "need to do a better job" of providing visibility and communicating to the TSOs upstream.

Walsh said: "As things change on the distribution grid, with more electrons being generated on the distribution side than there was before, it all needs to be communicated to the TSO in close to real-time."

He says that bringing this data together offers utilities the opportunity going forward to potentially build new business models by becoming aggregators of all the electrons from the various sources, and thus create new markets.

"Having visibility of all the assets and getting all of this data under control would give utilities whole new degrees of freedom so they can innovate on their business models in the future," noted Walsh. "But in the short-term, it's about how to keep the grid reliable without significant levels of redundancy that are inefficient. Storage technologies will be part of that equation."

As a player in both the transmission and distribution parts of the electricity chain, GE Digital says it is well placed to help utilities meet their immediate needs as well as realise the future possibilities.

According to Walsh, the company operates in every level of the value stream. "From the time an electron is created to when it hits the consumer, we have software capabilities that can help orchestrate that," he said.

It also has geospatial capabilities that enable the physical world to be represented digitally, and the bringing together of all the changing assets in order to create the underlying data model that represents the complete grid.

Walsh summed up: "Our vision is to build a platform for the network operators that the rest of the participants on the network can consume. This enables the orchestration that we talk about. As a provider of the control platforms and operational systems for network operators, we are in a great position to provide natural extensions to the rest of the market participants, which then leads to better choreographing than we've ever seen before."

An integrated approach to energy efficiency

The European Green Deal promises to deliver on a net zero energy system by 2050, through higher ambition on energy efficiency, better system integration and enabling greater use of renewable energy. *TEIT Times* highlights a recent study that finds cogeneration can be a primary enabler in realising those goals.

System focus methodology: Artelys ran an economic optimisation to see the trade-off between providing heat and electricity via separate technologies versus investing in CHP

There is arguably insufficient focus on the value of energy efficiency in efforts to cut carbon emissions. This is especially true of cogeneration, which in spite of its benefits, has considerable untapped potential. Certainly in a world where resources are finite, energy wastage should be minimised wherever possible.

At the end of October, as part of its 'Power and Heat Boost' webinar series, Cogen Europe presented the results of a study commissioned with the consultancy Artelys, that makes a case for the role the technology can play in Europe's goal of achieving net zero carbon emissions by 2050.

Introducing the study during the

in the context of the European Green Deal, which sets out the roadmap for making Europe the first climate neutral continent by 2050. It is also Europe's new growth strategy.

Guido Bortoni, Senior Advisor, Internal Energy Market Regulation, DG Energy, European Commission, noted: "By its nature, cogeneration already provides a solution for energy system integration. With one single input it generates two outputs, translating into physical energy links between energy carriers, heat and electricity, across sectors. In short, we have to extend what the nature of cogeneration already does."

"At the same time it offers potential in terms of energy efficiency, reduced

carbon-neutral economy cost efficiently; assess the role of cogeneration, building on the EC's Long Term Decarbonisation Strategy (LTS); and finally provide recommendations to better reap the benefits of efficient and local system integration solutions in policy-making and modelling.

It looks at whether it makes economic sense from a user viewpoint to include cogeneration in the portfolio of technologies for various different use cases in different countries. It then looks at the benefits of CHP in terms of the energy system as a whole.

Presenting the results, Christopher Andrey, Project Director Artelys, noted: "In all the cases we looked at, there are savings – Spain, Poland and Sweden – with the key indicator being the cost of providing heat per MWh."

The user viewpoint makes comparisons between two configurations (with and without CHP) in seven use-cases in the residential, industrial and heating sectors. Simulations were performed over one year in three different countries – Spain, Poland and Sweden – with the key indicator being the cost of providing heat per MWh.

The cost benefits (excluding benefits from network tariffs and tax avoidance by own consumption) vary by use case, country, fuel prices, technology cost and characteristics) but showed cost savings in all cases. For example, in a district heating application for 500 GWh consumption, saving over the year range from €0.4-3 million annually. In a high temperature industrial setting for 684 GWh annual consumption, savings are between €3 million and €10 million.

To analyse the benefits at the system level, a number of scenarios were first defined. The scenarios are inspired by the 1.5 TECH scenario in the European Commission's LTS. The study therefore considered: energy consumption, heat supply in each sector; energy efficiency and electrification; installed capacity of variable renewables, hydropower and nuclear; and assumes the rest of the electricity generation mix (biomass, biogas, natural gas, hydrogen) is optimised.

