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Special Project Supplement

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Mirror to the future

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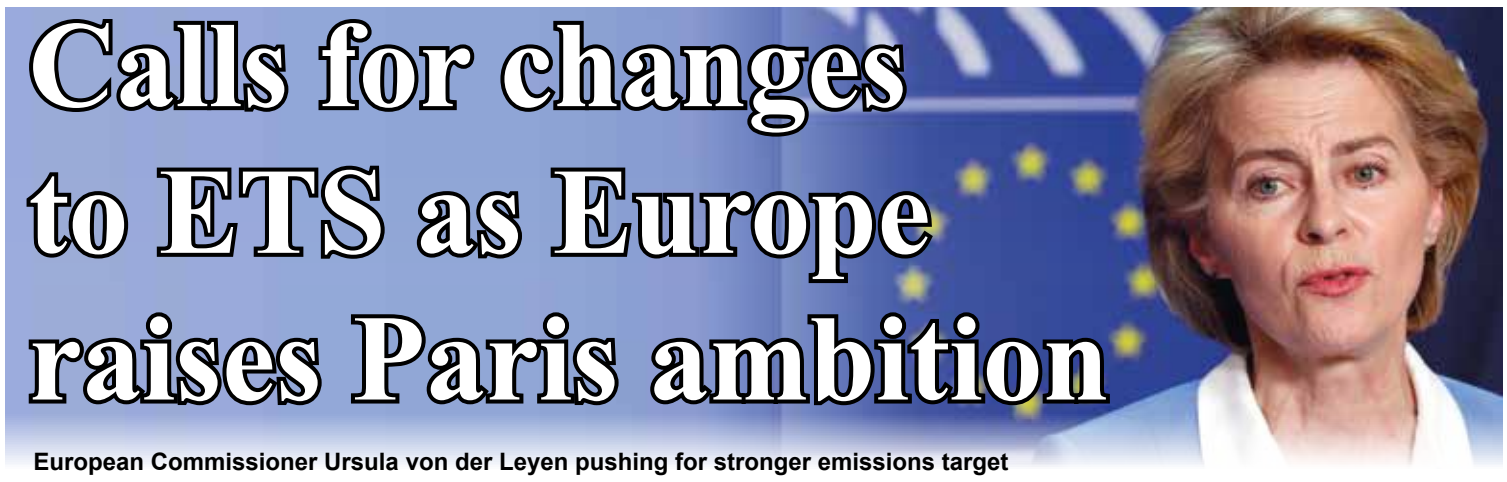
Calls for changes to ETS as Europe raises Paris ambition



European Commissioner Ursula von der Leyen pushing for stronger emissions target

Changes are needed to Europe's emissions trading scheme if it is to fulfil its new target for carbon emissions. **Junior Isles**

There has been a growing number of calls for the European Commission to upgrade it Emissions Trading Scheme (ETS) following the announcement of the bloc's proposal to increase its climate commitment and reduce carbon dioxide emissions by at least 55 per cent by 2030 relative to 1990 levels. This is the level necessary to put the EU on a path to climate neutrality by 2050.

A new report by the European Court of Auditors (ECA) called for the Commission to update its procedure for targeting free allowances to reflect the Paris Agreement and recent developments. It noted that free allowances still make up over 40 per cent of all available allowances under the EU's 'cap and trade' ETS, and that these free allowances, distributed to industry, aviation and, in some Member States, the electricity sector, were not well targeted.

The EU's ETS uses free allowances to discourage EU businesses from transferring activity to non-EU countries with lower environmental standards, as this would reduce investment in the EU and increase global emissions. This is known as carbon leakage.

The industrial and aviation sectors benefit from free allowances, unlike most operators in the power sector, as it is considered that they can pass on carbon costs directly to the consumer. However, in the eight Member States with a GDP per capita below 60 per cent of the EU average, the power sector received free allowances to enable modernisation to take place. According to the ECA, this has significantly reduced the speed of decarbonisation in the power sector.

"Free allowances should be targeted at those industrial sectors least able to pass on carbon costs to consumers," said Samo Jereb, the ECA Member leading the audit. "However, this is not the case. Sectors representing over 90 per cent of industrial emissions are equally considered at risk of carbon leakage and benefit from continuous high rates of free allowances. Unless the allocation of free allowances is better targeted, the EU will not reap the full benefits the ETS could have on decarbonisation and public finances."

The auditors acknowledge, however, that the Commission has tightened rules affecting the power sector for 2021-2030.

There were also calls to extend the ETS to heating. EGEC Geothermal said it is absolutely crucial the European Commission recognises the importance of decarbonising heating and make this a priority area for action.

The heating and cooling sector represents 51 per cent of final energy consumption in Europe and approximately 27 per cent of EU carbon emissions.

EGEC Geothermal noted that 80 per

Continued on Page 2

Trump administration continues pushback on Democrat clean energy stance

Trump administration has finalised its weakening of an Obama-era rule aimed at reducing polluted wastewater from coal burning power plants that has contaminated streams, lakes and underground aquifers.

Utilities are expected to save $140 million annually under the changes, which Environmental Protection Agency (EPA) Administrator Andrew Wheeler said in a statement would protect industry jobs in part by using a phased-in approach to reducing pollution.

But environmentalists and a former EPA officials warned the move will harm public health and result in hundreds of thousands of pounds of pollutants annually contaminating water bodies.

The new rule introduced at the end of August largely exempts coal plants that will retire or switch to burning natural gas by 2028.

It is the latest in a string of regulatory rollbacks for coal power under US President Donald Trump – actions that have failed to turn around the industry's decline amid competition from cheap natural gas and renewable energy.

The Democrats' clean energy vision has come under fire since Trump took office in 2016 and has become a point of political debate with the Californian forest fires that have caused blackouts in the Democrat-run state.

The American Energy Alliance said California was a preview of what Democratic presidential candidate Joe Biden's plan would do to the rest of country, stating that the blackout stemmed from a "severe heatwave and without the wind blowing and the sun shining".

"Residents are asked to conserve electricity to keep the power on – something most other states do not have to endure," the Alliance noted. "This should be a warning to America about the risks of Biden's Clean Energy Standard that would require 62 per cent of our electricity which is now produced from natural gas and coal to come from non-carbon sources, which would primarily be wind and solar power."

Renewables currently generate about 15 per cent of America's power. Biden has specifically pledged to eliminate carbon emissions from the power grid by 2035.

"The whole thing is a kind of fairytale that assumes you can run the electric grid on fairy dust," said Myron Ebell, Director of Competitive Enterprise Institute's Center for Energy and Environment. "What the Green New Deal and the Biden Energy Plan have not figured out is where the electricity is going to come from when the wind isn't blowing and the sun has been down for a day."

Meanwhile, Wyoming's governor is promoting a Trump administration study that says capturing carbon dioxide emitted by coal fired power plants would be an economical way to curtail pollution. PacifiCorp, the utility that owns the plants and wants to shift away from the fossil fuel in favour of wind and solar energy, has questioned the findings.

The study released in late August says adding carbon capture at the four plants would reduce carbon dioxide emissions 37 per cent, cost electricity customers 10 per cent less and produce up to five times more jobs compared with PacifiCorp's plans to shift to clean energy.

PacifiCorp took issue with the study, saying it ignored "everything associated with how a utility's costs flow into rates" and made a range of assumptions.

"As PacifiCorp continues to examine the study's assumptions and calculations to properly evaluate its conclusions, we're finding many of those conclusions are simply wrong," David Eskelsen, a spokesman for PacifiCorp subsidiary Rocky Mountain Power, said in a statement.

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cent of the heating market is dominated by fossil fuels, which benefit from direct and indirect subsidies that lock out geothermal energy and other renewable energy technologies. A uniform carbon price across Europe can address this unfair distortion of the internal market.

Sanjeev Kumar, Head of Policy, at EGEC Geothermal said: "Extending the EU to heating is an important step in accelerating the energy transition in buildings and delivering carbon neutrality by 2050." He added: "A robust carbon price sufficient to drive transformative change is key to the race against the clock to tackle the climate emergency."

There is growing recognition that emission reduction policies need a more integrated approach. Commenting on the EU announcement, COGEN Europe, said additional ambition requires a robust impact assessment comprising all solutions for all sectors. It said higher targets should be based on "sound economic analysis and take into account the different energy needs of different economic sectors".

Korteweg says targeted measures for heating needed

Hans Korteweg, Managing Director of COGEN Europe, commented: "Any targeted measures on heating and cooling should fully leverage the benefits of cogeneration to decarbonise heating and cooling, to efficiently integrate the heat sector with the power and gas networks and to support industrial competitiveness."

Solar Heating Europe also stressed the need for faster deployment of renewable heating and cooling solutions. "We believe that 55 per cent is the absolute minimum that the Member States need to agree to," stated Pedro Dias, Secretary General of Solar Heat Europe. "This commitment must prioritise higher and mandatory targets for direct renewable heat."

The Commission's move to increase its CO_2 reduction targets has been broadly welcomed.

Johannes Teyssen, CEO of German energy company E.On said: "We welcome Ursula von der Leyen's initiative to reduce greenhouse emissions within the EU by 55 per cent by 2030. The EU is thus demonstrating its leading role within the international community and is clearly committed to the Paris Agreement in 2015."

Business leaders had also pushed for stronger targets ahead of the Commission's proposal. More than 150 European businesses, investors and business networks, including Microsoft, IKEA, Deutsche Bank, Unilever, H&M, Google, EDF and Apple all called on EU leaders to back the increased ambition.

In an open letter they stated: "From a business and investor perspective, clarity on the net zero transition pathway and timetables for each sector, as well as policy that enables substantial investments in carbon neutral solutions is essential. This in turn would provide us with the confidence needed to invest decisively at the necessary pace and scale to reduce emissions, create decent green jobs, drive innovation, and accelerate the rebuilding of a resilient zero carbon economy."

Urgent scale-up of clean energy technologies needed

The world needs a dramatic scale-up of clean technology if it is to achieve its net zero ambitions. Several reports have identified hydrogen as a key technology. **Junior Isles**

Junior Isles

A major effort to develop and deploy clean energy technologies worldwide is urgently needed to meet international energy and climate goals, particularly in order to reduce carbon emissions from areas beyond the power sector such as transport, buildings and industry, according to a new report published by the International Energy Agency (IEA).

In its 'Energy Technology Perspectives (ETP) 2020', the Paris-based agency stresses that with global carbon emissions at unacceptably high levels, structural changes to the energy system are required to achieve the rapid and lasting decline in emissions called for by the world's climate targets.

ETP 2020 – the first since 2017 – analyses over 800 different technology options to assess what would need to happen to reach net zero emissions by 2070 while ensuring a resilient and secure energy system.

It finds that transitioning just the power sector to clean energy would get the world only one-third of the way to net zero emissions. Completing the journey will require devoting far more attention to the transport, industry and buildings sectors, which today account for about 55 per cent of CO_2 emissions from the energy system. Much greater use of electricity in these sectors – for powering electric vehicles, recycling metals, heating buildings and many other tasks – can make the single largest contribution to reaching net zero emissions, according to the report, although many more technologies will be needed.

The report not only shows the scale of the challenge but also offers vital guidance for overcoming it.

It says governments need to play "an outsized role" in accelerating clean energy transitions towards meeting international goals, and highlights core areas that policy makers need to ensure they address.

During the report's launch, Dr Fatih Birol, the IEA's Executive Director, said solar is "leading renewables to new heights" and singled out batteries, bio-energy, carbon capture usage and storage (CCUS) and hydrogen as "game-changing technologies".

Notably, hydrogen is expected to play a large and varied role in helping the world reach net zero emissions by forming a bridge between the power sector and industries where the direct use of electricity would be challenging, such as steel and shipping.

In its 'Energy Technology Outlook' 2020 launched in September, DNV GL said hydrogen is vitally important for reducing emissions from hard to abate industries, such as building heating and industries with high heating demand, but requires a massive boost from policy to achieve a meaningful impact. It noted that hydrogen has been given a boost by policy developments in the European Union, but it will still only contribute 6 per cent of energy demand by 2050.

In late August a report by the Institute for Energy Economics and Financial Analysis (IEEFA) revealed the green hydrogen industry is accelerating with 50 new projects announced in the last year. It stressed, however, that the pace is not fast enough to meet global energy demand, with massive capital shortfalls and government inaction stalling start-ups.

BP Outlook says energy transition can still be delivered

Although the world remains on an unsustainable path, the energy transition can still be delivered, says BP in its latest Energy Outlook.

The 2020 edition of the 'BP Energy Outlook' explores possible paths for the global energy transition, how global energy markets may evolve over the next 30 years and the key uncertainties that may shape them. Looking out to 2050 – a decade further than in previous editions – the Outlook is focused around three main scenarios.

In the main scenarios it considers, global energy demand continues to grow for at least part of the period to 2050. However, over this time, the structure of energy demand fundamentally shifts, with a declining role for fossil fuels offset by an increasing share for renewable energy and a growing role for electricity.

Launching the Outlook, BP's CEO Bernard Looney commented: "This year the Outlook reaches out a decade further than before, to 2050 – the year by which we intend to deliver our net zero ambition.

"Even as the pandemic has dramatically reduced global carbon emissions, the world remains on an unsustainable path. However, the analysis in the Outlook shows that, with decisive policy measures and more low carbon choices from both companies and consumers, the energy transition still can be delivered. It is one of the reasons I remain optimistic about the future."

The Outlook's three main scenarios – 'Rapid' (70 per cent reduction in CO_2 by 2050), 'Net-zero' (over 95 per cent reduction) and 'Business-as-usual (BAU)' (less than 10 per cent reduction) – are not predictions but, based on alternative assumptions about policies and societal preferences, are designed to help explore the range of outcomes possible over the next 30 years.

In all three scenarios, global energy demand grows, driven by increasing prosperity and living standards in the emerging world. Primary energy demand plateaus in the second half of the Outlook in 'Rapid' and 'Net Zero' as improvements in energy efficiency accelerate. In 'BAU', demand continues to grow, reaching around 25 per cent higher by 2050.

The transition to a lower carbon energy system results in a more diverse energy mix, as all three scenarios see a decline in the share of the global energy system for hydrocarbons and a corresponding increase in renewable energy as the world increasingly electrifies. The scale of the shift varies significantly across the scenarios, with the share of hydrocarbons in primary energy declining from around 85 per cent in 2018 to between 65-20 per cent by 2050 and renewable energy rising to 20-60 per cent.

While oil demand shrinks in all three scenarios, the Outlook shows gas to have much more resilience.

Global gas demand varies significantly across the scenarios. It peaks in the mid-2030s in Rapid and in the mid-2020s in Net Zero, and in those two scenarios by 2050 is broadly similar to 2018 and around a third lower, respectively. In BAU, gas demand increases throughout the next 30 years to be around a third higher by 2050.

According to BP, natural gas can potentially play two important roles in an accelerated transition to a low-carbon energy system: supporting a shift away from coal in fast growing, developing economies where renewables and other non-fossil fuels may not be able to grow sufficiently quickly to replace coal; and combined with CCUS as a source of (near) zero-carbon power. Gas combined with CCUS accounts for between 8-10 per cent of primary energy by 2050 in Rapid and Net Zero.

Hitachi exit from UK nuclear threatens net zero ambitions

Hitachi's announcement that it will be terminating its involvement in UK nuclear projects at Wylfa Newydd and Oldbury has cast a shadow on the nation's plans for a new nuclear fleet and the country's carbon reduction goal.

The projects have been experiencing financing difficulties. Both were suspended in January 2019 due to the absence of a clear funding package for the lead Wylfa Newydd project in Wales.

"Hitachi made this decision given that 20 months have passed since the suspension, and the investment environment has become increasingly severe due to the impact of Covid-19," it said in a statement.

Hitachi said it would coordinate with the British government and relevant organisations regarding the handling of the planned construction sites and other issues.

The official announcement last month will make the UK's aim to reach net zero by 2050 more difficult.

While describing the decision as "disappointing," a UK government spokesperson told the *Financial Times* it was open to discussing new nuclear projects with any viable companies and investors that are willing to develop sites in the UK, including in North Wales.

"Nuclear power will play a key role in the UK's future energy mix as we transition to a low-carbon economy, including through our investments in small and advanced modular reactors," the spokesperson added.

Wylfa and Oldbury are two of eight sites earmarked for new nuclear power stations to replace the UK's current ageing fleet, which provides about 20 per cent of the nation's electricity but almost all of which is set to come offline within the decade.

Development of those sites is looking increasingly likely, however, given both private companies and governments are wary of the huge costs of nuclear power and long payback time. The falling cost of wind and solar has also made the projects more questionable.

Toshiba abandoned plans for a new station in Moorside, Cumbria, amid financial troubles in 2018 and a potential rescue by the South Korean group Kepco failed to materialise. This leaves only EDF and its Chinese state partner CGN now developing new nuclear power plants in the UK. It has started construction of Hinkley Point C in Somerset and is hopeful that Sizewell C in Suffolk will still proceed.

A spokesman for EDF said: "Hitachi's decision does not change the need for large scale nuclear in the UK.

"It is the only technology ready to deliver the always-on low carbon electricity we will need alongside renewables to get to net zero emissions.

"With fewer new nuclear projects in planning, it is vital that Sizewell C gets built."

FERC to exploit value of DERs

- Residential solar and EVs can supply wholesale markets
- Solar grows despite pandemic

Junior Isles

New rules approved by the Federal Energy Regulatory Commission (FERC) look set to bring the value of distributed energy resources (DERs) to the wholesale electricity system and to end-consumers in the US.

Last month FERC said it would allow rooftop solar generators, electric vehicle (EV) batteries and other small energy resources to supply wholesale power markets in the US, thereby challenging delivery systems controlled by electric utilities.

The order on DERs is the latest supported by Neil Chatterjee, the Chairman of FERC, to reflect the changing patterns of generating, transmitting and distributing electricity.

"DERs can hide in plain sight in our homes, businesses and communities across the nation. But their power is mighty," Chatterjee said.

He noted that EVs could be tied together by an aggregator while they are parked and plugged in, effectively becoming a large battery that could feed the grid at certain times. He also cited rooftop solar arrays and home storage batteries as technologies that could be used to help implement "demand response" schemes, where customers are paid to reduce consumption, thereby reducing demand on the grid.

The FERC order builds on a policy that already allows energy storage facilities to sell into power markets. It will allow companies to bundle electricity and other services from thousands of individual sites and sell it into FERC-regulated wholesale markets. Groups of state regulators and utilities previously lost legal challenges to the 2018 storage rule.

The decision has been welcomed by the Solar Energy Industries Association (SEAI). Katherine Gensler, Vice-President of Regulatory Affairs for the association, said: "Competition in our electricity markets is a critical part of our clean energy transformation. This rule will create jobs, drive local economies and enable the solar industry to supply 20 per cent of US electricity generation by 2030."

The rule is likely to further boost the fast growing solar market. Last month, SEIA and Wood Mackenzie reported that utility-scale solar had its best second quarter, installing a record 2.5 GW of capacity.

In their latest 'US Solar Market Insight' report solar parks represented 37 per cent of all new power capacity installed in the US in the first six months of this year. In the second quarter, the capacity of newly announced power purchase agreements (PPAs) reached 8.7 GW boosting the contracted pipeline to 62 GW in direct current (DC).

Between 2021 and 2025 the US is seen to install almost 100 GW DC of solar capacity, 42 per cent more than in the last five years. In mid-2020, the country's solar capacity was 85 GW, including 50 GW of utility-scale photovoltaic (PV) parks in operation.

The report noted, however, that the market has been impacted by the pandemic, particularly the residential segment. It shows a 23 per cent quarter-on-quarter drop in residential and a 12 per cent decrease in non-residential solar installations because of the measures taken to limit the spread of Covid-19.

Wood Mackenzie expects 2020 capacity additions to be up 37 per cent year-on-year to more than 18 GW DC. This is 6 per cent below the company's forecast before the pandemic.

Brazil moves ahead with power sector modernisation

Renewables will account for nearly 25 per cent of Brazil's total electricity generation by the end of the decade

Brazilian President Jair Bolsonaro has signed a provisional measure to put into effect several of the measures proposed to modernise power sector regulations that are currently under discussion in Congress. The decision is expected to help reduce power tariffs, especially for consumers in the north region, which is supplied by distributors that were privatised in recent years.

"We could have a reduction in future tariffs of 13 per cent in Amazonas, Acre, Rondônia and Roraima states. Those states will have the largest reductions but of course those measures benefit all Brazilians," Energy Minister Bento Albuquerque said. "There will also be a subsidies reduction, as those currently account for 20 per cent of power bills."

The proposed changes were approved in the upper house in March and are now awaiting the nod from the Lower House. The issue was put aside due to the urgent bills pushed through to deal with the health crisis, but executives in the sector say the measures will be essential to help underpin the nation's economic recovery.

Brazil's plan to modernise power sector regulations has been debated for at least five years and also includes updates to energy price formulas, with hourly prices, auction models, reduction of red tape, the opening of the market, use of new technologies and the integration of the gas and electricity markets. One of the most notable changes is to allow all consumers to choose energy suppliers, regardless of the load or voltage they use. Currently, only large consumers with demand above 2.5 MW are allowed to choose.

- Brazil's Casa dos Ventos has signed a protocol of intentions with the Bahia state government for the implementation of wind projects with a total investment of about BRL9.1 billion ($1.7 billion). The company will build the Santa Diana, Santa Luzia, Santo Adalberto and Sao Carlos wind complexes to produce a combined 6.6 TWh per year, the state government said last month.