It analyses different sectors in terms of heating demand in order to assess the potential for CHP in different sectors. Having identified the maximum heat demand that could be covered by CHP, Artelys ran an economic optimisation to see the trade-off between providing heat and electricity via separate technologies versus investing in CHP.

While there is the capital cost for investing in CHP, there are some savings in terms of fuel costs. Andrey noted: "So the question is: what is the balance between the additional capex and the avoided fuel cost. For the study we installed CHPs only where they were found to be economical."

Four different heating sectors that are interconnected with electricity were modelled: district heating for

industries; district heating for buildings; on-site heat generation for industries; and onsite heat generation in buildings. This was done from two different starting points: the 1.5TECH scenario and an Integrated Energy Systems (IES) scenario (a variation of 1.5 TECH where the share of thermal generation is increased with biomass, biogas, syngas and natural gas with CCS), in order to determine the optimal deployment of CHP at the EU level in terms of costs, CO₂ emissions, flexibility, etc. for the different sectors.

A range of results was produced, due to the consideration of the two starting points or base scenarios (1.5 TECH and IES). In terms of energy costs, the analysis reveals there is a €4-8 billion/year saving each year at the European system level. Primary energy savings across the energy system amount to 15-220 TWh annually. The modelling calculates CO₂ is reduced by 4-5 Mt/year. Andrey notes: "Even though it is a carbon neutral scenario, natural gas is still being used with CCS, so there are still emissions."

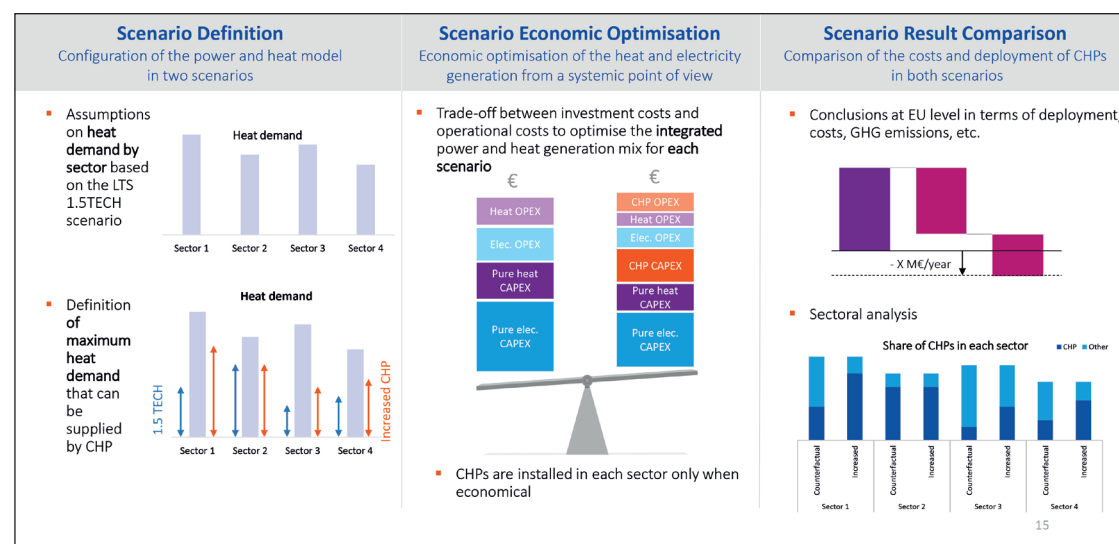
The results also showed CHP contributed 13-16 per cent of total electricity directly connected to the network. In terms of total heat demand, it represented 19-27 per cent depending on the scenario, and 52-100 per cent of thermal heat in building, industry and district heating.

Artelys projects this leads to an optimal CHP deployment capacity of 142-154 GWe in the 1.5 TECH and IES scenarios, respectively, compared to 117 GWe in 2018 and around 56 GWe in the 1.5 TECH scenario.

Summarising the findings of the report, Andrey said: "From both the end user and system perspective, we have found that CHP can be an efficient enabler for reaching carbon neutrality by 2050 in a cost-effective way. So there is a more cost-effective potential for CHP to tap into to support a highly electrified and low demand energy system compared to the 1.5 TECH LTS scenario. And in a scenario where there is a higher uptake of bioenergy resources, the deployment of CHP is even more important to enable efficient use of the fuels produced – biomethane or e-gases."