First US SMR design approved but doubts remain

NuScale Power has secured the Final Safety Evaluation Report (FSER) from the US Nuclear Regulatory Commission (NRC) for its small modular reactor (SMR) but some experts have expressed concerns over the potential expense and remaining safety issues that the industry would have to address before any such reactors are built.

By obtaining the FSER, NuScale aims to bring its SMR technology to market this decade. The NRC's design approval and FSER do not mean the company can begin building reactors but utility companies can now apply to the NRC to build and operate NuScale's design.

NuScale Chairman and CEO John Hopkins said: "This is a significant milestone not only for NuScale, but also for the entire US nuclear sector and the other advanced nuclear technologies that will follow."

SMRs are being developed to speed up construction, lower cost and improve safety over traditional nuclear reactors, which are typically many times larger. NuScale's design has a generating capacity of 50 MW and the NRC says it expects an application for a 60 MW version in 2022.

NuScale says it expects to sell anywhere from 674 to 1682 reactors between 2023 and 2042. Its first scheduled project is with Utah Associated Municipal Power Systems (UAMPS). It will deliver an SMR for a project at the Idaho National Laboratory by 2027 that it is scheduled to be operational by 2029.

Some experts, however, have expressed concerns over the UAMPS project. M. V. Ramana, a professor and nuclear expert at the University of British Columbia, said: "I am sorry to say that what lies ahead is risky and expensive."

He noted that in the past five years alone, cost estimates from various sources for the UAMPS project have risen from approximately $3 billion to more than $6 billion. Ramana also said costs to consumers could far exceed those of other emissions-free power sources such as solar and wind.

Others point out that despite the NRC's design approval, some safety features still require adjustment. "I don't think future NuScale applicants will benefit from a design certification that has safety gaps in it," said Edwin Lyman, Director of nuclear power safety at the Union of Concerned Scientists. He said the NRC has issued its final safety report in spite of questions raised both by an expert at the agency and an external advisory board.

The NRC says those questions will be further assessed when site-specific licensing applications – the step needed to actually begin building and operating a reactor – are submitted.

US utilities preparing for switch from gas to hydrogen

Three US utilities are preparing for the switch from natural gas to hydrogen, which many say is needed if the power sector is to dully decarbonise.

At the start of September, three developers of more than $3 billion in planned natural gas fired generation projects in New York, Ohio and Virginia selected Mitsubishi Power Americas Inc., to supply hydrogen-compatible gas turbines along with the facilities for generating and storing hydrogen produced from renewables.

The three projects, totalling nearly 3300 MW, are Tiger Partners LP's Danskammer Energy Center (Repowering) in Orange County, New York, Ember Partners LP's Cadiz Combined Cycle Plant (Harrison County Industrial Park) in Harrison County, Ohio; and Balico LLC's Chickahominy Power project in Charles City County, Virginia.

The projects are part of a growing drive to establish hydrogen as a critical element of utility, corporate and state efforts to develop power systems relying on very high levels of variable wind and solar energy.

Notably, the projects will be the world's first to use Mitsubishi Power's standard packages for green hydrogen integration.

"[The] three projects will utilise the Hydaptive package to provide greatly improved power plant flexibility and make a power plant 'hydrogen ready' as hydrogen infrastructure matures and renewable storage requirements increase," said Paul Browning, President and CEO of Mitsubishi Power Americas. "With these projects and others to come, we will create a true path to the zero-carbon power grid of the future."

The three projects would initially be capable of operating on a mix of 30 per cent hydrogen and 70 per cent natural gas.

US tensions impact China power sector

Government reduces gas fired power tariffs

US reactors no longer in favour

Syed Ali

Tension between the US and China is having an indirect impact on China's power sector.

Last month Wood Mackenzie reported that gas power plants are struggling to stay afloat as they face mounting pressure from lower tariffs and the ongoing trade war.

The Chinese government has been reducing regulated gas fired power tariffs by 16 per cent to 28 per cent in key provincial markets since June 2020. This is driven by political goals of reducing end-user power prices and improving manufacturing competitiveness in the wake of trade tensions with the US. Power tariffs for industries in China have fallen 25 per cent in the last three years.

Gas fired power tariffs at some higher-utilised gas plants (>3500 hours per year) have even been lowered to a level similar to the much cheaper coal fired power. This 'coal parity' initiative has a huge impact on the economics of the current gas fleet and investment decisions for new units.

Wood Mackenzie principal consultant Frank Yu said: "The new regulations will cause at least a 5 to 6 percentage point decline in the already poor margins of gas power plants. Delivered fuel costs at most gas power plants have only declined by 10 per cent to 13 per cent, while revenues have been cut by 16 per cent to 28 per cent due to the new regulations. Most projects are now loss-making or barely breaking even."

Despite strong demand growth for clean power, government policies have been moving to limit gas power development and support energy security goals.

By 2025, around 8 billion m^3 or 17 per cent of gas demand for power generation in four coastal markets could be at risk due to fewer new builds and lower utilisation hours as a result of poor economics. Wood Mackenzie estimates around 7 GW out of 17 GW of gas fired power projects scheduled for commissioning between 2022 and 2025, to be at risk of delays or cancellations. These projects are located in the coastal provinces of Zhejiang, Jiangsu, Shanghai, and Guangdong.

Worries over energy security and increasing geopolitical uncertainties, has also seen the country switch from US nuclear power technology to a domestically developed alternative, according to a recent report in the *South China Morning Post*.

The AP1000 technology, designed by America's Westinghouse Electric Company, was once the basis of China's third-generation nuclear power, but now the country has more third-generation reactors based on its own Hualong One technology under construction or approved, than it does AP1000 reactors.

Meanwhile, four units approved last year and another four nuclear reactors approved on September 2 – in Hainan and Zhejiang province – will also use Hualong One technology.

Wang Yingsu, Secretary General of the nuclear power branch of the China Electric Power Promotion Council said that technology localisation, development of indigenous nuclear power technology, and the capability of constructing and operating nuclear power plants independently had always been China's goal since it began its nuclear power journey more than 50 years ago.

"More power plants will choose Hualong One in the future because it's China's independently developed technology and it's as good as AP1000," Wang commented. However, he added: "AP1000 is Westinghouse's technology and we might be controlled by them if we want to build the reactors, sell and export to other countries."

When the US sanctioned China General Nuclear Power Group (CGN) and three of its subsidiaries in 2019 over accusations of stealing US technology for military use, CGN said the impact on the company was "controllable".

Xu Kan, assistant general manager of Qinshan Nuclear Power Plant, a subsidiary of China National Nuclear Corporation (CNNC), said last year that CNNC began investigating the possible impact of geopolitical factors on its 21 reactors in 2018.

Japan prepares offshore wind blueprint

Japan is set to draft new rules and cretae a support framework in a drive to construct offshore wind projects at 30 locations by the end of the next decade.

Under the plans, three or four projects would be built per year with a total generation capacity of 1 GW, from the fiscal year beginning in April 2021 until 2030-2031. By the end of the decade, a total of 10 GW of potential generation sites are expected to be identified for further development, according to data and analytics company GlobalData.

Japan's offshore wind sector is already proving attractive to investors. In September Equinor, Jera and J-Power announced a partnership to enter a joint bid agreement prior to Japan's upcoming Round 1 offshore wind auction.

The three companies will jointly evaluate and work towards submitting a joint bid in the Round 1 auction once the Japanese government officially opens what will be country's first offshore wind auction.

The Japanese government has dedicated Yurihonjo and Noshiro, two areas offshore the northern Japanese prefecture of Akita, as promotional zones for offshore wind, each representing an area for bottom-fixed offshore wind farms of approximately 400 MW and 700 MW, respectively.

The upcoming auction is anticipated to start within the next months, with bid submission taking place six months after the auction opens. Once the auction is closed, the results are expected to be announced towards the end of 2021. Potential wind farms would then tentatively be operative post 2025.

Also in September, Spanish energy company Iberdrola reached an agreement with Macquarie's Green Investment Group (GIG) for the acquisition of 100 per cent of Japanese developer Acacia Renewables. Acacia Renewables currently has two offshore wind farms in development, with a combined power of 1.2 GW, which could be operational by 2028.

It also has four other projects in its pipeline, with a total generating capacity of 2.1 GW. Three of the six projects will use floating foundations. Iberdrola will hold an equal share in the six projects alongside GIG, and the partners will develop the portfolio.

The acquisition of this local renewable developer gives Iberdrola the opportunity to position itself in the Japanese offshore wind sector, which is at an early stage of development.

Installed offshore wind capacity in Japan is currently around 70 MW, but the forecasts indicate that the market will reach 10 GW of installed capacity in 2030, and up to 37 GW in 2050.

ADB advised to formally stop funding coal fired plants

■ ADB should also revisit its energy policy ■ Coal investment will fall to $18 billion by 2030

Syed Ali

The Independent Evaluation Department (IED) of the Asian Development Bank (ADB) has recommended that the Manila-based multilateral development bank (MDB) formally withdraw from financing new coal fired power projects to help the region play a bigger part in tackling global climate change.

In a statement, the IED said the bank should also revisit its energy policy. The IED said ADB has refrained from investing in coal fired power plants since 2013 but noted there is now a need for ADB to clarify its formal institutional position regarding the financing and use of coal energy resources.

"Asia has the highest demand for natural resources and the largest emissions of greenhouse gases contributing to climate change. Therefore, efforts of ADB's developing member countries to curb these emissions will have worldwide impact," ADB Director General for Independent Evaluation Marvin Taylor-Dormond said.

The Asia and Pacific region has the world's most coal projects in the pipeline, with 78 per cent of those plants located in ADB's developing member countries.

The sector-wide evaluation of ADB Energy Policy and Program 2009-2019, assessed ADB's assistance to the energy sector across all its developing member countries from 2009 to 2019 and the relevance of its Energy Policy 2009.

"As a leading development partner in the region, ADB can play a key role in helping address these serious environmental challenges through its energy policy," Taylor-Dormond said.

IED Director Nathan Subramaniam added: "The energy sector is undergoing a dramatic, rapid and global transformation due to new technological advances and climate change concerns. ADB's current energy policy is no longer adequately aligned with the ongoing transformation and with its new corporate strategy. ADB needs to ensure the new policy is aligned with the global consensus on climate change, its corporate strategy and recent changes in the energy sectors of the developing member countries."

The region's energy transition presents a significant opportunity. A recent Wood Mackenzie report shows that the power generation sector in Asia-Pacific could attract $1.5 trillion worth of investments over the decade ending 2030.

Solar and wind represent 66 per cent or $1 trillion investment opportunity in Asia-Pacific through 2030, while fossil fuels, mainly coal and gas, make up the remaining $500 billion. Investments in renewables have overtaken fossil fuel power since 2013.

Wood Mackenzie senior analyst Rishab Shrestha said: "The next decade will see gas/coal investment split at 40/60 but the share of coal is falling and beyond 2030 gas will contribute 70 per cent with coal falling to only 30 per cent.

"Traditionally, energy security and availability of low-cost coal are key drivers of coal investment in Asia. However, investment sentiment towards coal is waning as economies strive for a more sustainable and greener future."

"Coal investment will fall from its peak of $57 billion in 2013 to $18 billion by the end of the decade."

Vietnam facing power shortages

Vietnam is facing the risk of power shortages from 2021-25 due to the slow progress of several large power projects both in the northern and southern regions, according to the Ministry of Industry and Trade (MoIT).

A recent report submitted by the National Assembly's Economic Committee on the current situation and solutions for electricity development towards 2030 showed that high economic growth over the past two decades had caused electricity demand to jump.

Electricity output has increased by about 10 times from 1990 to 2019 with a series of projects being launched in accordance with a power master plan to meet the demand but their progress has not been fast enough to keep up with demand.

To ensure the balance of power supply and demand from 2021, the MoIT said it was studying operational solutions to maximise the use of existing power sources and enhancing the development of renewable energy sources that could be constructed quickly.

State utility Electricity Vietnam (EVN), however, recently highlighted potential problems with the plan to utilise more renewables. In a report last month it said that the construction of new transmission lines might not be able to match the speed of new solar and wind power projects.

Experts said constructing a new solar power project takes about six months, while building a transmission line could take two or three years. Land clearance, which typically takes a long time in Vietnam, could further delay the completion of transmission lines, they added.

EVN said that until now, it has been able to ensure production for 113 wind and solar projects in the country by building or upgrading 21 transmission lines since the second quarter last year.

Investors see floating opportunities in S. Korea

Floating wind and solar projects in South Korea are increasingly attracting the attention of both international and domestic companies.

At the start of September French energy giant Total announced the establishment of a 50/50 partnership, which will see it working alongside Macquarie's Green Investment Group (GIG) to develop a portfolio of five floating offshore wind projects with a total capacity of 2.3 GW.

The projects will be located in Ulsan and South Jeolla provinces, on the country's Eastern and Southern coasts. The partnership is due to become effective in Autumn 2020, with construction of the first project of 500 MW intended to commence by the end of 2023.

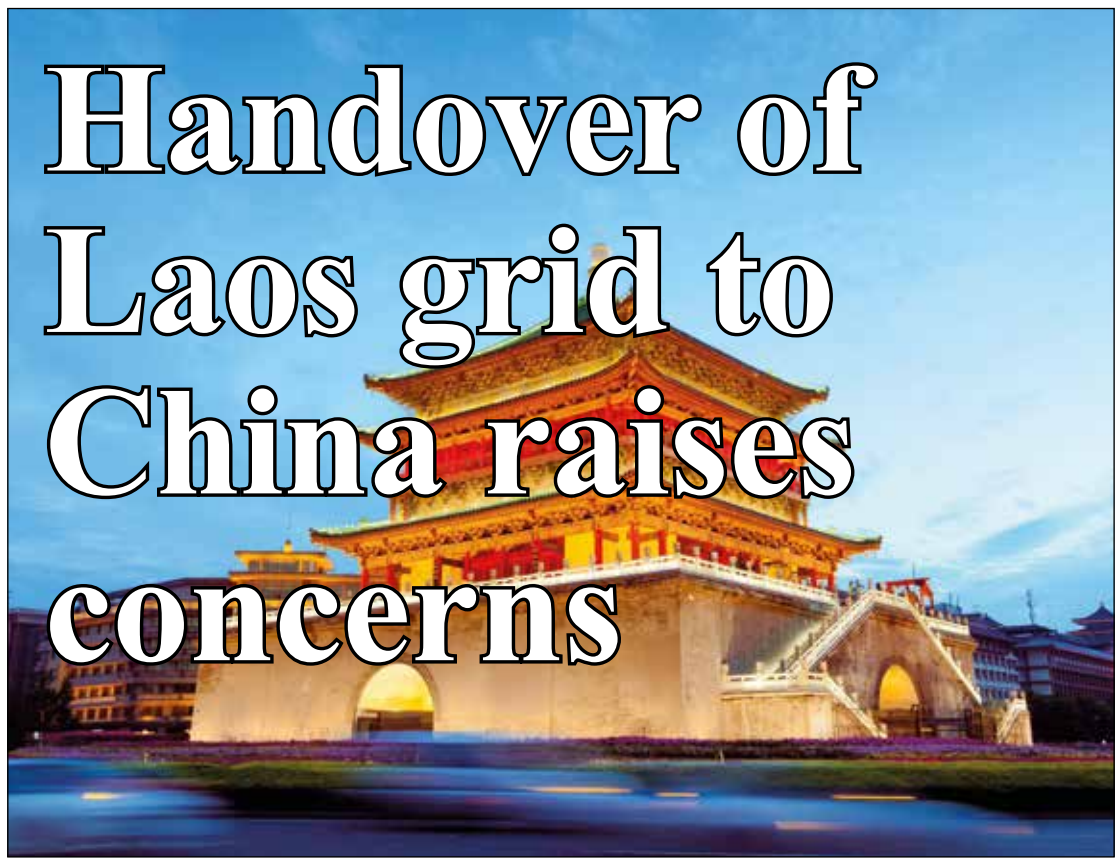
The plan is "in line with Total's strategy to profitably develop renewable energy worldwide and contribute to our net-zero ambition," Chief Executive Officer Patrick Pouyanne said in the statement.

"We strongly believe in the potential of floating offshore wind in South Korea, which will play a key role in achieving the country's renewables objectives. Thanks to its extensive experience in offshore projects, in cooperation with many Korean shipyards, Total is particularly well positioned to contribute to the successful development of this new technology in South Korea together with our partner GIG."

Floating solar technology is also attracting attention. In mid-September SK E&S Co., the clean energy & solution unit of South Korea's third largest conglomerate SK Group, said it was named the preferred candidate to build a 200 MW floating solar power plant near Saemangeum zone.

The company plans to spend up to Won500 billion ($420 million) in total for the project, which is part of the agency's ambitious plan to build a total of 2.1 GW solar power plant in the area, of which 0.5 GW is assigned to private companies.

If SK E&S secures the deal, it will install solar panels on a water surface area of about 2.64 million m^2. It aims to kick-off construction in the second or third quarter of next year to start operation by early 2023.



Handover of Laos grid to China raises concerns

Critics are concerned that a deal between Laos' state-run electricity company and China to ease debt cedes too much control to a foreign government concern.

In a move to save the debt-ridden domestic firm, last month Electricite du Laos (EDL) and the China Southern Power Grid Company established a new corporate entity called Electricite du Laos Transmission Company Ltd. (EDLT), which has control of Laos' power grid. The new entity also has the rights to purchase and sell power in Laos.

China Southern will take a majority equity share in the new company, according to an EDL official, who said the partnership with China Southern is necessary to continue to fund its ongoing projects.

"The new company will connect the [EDL and China Southern] power grids together. It's all about capital. It is necessary to join the two grids," a Lao Energy and Mines Ministry official told the *Radio Free Asia (RFA)* Lao Service.

"We don't have money for all of these projects, so we have to rely on the Chinese," the official added.

Laos is struggling from the impact of Covid-19 on its economy, but its biggest problem – government debt – predates the global pandemic. Fitch Ratings warned in May this year that the country's public debt would rise to $12.6 billion, or 65 per cent of its GDP, by the end of this year. The EDL's portion of that debt is higher than $8 billion mostly to China and Thailand.

A Lao Finance Ministry official said that the country had built up debt building dams and other big-ticket infrastructure projects.

"Our national debt has been accumulating over the years because we have many development projects. Right now, we're trying to pay back our debts step-by-step and in many different ways."

Commenting on the deal, Keith Barney of the Australian National University's Crawford School of Public Policy, said: "Needless to say that there are certain sovereignty concerns involved when a state-linked investor from China holds a controlling financial stake in Laos' national electricity grid."

The EDL official acknowledged that the Lao government would at first be a minority partner in the new enterprise but tried to assuage concerns that Laos would be losing control of its electrical grid.

The official said EDLT will operate under Lao government control, but at first the Chinese firm would hold a majority of shares. Laos would later gradually buy those shares back under the plan.

The power grid agreement took place against a backdrop of concern among many in Laos about growing Chinese influence as a result of its massive investment in hydropower dams and other infrastructure projects under Beijing's $1.3 trillion Belt and Road Initiative. China is Laos' largest foreign investor and aid provider, and its second-largest trade partner, after Thailand.

HVDC boosts cross-border offshore wind expansion

- Test shows technologies for meshed grid are ready
- The Netherlands and UK to explore multi-purpose interconnector

David Flin

A recent development in high voltage direct current (HVDC) technology will help Europe better utilise its use of offshore wind, thereby helping the bloc to achieve its climate ambitions.

In late September, the EU-funded Horizon 2020 project "Progress on Meshed HVDC Offshore Transmission Networks" (PROMOTioN) said that the technologies for such a meshed grid are ready, and a full-scale pilot project at sea, with development of common system operation guidelines and grid codes for standardisation will demonstrate the benefits of multi-terminal HVDC networks and gain practical experience.

As Europe becomes increasingly dependent on wind power generation and interconnection capacity with other countries, meshed offshore grid topologies are being considered to enable efficient, economical, and reliable transmission offshore. Due to the high power levels and long distances involved, HVDC is likely to be employed, requiring converter stations both on- and offshore.

The PROMOTioN project conducted full-scale demonstrations of HVDC system control, system protection, gas-insulated switchgear, and circuit breakers. It concluded that these are ready for use and can be manufactured industrially immediately.

A stronger cross-border expansion of offshore wind energy will improve energy security, reduce environmental impact, and can trigger investments during the Covid-19 pandemic. Interconnected HVDC transmission infrastructure is the optimal way to integrate offshore wind energy into the existing transmission infrastructure.

Although the project demonstrates that the technologies are ready for use, political will and more European cooperation are required to develop the necessary regulatory and technical frameworks to implement them.

Catharina Sikow-Magny, Director of Internal Energy Market for the European Commission, said: "Offshore renewable energy is at the core of the transformation of the energy sector and of reaching the European climate goals. Europe needs strong coordination and cooperation on planning processes beyond national borders to be able to tap into the potential of offshore renewable energy."

Two recent announcements illustrate the inter-country coordination that is already under way.

In September the UK's National Grid and TenneT of the Netherlands entered a cooperation agreement regarding connecting Dutch and British wind farms to the energy systems of both countries. Under the agreement, TenneT and National Grid Ventures will explore development of a multi-purpose interconnector (MPI) to simultaneously connect up to 4 GW of offshore wind between their respective electricity systems. The MPI will enable spare transmission capacity to be used to trade electricity between the countries.