He noted, however, that certain barriers have to be removed. He concluded: "The market structure and regulatory regime at national and European levels should allow CHP to capture all the value it brings to heat and power systems, also in terms of avoided network costs and generating capacity."

"As revenues from CHP can also be scattered across different markets, some being country-specific, taxes and tariffs may not always provide the appropriate price signals. So we have to make sure they do in order to provide the most cost-effective solution from a system point of view."



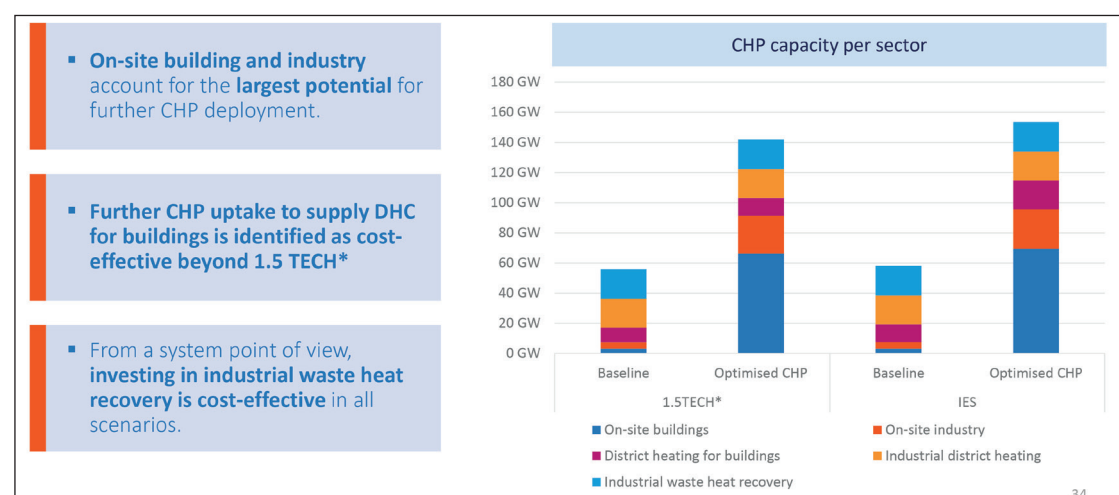
Optimal CHP deployment: Optimising CHP leads to a total CHP capacity of 142-154 GWe in the 1.5TECH and IES scenarios, respectively, compared to 117 GWe in 2018 and 56 GWe in the 1.5 TECH scenario

online event Marco Pezzaglia, Chair of Cogen Europe, said: "Cogeneration needs to be prioritised over the inefficient separate production of heat and power. This will help maximise the energy efficiency of the economy and integrate the European energy system at least cost. The next 5-10 years will be critical in driving investments in the right direction."

Cogeneration is particularly relevant

CO₂; renewable deployment; system efficiency by providing flexibility as well; grid cost reduction; and of course energy bill reduction."

In this respect, the study – "Towards an efficient, integrated and cost-effective net-zero energy system in 2050: the role of cogeneration" – sets out three objectives: explore the potential of further integrating Europe's energy system in an efficient way to reach a



On-site building and industry account for the largest potential for further CHP deployment.

Further CHP uptake to supply DHC for buildings is identified as cost-effective beyond 1.5 TECH*

From a system point of view, investing in industrial waste heat recovery is cost-effective in all scenarios.

A new way to combust solid wastes

The Horizon+ rotary boiler is capable of handling any type of biomass and most fuels, particularly problematic solid waste fuels such as RDF and SRF. Tidy Planet's **Simon Webb** explains the new technology.

Webb: One of the biggest difficulties often facing WtE plant operatives is keeping systems running continuously



As the world's populations strive to implement greener, carbon-footprint-minimising processes and technologies, the global waste-to-energy (WtE) landscape is one that is continuing to evolve at an accelerated rate.

When it comes to the adoption of WtE technologies, the picture varies greatly from one country to another. While European nations such as Germany, Austria and Sweden have been utilising alternative fuels – including Refuse Derived Fuel (RDF) and Solid Recovered Fuel (SRF) – for many years, and have advanced national waste infrastructures to mirror this, the degree of uptake has a lot further to go in fellow European countries such as Romania.

However, regardless of geography, there is one constant at the heart of the entire energy and power generation industry – innovation.