The two companies plan to have an operational asset by 2029. Manon van Beek, CEO of TenneT, said: "This agreement allows us to work with National Grid in the North Sea to develop innovative infrastructure that uses every spare electron of offshore wind generation to reach our decarbonisation targets."

Earlier in the month, French cable company Nexans announced that the NordLink interconnector transmitted the first power between Norway and Germany. The system is under testing and 70 MW was transferred between the countries at the end of August. The 1400 MW interconnector is a joint project of Statnett of Norway and Germany's DC Nordseekabel, a joint venture of TenneT and KfW.

Greece eyes solar as it plans coal phase-out

Greece is planning to phase-out coal and develop solar power plants with a combined capacity of 2.8 GW by 2028.

Last month the Greek government said it has budgeted €5 billion for the plan, part of which will support state utility PPC's goal to stop operating all of its existing lignite-fired power plants by 2023. These include: five units at Agios Dimitrios (around 1.5 GW), two units at Amynteo (nearly 600 MW), Meliti (289 MW), all four Kardia units (1250 MW), and the two Megapoli units (511 MW). It is uncertain what will happen to the Ptolemaida V lignite-fired plant, currently under construction. It is probable that this will operate using coal until 2028, before switching to a different fuel.

Analytics company, GlobalData, however, believes the coal phase-out targets are highly optimistic, particularly considering the fact that back in 2015 coal-based generation formed 41.6 per cent of the generation mix. In 2019 this reduced to 27.9 per cent but is still predicted to have a small share of less than 10 per cent by 2030.

The funding will come from the national budget, the Juncker Plan, and the European Investment Bank, and will largely be used to finance 16 large solar investments in Western Macedonia and Megalopolis. PPC will develop 2.3 GW in Western Macedonia and 500 MW in Megalopolis. In addition, Hellenic Petroleum is planning a 130 MW solar plant in Kozani, and Solaris a green hydrogen production unit in Western Macedonia.

Somik Das, Senior Power Analyst at GlobalData, said: "This is one of the largest investments Greece has made in recent times, which is strong enough to leave coal-based generation behind, and bolstering renewables in the power segment. The renewable energy segment, including small hydro, will get a huge boost over the decade, with 85-90 per cent of total new capacity between 2019-30 being renewable. Around 55-60 per cent of the renewable energy capacity will be solar PV."

Lithuania pursues energy independence from Russia

Lithuania is hoping the listing of shares in its leading utility, Ignitis, on the Vilnius and London stock markets will raise funds to develop renewables and thereby gain energy independence from Russia.

In September, the company said it plans to sell new shares between a quarter and a third of its capital in an initial public offering (IPO) that is estimated will raise around €500 million. The Lithuanian government will retain a stake of at least two-thirds in the company. Ignitis made €1.1 billion in revenue in 2019, with an operating profit of €83 million.

Darius Maikstenas, Chief Executive of Ignitis, said the company would use the proceeds of the IPO to invest in renewable energy as part of Lithuania's attempts to boost the amount it generates within the country to 70 per cent by 2025, up from the current level of 23 per cent.

Like its Baltic neighbours, Lithuania is trying to end their energy dependence on Russia and become more self-sufficient in power generation. Estonia, Latvia, and Lithuania hope to synchronise their electricity grids with the EU rather than, as currently, with the Russian and Belarusian networks.

To help with this, the Lithuanian Energy Ministry has prepared a package of draft laws to regulate offshore wind development in the Baltic Sea, preparatory to holding an auction in 2023. The financing model will be Contract-for-difference. Žygimantas Vaičiūnas, Minister of Energy for Lithuania said: "Taking into account the experience of the EU countries with the greatest wind energy, the legislation will create a clear and transparent regulatory environment for offshore wind energy development and ensure a level playing field for all bidders."

Lithuania has already picked a site in the Baltic Sea that can support up to 700 MW by 2030. Such a wind farm would generate 2.5-3 TWh annually, around 25 per cent of the country's current electricity demand. The site covers 140 km^2, with an average distance from shore of 29 km, an average water depth of 35 m, and an average wind speed of 9 m/s.

More delays at Olkiluoto 3

Olkiluoto 3 nuclear power plant in Finland will now not start operation until February 2022 at the earliest. The plant supplier Areva-Siemens sent an updated schedule on the commissioning of the EPR to the Finnish power utility Teollisuuden Voima Oyj (TVO) at the end of August.

Areva's EPR reactor design has had a chequered start in Europe; delays have beset Olkiluoto, Flamanville in France, and Hinkley Point C in the UK. Only in China, at Taishan 1 and 2, have units entered operation (2018 and 2019, respectively).

Under the new schedule for Olkiluoto 3, fuel will be loaded in March 2021, the unit will be connected to the grid in October 2021, and regular electricity generation will start in February 2022.

TVO said that the project schedule was delayed by: "Slow-moving tests, technical problems identified in the tests, and an increase in the number of maintenance tasks due to project delays." There have also been delays brought about by a lack of necessary spare parts. "The technical problems that arose have been resolved and repair work is currently underway. The technical problems were related to the seawater systems, cracks were detected in the mechanical control valves of the pressuriser safety valves, faulty components of the backup power diesels, and a vibration problem with the pressuriser connection line. Damaged cable insulation has also been found in some automation cabinets and will be repaired during the autumn."

Areva's new management, appointed in summer 2020, is preparing a financial solution to complete the project by the end of the warranty period. The Olkiluoto plant supplier consortium will, TVO said, build the plant with a fixed-price turnkey contract. It said: "The consortium of plant suppliers includes Areva GmbH, Areva NP SAS, and Siemens AG, which are jointly and severally liable for the obligations under the plant supply contract until the end of the plant unit's warranty period."

Flexing the power of hydrogen

Smurfit Kappa PRF's site in Saillat-sur-Vienne, France where the HYFLEXPOWER project will be built

In May this year, Siemens Energy together with its consortium partners announced a project that will see a dry low emissions gas turbine burn up to 100 per cent hydrogen produced from renewable energy. Known as HYFLEXPOWER, the project will be the first to achieve this at an actual industrial site. **Junior Isles**

The potential of hydrogen as an energy vector – capable of decarbonising heat, industry, power and transport – has long been recognised. But it is only during the last couple of years, with the plummeting cost of electricity from wind and solar, that developments have really escalated.

Using renewable electricity to decarbonise energy across all sectors has huge environmental and business benefits. And with the first significant projects now taking shape, this so-called 'sector coupling' – bringing renewable energy from the power sector into the other sectors to thereby decarbonise the entire energy system – is finally set to play a crucial part in the energy transition.

It is an area that Siemens Energy believes has enormous potential and over the last few years has therefore been ramping up investment in power-to-X (P2X) technologies that enable sector coupling.

In May this year, the company unveiled a significant venture known as HYFLEXPOWER, a project that will play a key role in decarbonising its fleet of gas turbines. Siemens Energy notes that although the power sector has decarbonised significantly by switching from coal to gas and using renewables, there has not been the same level of focus on using hydrogen to cut carbon dioxide (CO_2) in the power industry compared to other sectors.

Eva Verena Klapdor, Head of Gas Turbine Technology at Siemens Energy, commented: "There has been a lot of discussion on how hydrogen could reduce emissions in the industrial and transport sectors, but not so much on how to it could reduce carbon emissions in the power sector itself, i.e. power-to-X-to-power."

She added: "Batteries are fine for short-term storage of excess renewable energy but if you want to move to a future where you decarbonise the energy system completely, then you have to look at systems where you can store energy for more than a couple of days. Hydrogen is really an optimal solution, whereby you could use it to store renewable energy and then convert it back to electricity at a later date through a gas turbine in a combined cycle plant or combined heat and power plant.

"We have a vision that needs to be demonstrated. You can do lots of calculations and modelling of the economic viability of such a solution but… ultimately you have to go and demonstrate it."

The HYFLEXPOWER project will see a consortium made up of Engie Solutions, Siemens Energy, Centrax, Arttic, German Aerospace Center (DLR) and four European universities implement a project funded by the European Commission under the Horizon 2020 Framework Program for Research and Innovation (Grant Agreement 884229).

The project, which is being hailed as the world's very first industrial-scale power-to-X-to-power demonstrator with an advanced hydrogen turbine, will be launched at Smurfit Kappa PRF's site in Saillat-sur-Vienne, France. Here Engie Solutions operates a combined heat and power (CHP) facility, which produces 12 MWe of electricity and 20 MWth of heat as steam for Smurfit Kappa's recycled paper manufacturing process.

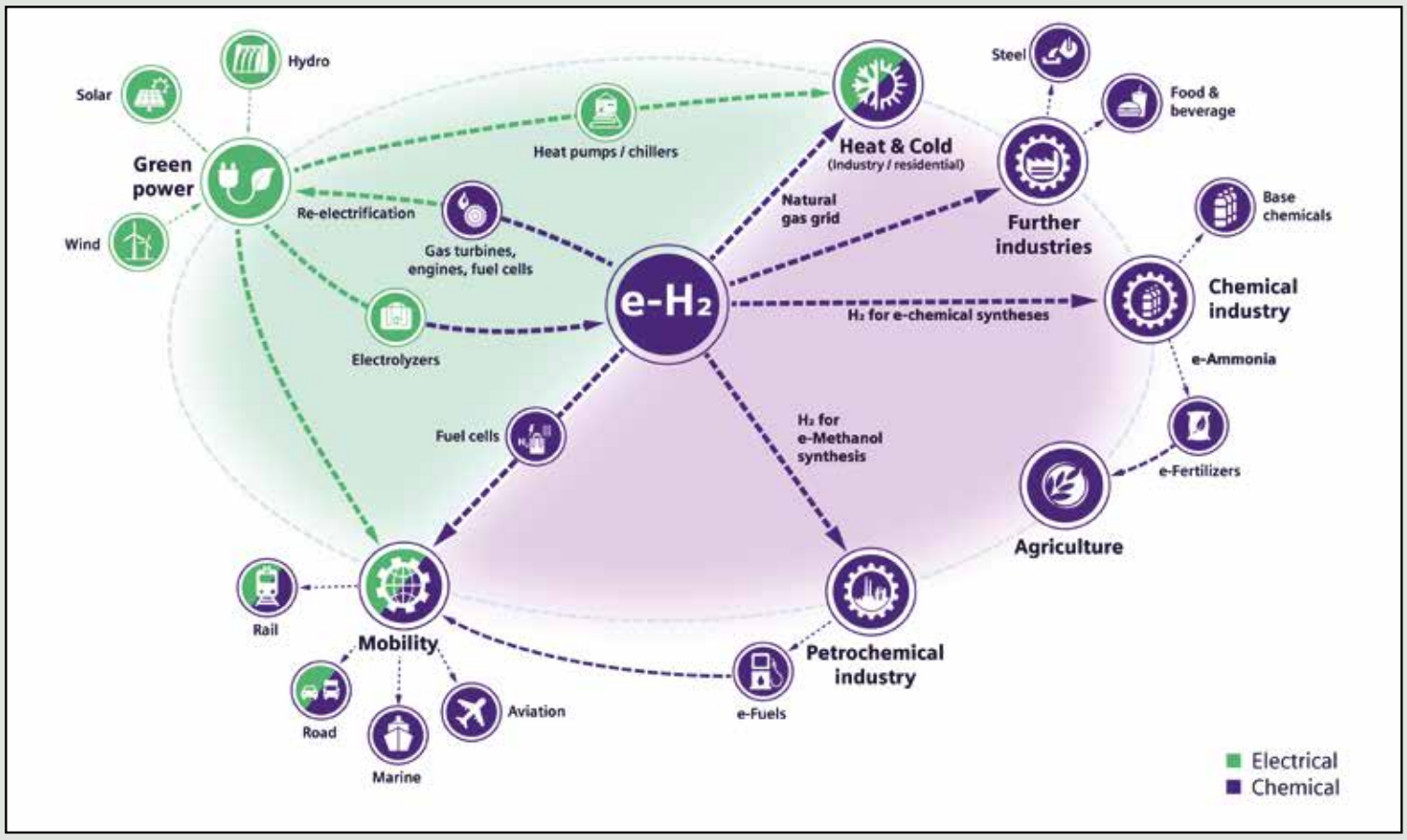
The aim of the HYFLEXPOWER project is to prove that hydrogen can be produced and stored from renewable electricity and then mixed, up to 100 per cent by volume, with the natural gas currently used at the CHP plant. This means it will be a completely dispatchable CHP unit, even if insufficient hydrogen is available.

Blending natural gas and hydrogen can substantially lower carbon emissions. The EU is closing coal fired plants and has made renewables a central pillar of achieving carbon neutrality by 2050 but in the long term it will also have to remove carbon from its gas fired plant. Displacement of natural gas fuel with hydrogen is a viable means of enabling carbon neutral power plant operation as hydrogen combustion produces no CO_2.

Notably, when operating on 100 per cent green hydrogen the SGT-400 in baseload operation at the Smurfit Kappa site would save up to 65 000 tons of CO_2 per year.

Hydrogen fuel blending not only lowers CO_2 emissions, it also ensures that the gas turbines can participate in electricity storage and re-electrification. Hydrogen can serve as a chemical storage vehicle by being produced through electrolysis of water during times of excess renewable energy generation, and then used to fuel gas turbines or sold to other industries

Ertan Yilmaz, Strategy Manager for Gas Turbine Technology at Siemens Energy, and coordinator for the HYFLEXPOWER project commented: "The project is not only a world first



Sector coupling: using renewable electricity to decarbonise energy across all sectors has huge environmental and business benefits

Klapdor: Hydrogen is an optimal solution to store renewable energy and then convert it back to electricity at a later date

but will demonstrate the importance of hydrogen as a long-term energy storage technology for a grid that has a high renewables penetration."

HYFLEXPOWER is an important advance on another project that Siemens Energy is working on for chemical company Braskem in Brazil, where two SGT-600 DLE (dry low emissions) gas turbines are scheduled to begin commercial operation on hydrogen in early 2021. Here, hydrogen will be produced from an industrial process as opposed to coming from renewables. Delivery tests conducted in 2019 proved the turbines for that plant can run on a mixture of up to 60 per cent hydrogen by volume, while maintaining NOx emissions of 25 ppm. According to Siemens Energy, the burners are designed for reliable operation on 80 per cent hydrogen.

For hydrogen mixtures the relationship between CO_2 reduction and hydrogen content is non-linear because the hydrogen molecule has 2.5 times the energy content of methane by mass, but one-third on a volumetric basis. Carbon dioxide emissions scale by hydrogen mass content in the fuel, while typically hydrogen and natural gas mixtures are defined on a volumetric basis.

Explaining the significance, Klapdor said: "If you look at the CO_2 reduction with 100 per cent hydrogen versus 60 per cent hydrogen, you can achieve more than double the amount."

It is clear that even with smaller amounts of hydrogen in the fuel it is still possible to make significant emission reductions. For example, adding only 10 per cent volume hydrogen in the fuel will reduce CO_2 emissions by 2.7 per cent, which would result in a reduction of 1.26 million metric tons of CO_2 for a reference 600 MW combined cycle power plant that runs for 6000 hours a year at an average 60 per cent efficiency

This is why the concept to be demonstrated at HYFLEXPOWER is so important. As Yilmaz noted: "HYFLEXPOWER will be the first time that we will be creating hydrogen using renewables and storing it long-term; then supplying it back to the gas turbine at the right time so it can generate power for the grid and heat for the process. It will be the first time that this will be done with no CO_2 emissions."

The HYFLEXPOWER project essentially kicked off just over two years ago when Siemens began to lay out its technology roadmaps for its gas turbines and other technologies related to decarbonisation and the role of hydrogen. Siemens' vision to cut carbon emission from gas fired power generation was one shared by Engie.

Yilmaz commented: "We wanted to work with an industrial partner and at the same time partner with government. We found out that Engie, which also had significant interest in decarbonisation and CO_2 reduction, could offer potential sites. We were also aware that there was a government opportunity under the European Commission's Horizon 2020 programme. Following discussions, we engaged Centrax and began really intensifying our efforts and developing the proposal about a year ago."

Under the project, an existing Siemens SGT-400 industrial gas turbine will be upgraded to convert stored hydrogen into electricity and thermal energy. According to Siemens Energy it will be the first time an industrial scale power-to-hydrogen-to power project will be demonstrated in a real world application. The total budget for the project is €15.2 million, of which €10.5 million will be covered by the Horizon 2020 grant. The remainder will be provided by the industry partners, who will be responsible for the overall project implementation.

Engie Solutions will build the hydrogen production and storage facility, including the natural gas/hydrogen mixing station prior to the turbine; Siemens Energy will supply the electrolyser for hydrogen production and develop the hydrogen gas turbine; and Centrax will upgrade the package for hydrogen operation and install the new turbine.

The universities will support the project's implementation with their research know-how. "Our university partners will play a vital role in understanding the detailed physics as well as the social impact of the programme," said Klapdor. "The Athens university is currently doing an economic analysis and assessing the social impacts. The Stuttgart university is studying the flame behaviour to support the combustion system development."

Following the kick-off meeting in May, the consortium is progressing with the designs. The first important milestone will be at the end of 2021 when the hydrogen production and storage facility, including the electrolyser, will be installed. The following year will see the upgrade and installation of the gas turbine, and during that summer the demonstration of what Siemens Energy calls the "advanced plant concept".

Yilmaz said: "This will be the initial demonstration of the entire plant – the electrolyser for generating the hydrogen and the equipment for storing the hydrogen and supplying it back to the gas turbine. It will be done in phases. Each time we will learn more about operating with higher percentages of hydrogen."

Initially, Siemens Energy says that the hydrogen content will be higher than the 10 per cent the unit is already capable of handling. The end goal is to demonstrate the advanced energy plant concept sometime in the summer-autumn of 2023 for 100 per cent hydrogen.

In the meantime, Siemens Energy will continue to adapt its turbine combustor, while Centrax will make the necessary upgrades to the turbine package.

Siemens Energy also aims to demonstrate the gas turbine can operate on pure hydrogen in DLE mode. In DLE combustion systems, fuel and air are mixed prior to admission to the combustion zone in order to precisely control flame temperature. This in turn allows the control of the rates of chemical processes that produce emissions such as nitrogen oxides (NOx). The relative proportions of fuel and air is one of the driving factors for NOx but also for flame stability. Hydrogen's higher reactivity poses specific challenges for the mixing technology in DLE systems. According to Siemens Energy, this has never been demonstrated when burning 100 per cent hydrogen at an industrial site.

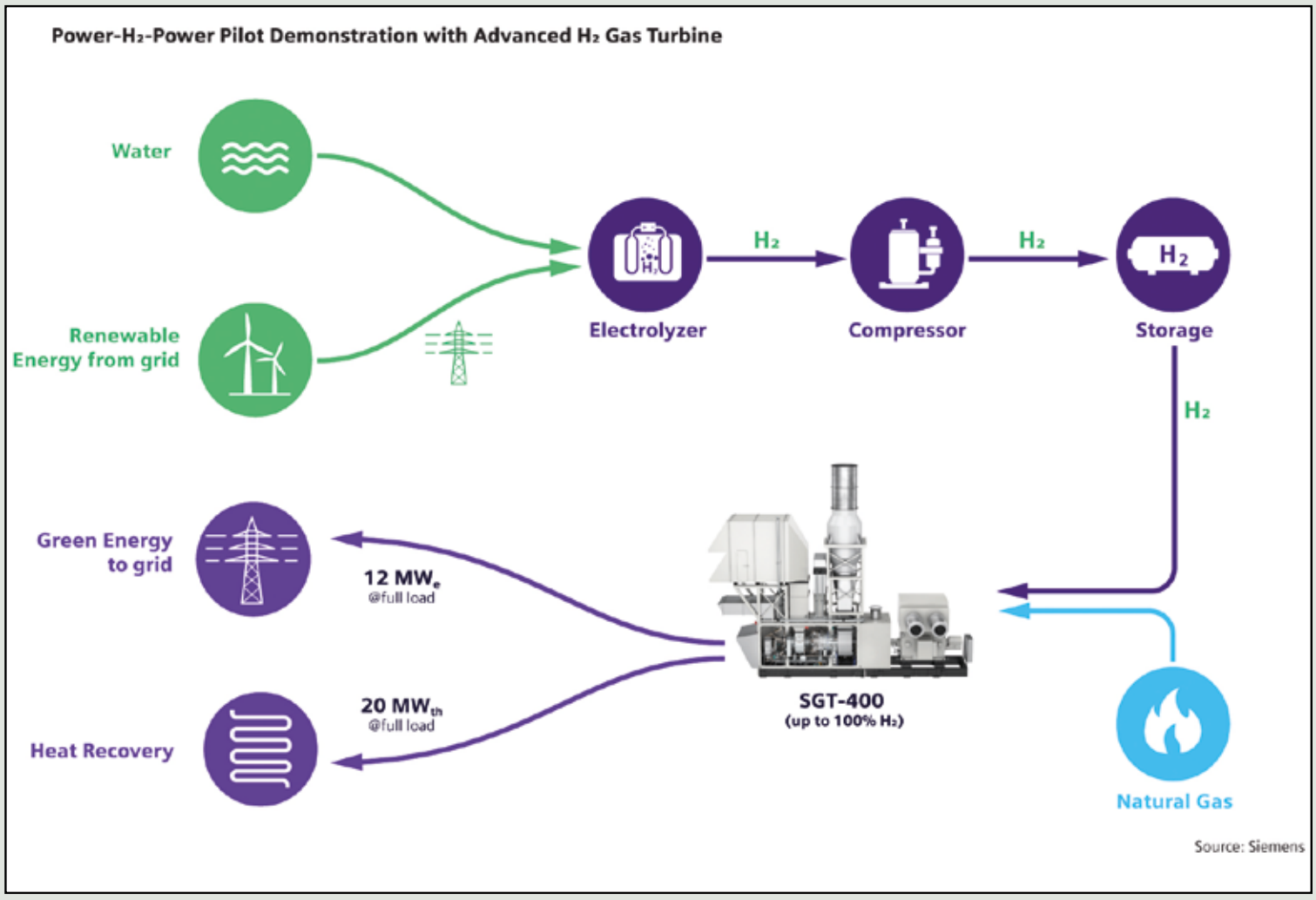
Hydrogen differs from hydrocarbon fuels by its combustion characteristics, which pose unique challenges for gas turbine combustion systems designed primarily for natural gas fuels. A key challenge is the fast burning nature of hydrogen compared to natural gas.