And as the spotlight shines – from both a legislative and societal perspective – firmly on harnessing the resource potential of more of the globe's wastes, equipment that is able to process the more 'challenging' fuels which generate significant levels of slag and ash, is now occupying a higher place than ever before on the waste management agenda.

This was one of the primary catalysts behind the development of the Horizon+ rotary boiler – equipment that is designed and manufactured to work with flue gases from the combustion of solid wastes, for either a hot water or thermal oil application. Developed by Sugimat, headquartered in Valencia, Spain, the boiler is now being solely distributed in the UK by Tidy Planet.

One of the biggest difficulties often facing WtE plant operatives is keeping systems running continuously – driving the maximum operational hours possible while simultaneously optimising combustion efficiency and maintaining equipment cleanliness. This is because, traditionally, a boiler's efficiency starts to drop within a few hours of it firing up, and in order to achieve peak productivity levels, plenty of manual intervention is typically required.

Xavier Mas, Technical Service Director of R&D at Sugimat and developer of the Horizon+ patent, added: "When using solid fuels that generate high volumes of slag and ash – especially those with ash content over 6 per cent – this can quickly contaminate the boiler, with sticky residue clogging up the heat exchange ducts. As a result, this reduces the continuous operation hours possible and ultimately, results in unplanned plant downtime.

"This kind of technical failure is likelier to occur in conventional boilers, due to the ease of ash build-up when there's no rotating, self-cleaning and ash-extraction elements in place.

"And it was the operational difficulties and cost of maintenance of normal systems apparent in the market, that catalysed the development of the Horizon+ innovation."

As the UK continues to struggle exporting its waste overseas due to evolving legislation, various waste import bans – and most recently, the logistical impacts caused by the pandemic – an increasing number of organisations are turning their attention to the value of RDF and SRF, with many looking for more sustainable and circular ways to utilise them in line with the European Union's Waste Hierarchy model.

And as the country's economic recovery looms ahead, it could perhaps be argued that it has never been more important, or timely, for the UK's private and public sectors to begin – or ramp up their efforts – to harness the potential of these waste streams, and close the loop.

The implementation of more decentralised energy recovery facilities is perhaps the way forward in helping to halt the shipment of our valuable energy sources – or 'wastes' – overseas for recovery.

But with the increase in demand for sustainable WtE technologies, comes the need for machinery that is built upon innovation, reliability and efficiency.

Further elaborating on how the rotary boiler operates with productivity and sustainability in mind, Xavier explained: "The Horizon+ technology has a self-cleaning capability, which allows it to cope with the high ash content and low melting point sticky ashes, typically associated with 'dirty' fuels like RDF and SRF – meaning there is no loss of efficiency.

"The rotating element of the equipment enables fluid to easily circulate within the sealed system and causes the ash to fall from the boiler tubes – keeping them clear of residue and therefore elevating performance and maximising plant uptime. For particularly sticky ashes, a recyclable cleaning medium can be introduced to further improve the self-cleaning capabilities."

The newly designed Horizon+ system – available in models spanning 300 kW to 12 MW outputs – has been constructed with 'fuels of the future' in mind. This encompasses the fuels that have been overlooked or excluded to date because of the

challenges associated with their combustion.

The horizontal heat exchanger is composed of several connected coils – through which the heating fluid for the installation circulates. And the heat exchanger inlet and outlets are connected by rotary couplings, with seals designed to work at high temperatures.

The boiler itself is mounted on a frame – equipped with casters – and driven by a gear motor, which enables it to rotate on the axis of the coils at a slow speed up to four revolutions per minute. As a result, the rotary movement – coupled with the screw action of the coils that form the heat exchanger body – allows suspended particles in the gas flow to be discharged through an outlet.

Additionally, unlike conventional boilers that are often unable to manage flue gases with high fly ash content, the continuous granular cleaning system of the Horizon+ removes any surface ash on the heat exchanger coils – negating the need to stop the operation and maintaining heat exchanger optimum performance at all times. In turn, this prevents lengthy shutdown processes, whereby the system would typically have to cool to fix the problem, before being fired back up.

But what exactly makes the equipment unique? In conventional vertical and horizontal boilers, combustion gases are not distributed uniformly within the heater – creating dead spots and areas with high gas flow – and in static heat exchangers, gases do not behave consistently across the surfaces.