Klapdor explained: "The real challenge is having a combustion system that can run on various mixtures hydrogen and natural gas – from 0-100 per cent hydrogen. The tricky part is to stabilise the flame in the right part of the burner. With the burner design and the guidance of the airflow, you have to counteract the burning velocity of the hydrogen fuel/natural gas mixture. So it has to be designed in such a way as to create a stable, controlled stream inside the combustion chamber."

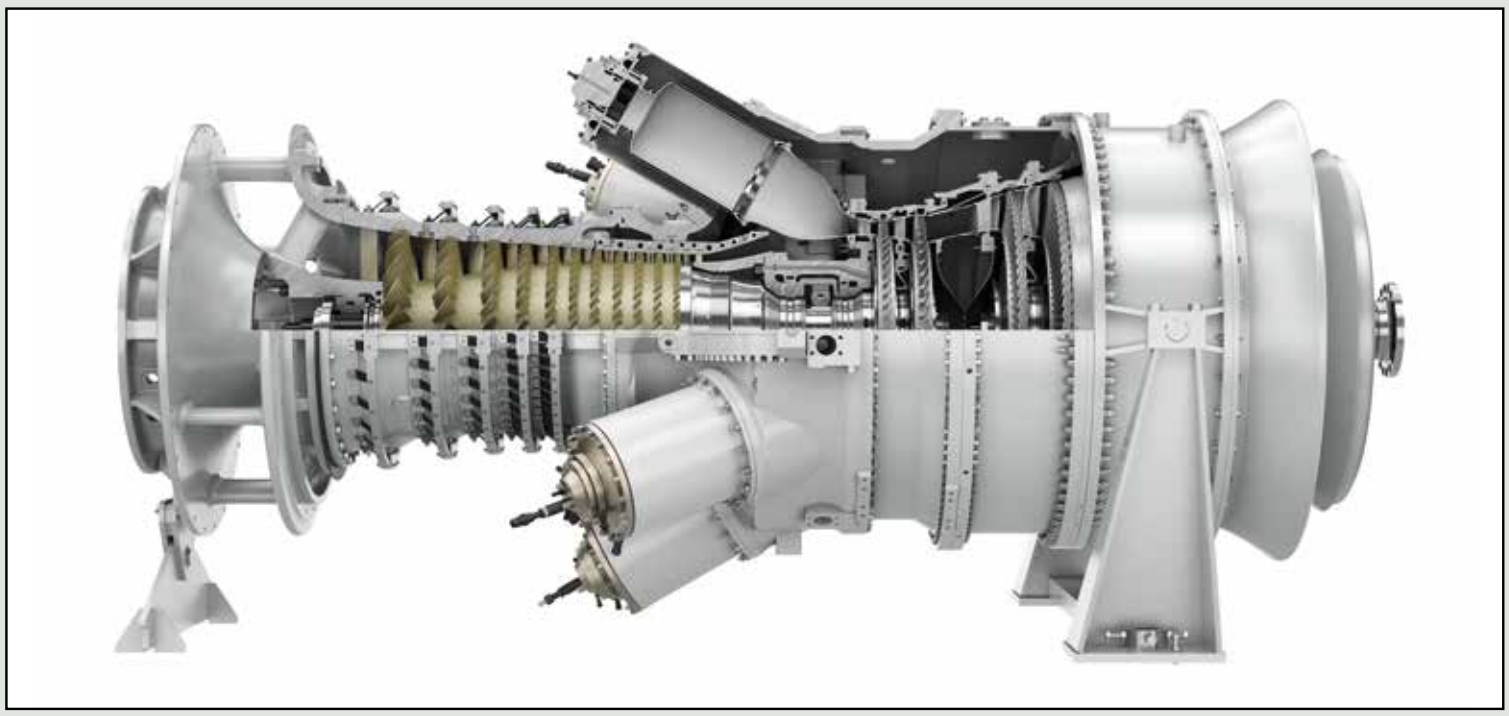
Yilmaz added: "When you premix the fuel, as the amount of hydrogen increases you increase the chance of combustion upstream – in an area that is not designed to withstand high temperatures."

With regards to the turbine package, the piping and materials used will have to be altered according to the site. If the materials at the site cannot accommodate 100 per cent hydrogen, they will have to be upgraded. The pipe diameters may also need to be adjusted.

Another key area is the explosion safety systems. For an existing installation, the fire protection system and enclosure ventilation have to be



Schematic of the EU-funded HYFLEXPOWER project



SGT-400 industrial gas turbine: Siemens Energy also aims to demonstrate the gas turbine can operate on pure hydrogen in dry low emissions mode

configured for hydrogen. "There are stricter rules around safety standards for high hydrogen content, since the explosion risk is higher than for natural gas," said Klapdor.

Hydrogen for the gas turbine package will be generated by an electrolyser based on the Siemens Energy Silyzer portfolio. It is a PEM (proton exchange membrane) type electrolyser, with high operational flexibility. This makes it ideally suited to produce energy generated from volatile wind and solar power. Notable features of PEM electrolysers are: high efficiency at high power density; high product gas quality, even at partial load; low maintenance and reliable operation; and no chemicals or impurities.

Siemens Energy has been using its PEM technology to produce hydrogen from water since 2011, with the introduction of its Silyzer 100. This was a lab-scale unit of 0.1 MW. Since 2015, Siemens Energy has (with its Silyzer 200) a MW-sized electrolyser in operation. On average the company has been scaling its electrolyser portfolio by a factor of 10 every four to five years and in 2018 launched the double-digit megawatt-class Silyzer 300. This is already being used in the world's largest power-to-gas project in a steel plant .

The trend towards higher capacity units is well under way. In a presentation on its hydrogen strategy, Siemens Energy said the next generation of electrolysers is already under development. These will be in the 100 MW range and could be available by 2023. Looking further ahead, it believes that 1000 MW units could be a reality around the end of the decade.

This scaling is important if green hydrogen is to compete with so-called grey hydrogen. The hydrogen market currently stands at around 80 million t/year, the vast majority of which is grey hydrogen produced by steam methane reforming of fossil fuels. Green hydrogen currently only represents 5 per cent of the market – about 3.5 million t and less than 300 MW. But according to the International Energy Agency, this is predicted to reach nearly 3 GW in three years, driven by ambitions for net-zero carbon emissions by 2050.

To achieve this will require a big push by policies and market design, as well as an acceleration of renewables deployment and continued scale-up of electrolyser capacity.

Siemens Energy's latest product, the Silyzer 300, represents the current state-of-the-art in terms of size for PEM technology. The electrolyser system that is currently being marketed uses a standardised, modular and pre-fabricated system concept based on so called half- and full-array (24 modules) configurations. Silyzer 300 is equipped with a fully automated water management system (water treatment and refinement loop), leveraging natural water circulation. Operation with a natural circulation of the process water means that there are no pumps, actuated valves, or other moving parts required in the electrolyser core. This leads to high reliability and availability and reduced maintenance requirements.

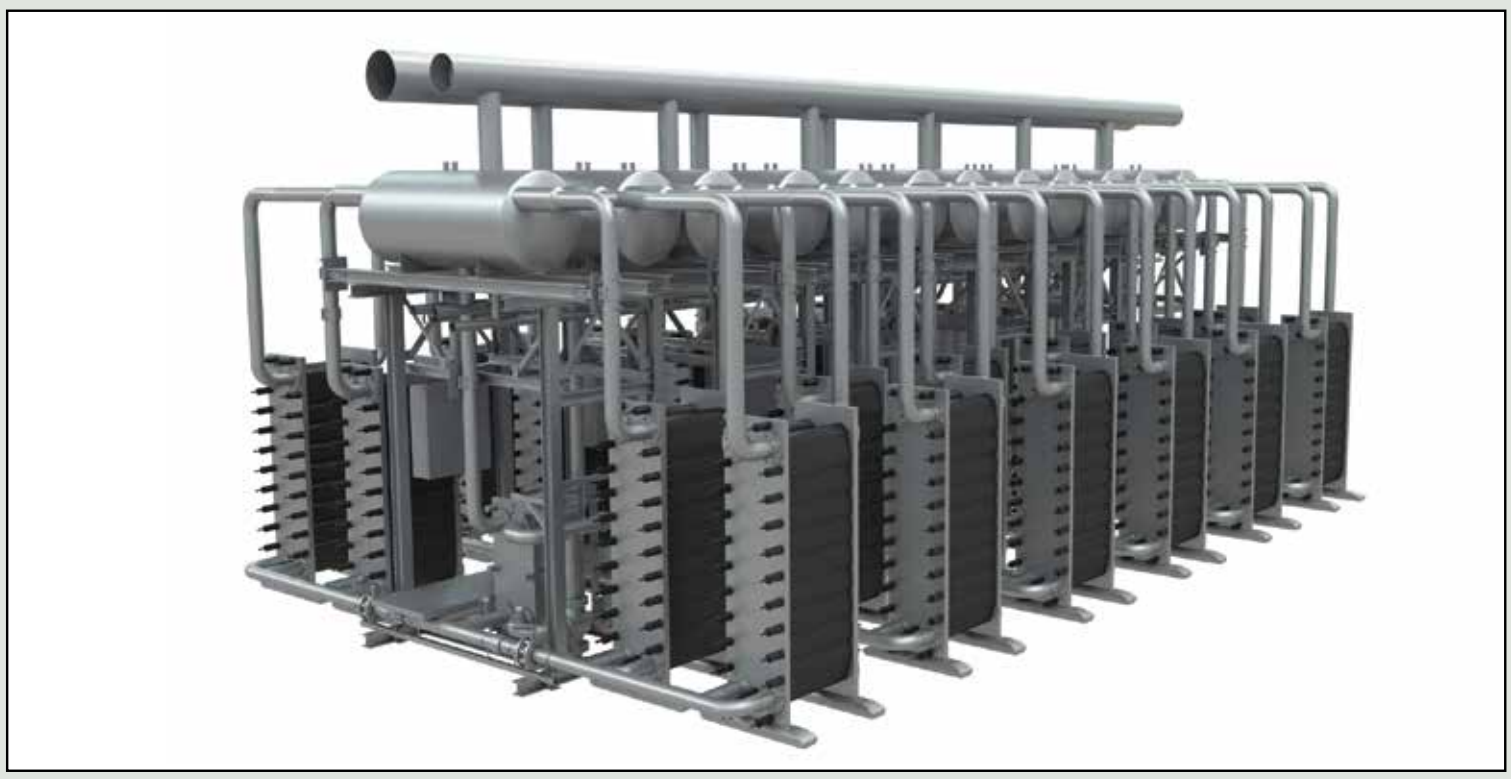
The full array configuration has a power rating of 17.5 MW and is scalable to 100 MW and more.