The constant movement of the coils in the Horizon+ affords a more homogenous and consistent transfer of heat, which eliminates the dead spots and ash deposit build-ups, and prevents coil abrasion traditionally caused by areas of high flow. It's this slow revolving movement which encourages in-furnace impurities to move along the surface of the heat exchange tube – comparable to the thread of a screw – until they end up at the bottom of the boiler, where they are automatically extracted.

Therefore, the rotary boiler's design works to achieve an increase in the performance and overall lifespan of the heater. And as the machine is turning slowly, mechanical maintenance issues are not only rare, but the technology is able to guarantee 8000 operational hours per annum.

This contrasts with traditional static boilers, which use air to blast the surfaces clean, causing the ash to be mixed with flue gases. This results in suspended solids contaminating

analyser outlets and flue gas filters, preventing regulatory compliance, and shortening the longevity of the filtration equipment.

The optimised, rotary design is what makes the equipment perform more efficiently for longer periods, and in order to develop it effectively, this complex feature required more attention during the nascent conceptual and design phases.

Another benefit – and carefully considered element – is the size of the machinery. For electricity generation, boilers generating 12 MWth typically require a 20 m high building to house the system, but the horizontal design of the Horizon+ means it can be sited in a building less than 10 m high.

As a consequence, this not only helps to reduce potential planning issues and construction costs, but also makes it more viable for the equipment to be used in areas where space is at a premium. This includes decentralised WtE facilities and smaller-scale sites close to urban areas, where the heat and power generated can be used for surrounding residential areas or industrial estates.

Regarding market application of the rotary boiler technology, the first machine will be installed at an international reusable pallet company – creating its own on-site, closed loop system. This will see the waste from the pallet repair operations used as fuel within the boiler, generating heat for the line, which dries the painted pallets.

Also, the second rotary system is set to be installed in 2021 at a well-known event venue – where it will be operating on a mix of waste straw bales and waste wood as well as RDF, to supplement its fuel source. It will provide heat and power for the entire site – comprising hotel, farm, cottages and more – in a bid to reduce its carbon footprint and become a self-sufficient cycle of energy generation and consumption.

Looking at what the future holds for the rotary equipment, and the WtE scene more broadly, Tidy Planet has received multiple enquiries in the UK for applying the Horizon+ technology within decentralised WtE facilities. And it anticipates the appetite and demand for UK-centred recovery solutions to only increase over the next year, as the country continues to navigate the unknown waters ahead following Brexit and the aftermath of the pandemic.

Simon Webb is Managing Director of Tidy Planet Energy, the UK's sole distributor of Sugimat's Waste-to-Energy (WtE) boilers.



Junior Isles

While Rome burns

Millions of US voters could be forgiven for thinking that perhaps Nero was in the White House these last weeks. Much like the Roman emperor, who according to legend played the 'fiddle' while Rome burned, outgoing US President Donald Trump was playing golf as Covid deaths rose exponentially and concerns grew over the impacts of his failure to begin the transition to the next government.

The feeling of Rome burning while Trump occupied his time otherwise is perhaps how the international climate change community has felt during his four-year term.

Since taking office in 2016 with a campaign promise to rejuvenate the coal fired power sector, Trump has overturned over 100 major environmental regulations and, according to a recent report, auctioned off millions of acres of public land to the fossil fuel industry. New research conducted by the Wilderness Society Action Fund, and shared with *the Guardian* newspaper, in October found that the Trump administration has leased 5.4 million acres – an area the size of New Jersey – to oil and gas companies.

According to the report, drilling from the leases could result in the equivalent of 4.1 billion metric tons of carbon dioxide emissions – heating the planet as much as more than 1051 power plants burning coal for a year.

Trump has long shown scant regard for climate change. His views have been sceptical at best and adversarial at worst. Even before assuming office, in 2012 he said climate change was

“created by and for the Chinese in order to make US manufacturing non-competitive”. Since then he has continued to dismiss climate change proponents as “hoaxsters” and “prophets of doom”.

Having pulled the US out of the Paris Climate Accord, his loss in the recent US election will therefore bring a sigh of relief to countries around the globe doing their utmost to halt climate change. The arrival of Joe Biden as the new president and his promise to re-enter the Paris agreement has been welcomed by world leaders and those that continue to drive policies that will combat global warming. Paris Mayor Anne Hidalgo, referring to the US rejoining the climate accord, tweeted: “Welcome back America!”

“It is a big relief that the US comes back,” said Laurence Tubiana, Chief Executive of the European Climate Foundation, and one of the key architects of the Paris pact. “The positive domino effect from [the] Biden presidency will be enormous,” she added.

Bill Hare, Chief Executive of Climate Analytics, a research group said “this could be an historic tipping point,” noting that with the US on board, the Paris accord goal of limiting global warming to 1.5°C was within striking distance “for the first time ever”. In September, China, the world’s largest producer of CO₂, ahead of the US, promised to be carbon neutral by 2060. Net zero targets in both the US and China could reduce global warming from 2.7°C by the end of the century, to about 2.3-2.4°C, according to projections from German

research group Climate Action Tracker.

But even though climate change and green energy are high on Biden’s agenda, delivering his campaign proposal on energy and meeting the international goals on global warming will by no means be plain sailing. Better weather may lie ahead but there will be high waves to navigate before reaching that calm horizon.

At the international level, one challenge will be determining new climate targets. The Paris agreement would require the US to set climate targets for 2030, much nearer than Biden is proposing. The president-elect has said he will target net zero emissions by 2050, and for all electricity to be emissions-free by 2035. He also pledged to electrify large parts of the country’s transit network and crack down on pollution.

Biden’s climate plan released in July this year promised \$2 trillion over four years to fund clean energy and infrastructure as a way of reviving the US economy. He said his clean energy plan would create “millions of good-paying jobs” in sectors from construction to electric-vehicle manufacturing and the decommissioning of abandoned oil and gas wells.

But with a good chance the Republicans will retain control of the Senate, there is a limit to how much of his agenda he will be able to deliver. Even in the House of Representatives, where Democrats have a majority, the party’s moderates and liberals are divided over whether ideas like the Green New Deal backed by Bernie Sanders and

Alexandria Ocasio-Cortez would ultimately hurt the party’s chances in oil and gas states.

John Podesta, a Chief of Staff in the Clinton administration and later adviser to Barack Obama, said that without a majority, Biden would have to “scale back” his ambitions to secure his proposed level of funding. In an interview with *the Financial Times*, he said: “They’ll be able to get half of that... They’ll have to pick their shots in the Congress.”

Still, there are things Biden can do without Congress. According to Podesta, the new administration could immediately approve some offshore wind permits left unsigned by President Trump, including Iberdrola’s proposed 800 MW facility off Massachusetts. “There’s financing available and the north-east governors all want it,” he told the *FT*.

With the federal government constrained, state policies will continue to be important. The key influences shaping the US energy industry are likely to be market forces, just as they were under Barack Obama and Donald Trump. Nevertheless, research consultancy Wood Mackenzie noted that the change of federal government will have some significant consequences.

Listing what it sees as the most important, Ed Crooks, Wood Mackenzie Vice-Chair said there would be a boost for offshore wind. “The Trump administration has slowed the process of approving offshore wind and proposed to close off a section of the US Atlantic coast from Florida to Virginia. A Biden administration will act faster to support states and companies seeking to develop offshore wind industries,” he said.

Crooks also believes there will be restrictions on oil and gas development. “There will not be a ban on fracking, but Biden has pledged to end sales of new leases for oil and gas development on public lands and waters. Onshore, the impact would be minimal. Offshore, the effects would be more significant, although they would take some time to become apparent. A ban on new leasing, if permanent, would mean that by 2035 US offshore oil and gas production would be about 30 per cent lower than if lease sales had continued.

Notably he said decisions on federal permits for oil and gas infrastructure projects will take into account their implications for greenhouse gas emissions and climate change, creating new hurdles for developers of oil and gas pipelines and export facilities.

Only time shaped by politics will reveal how much of an impact a Biden administration makes on the climate. Nevertheless, it is probably safe to say that, while this is no time for complacency, there is now a greater chance that the storms of climate change will dissipate.

In his attempt to hang on to the White House, following an election result he still rejects, Trump has made no attempt to smooth the transition of power to Biden. Among other moves to obstruct the handover, his administration’s Treasury Department is refusing to extend certain stimulus measures beyond December.

Fortunately, it looks like the fears that Trump might embark on a “scorched Earth strategy” – burning the furniture before the Biden administration takes over – are looking less likely to fully pan-out. And so too, as Trump exits the building, the fears of a scorched Earth from climate change have receded just a little. Perhaps Rome can now breathe a little more comfortably.

Cartoon: jemsoar.com