Siemens Energy estimates that roughly 1 t/h of hydrogen would be needed to operate the HYFLEXPOWER project's SGT-400 on 100 per cent hydrogen. This is a significant amount, requiring a sizeable amount of renewable electricity – the bulk of which will come from nearby wind farms owned by Engie.

Klapdor notes, however, that the energy content of this quantity of hydrogen is in principle the same as for natural gas. She said: "People always say, that's a lot of hydrogen and talk about how much renewable electricity is needed, but we need to be cognizant that the amount of natural gas used coming out of the ground is taken for granted. We will be just substituting the natural gas with hydrogen containing the same energy content. However, it's good for people to think about it because it highlights the required investment in renewables to meet decarbonisation goals."

HYFLEXPOWER is a four-year project, and the plan is to complete all the data analysis and socio-economic assessments by April 2024. This will signal the finalisation of the demonstration.

Yilmaz says other customers and partners are interested in the application



Siemens Energy's Silyzer 300 full-array (17.5 MW) can produce hydrogen for a gas turbine package

It will be a key milestone in Siemens Energy's goal to make its entire turbine range capable of burning 100 per cent hydrogen. All of Siemens Energy's gas turbines can already operate on hydrogen fuel, with the specific capability of a unit depending on the gas turbine model and the type of combustion system.

While some of its small and medium DLE gas turbines can burn up to 60 per cent hydrogen, the current limit for its large machines is 30 per cent. The company's technology roadmap is to have its dry low emissions units capable of running on 100 per cent hydrogen by 2030 to meet customer demand for their gas turbine portfolio.

Demonstrating 100 per cent hydrogen capability at the HYFLEXPOWER project will be an important step in realising that goal. Further, the project's outcome will no doubt give potential users a realistic view on the technology's suitability in meeting their future decarbonisation goals. Certainly the project has attracted significant global interest.

Yilmaz concluded: "We have other customers and partners interested in this application and we are looking to apply what we learn from this installation to other countries and in different scenarios. The goal is to build on this momentum and really penetrate the combined heat and power market."

SIEMENS energy

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Debts hamper Ghana's nuclear plans

- Plans for nuclear to add base load capacity by 2030
- Power companies $1.4 billion in debt

David Flin

The debt-crisis facing power companies could threaten Ghana's ambitious plans to build a nuclear power station by 2030.

At the end of June, the power sector's debt had risen to $1.4 billion, with State-owned Electricity Co. of Ghana suffering an estimated annual revenue loss of $580 million, mainly as a result of transmission losses, illegal connections, and unpaid bills.

Last month Samantha Singh, an Africa Strategist at Absa Bank, said: "Debt levels could rise even further. The potential increase in these liabilities could hurt government finances even further in a time it is already strained due to Covid-19."

Ghana wants to develop a nuclear plant to add base load power to that already provided by the Akosombo and Kpong hydropower plants.

Last month Fred Oware, Board Chairman of Nuclear Power Ghana (NPG), said a nuclear power plant will guarantee the provision of regular and cheap power to advance the country's industrialisation.

He said: "A series of studies are being carried out to finalise a decision on Ghana's nuclear energy future, with special focus on the attraction of some private investment to aid in the process of finalising the research to reach a firm decision on nuclear energy."

Ghana's current peak demand is less than 3000 MW. Akosombo and Kpong hydropower plants together have a capacity of 1500 MW. Oware said that with nuclear power also providing up to 2000 MW, the country would be free from power outages. "Nuclear will run smoothly, and the other systems will come in to support when demand goes up. The plants we are currently using are susceptible to planned and unplanned shutdown while acting as base load, and that can cause outages across the country." He added that the development of a nuclear power plant would prevent reoccurrence of the power crises, which hit the country between 2012 and 2016.

Initial studies show there are four suitable locations for a nuclear power plant. These will be specified when the studies have been finalised.

Nigeria secures funding for power infrastructure development

Nigeria's plan to fully utilise its installed capacity has taken a significant step forward with the securing of over $6 billion in funding for developing the African country's electricity sector infrastructure.

Last month the government announced that it has secured $6.15 billion to enable the country to achieve generation, transmission and distribution of 25 000 MW of electricity by 2025.

Nigeria's Minister of Power, Saleh Mamman, said the total sum has been earmarked for the following critical projects: $2.3 billion for the 'Siemens Project'; $1.6 billion for the Transmission Rehabilitation and Expansion Programme (TREP); $1.7 billion to improve "last-mile" distribution capacities; and $550 million for the Nigerian Electricity Project for off-grid electrification.

The Siemens Project, also known as the Presidential Power Initiative (PPI) will save Nigeria around $1 billion annually. It is split into three phases. Phase One will upgrade transmission and distribution of the Transmission Company of Nigeria (TCN) and distribution companies, and this will upgrade the network by an additional 2-7 GW by 2021. Phase Two will achieve 11 GW over 2021-2023 by enhancing existing generation and developing last-mile distribution capacity. Phase Three will take place between 2023-2025, and will involve upgrades and expansion in generation, transmission, and distribution, achieving 25 GW by 2025.

The projects included in the PPI include: 105 substation rehabilitations, 70 new substations, installation of 35 power transformers, and installation of 3765 distribution transformers.

The TREP programme, which will receive $1.6 billion, has a number of major projects, including: $410 million for transmission links between Alaoji-Onitsha, Delta Power Station-Benin, and Kaduna-Kano; $29 million to build a 330 kV DC line 62 km long between Birnin Kebbi and Kamba; $200 million for the Lagos-Ogun Transmission Infrastructure Project; $170 million for the Abuja Transmission Ring Scheme; and $274 million for the Northern Corridor Transmission Project.

The World Bank will start the disbursement of $750 million approved for Nigeria's Power Sector Recovery Programme (PSRP) in 2021, completing the process in 2023. It said $426 million would be disbursed in 2021, followed by $162 million in each of 2022 and 2023.

PSRP is expected to improve the reliability of electricity supply, support financial stability, and enhance accountability in Nigeria's power sector.

Financial boost for Egyptian electricity sector

Egypt's renewable electricity sector has received a boost following a recent agreement with the African Development Bank (AfDB) for a loan of €225 million to support Egypt's Electricity and Green Growth Support Programme (EGGSP).

The AfDB said the loan will help finance a number of planned renewable energy projects in light of the Covid-19 pandemic and support a sound electricity infrastructure base.

Mohamed Shaker, Egypt's Electricity Minister, said: "The EGGSP aims to improve the security of energy supply by increasing the share of renewable energy and improving the financial sustainability of the electricity sector… ensuring greater participation of the private sector in injecting more investments."

This AfDB investment loan will be in addition to the investment planned by the Egyptian government of €2.4 billion over the coming year into the electricity sector.

In addition, Egypt's electricity ministry and China's Huawei are in discussions on how to gradually transform the Egyptian electricity network to a smart grid.

Egypt is set to invest EGP45.3 billion ($2.87 billion) in the electricity sector this fiscal year (FY) 2020/2021, according to a recent government statement.

Saudi Arabia looks to renewables to drive economy

Saudi Arabia's recently announced plan to localise its manufacturing base in the renewable sector will not only help create jobs but will also attract foreign investment.

Localising 40-45 per cent of the sector by 2028 will create up to 750 000 jobs over the next ten years, according to a recent report by the US-Saudi Business Council (USSBC).

The Saudi power sector is experiencing strong growth in demand for electricity, along with a desire to diversify its domestic energy mix. This, combined with the need to improve energy efficiencies, the decline in the cost of renewable energy sources, and the abundance of solar radiation across the country, will allow the country to develop its renewable energy potential.

The Saudi government aims to generate 50 per cent of its energy from renewable sources by 2030 and plans to prioritise the growth of the sector through private sector participation, attracting foreign direct investments, and localising domestic production and content. It is encouraging technology transfers to enable localisation of significant parts of the supply chain.

South Africa to fix Eskom debts

- Private businesses allowed to produce own power
- Eskom can renegotiate green power and coal contracts

David Flin

Eskom aims to reduce its $30 billion debt and become financially sustainable following an agreement between the South African government, business groups, and labour unions. The agreement signed last month will increase electricity output in an effort to end rolling blackouts in the country.

Eskom, which provides about 95 per cent of the country's power, has not been selling enough electricity to cover its costs and inability to meet demand has curbed economic growth. Maintenance on its ageing coal fired plants has been inadequate, resulting in frequent trips and consequent rolling blackouts.

The agreement commits the government to remove regulatory obstacles that hinder companies from generating their own electricity, while businesses agreed to implement projects to add 2500 MW within two years. The government has also agreed to buy an additional 2500 MW of emergency power, 500 MW more than previously announced.

Eskom is allowed to renegotiate contracts with coal suppliers and renewable IPPs as soon as possible. The agreement states these renegotiations will "ensure an outcome that is sustainable for suppliers, ensures a fair return, is affordable to Eskom, and is within the confines of the law."

Other elements of the plan state that: Eskom must review all its material contracts to ensure it is not overpaying for goods and services; power prices must be both cost-reflective and affordable for businesses and households; Eskom must adopt a zero-tolerance approach towards corruption; Eskom's operating model will be reviewed to reduce its management structure and associated costs.

The plan will also allow for development of a build programme, and South Africa will begin development of 11 813 MW of power, including 6800 MW of renewables, in 2022. The Department of Mineral Resources and Energy announced its intention to press ahead with this, and the National Energy Regulator of South Africa (NERSA) has agreed with this. Eskom stated that it welcomes NERSA's decision.

The procurement will open up a number of bid windows, including Bid Window 5 (BW 5) for renewable energy capacity. About 6800 MW of wind and solar capacity will be up for bidding, along with 513 MW of storage, 3000 MW of gas fired capacity, and 1500 MW of coal based plants.

Andre de Ruyter, CEO of Eskom, said: "Given the current supply constraints, this additional generation capacity is urgently required, and will be an important contribution towards ending load-shedding and ensuring energy security for the country."

The additional capacity will be in addition to the 2000 MW of emergency power currently being procured under the Risk Mitigation IPP Programme (RMIPPP).

Siemens Energy focuses on profitability as it starts "new era"

Siemens Energy has put a firm focus on ways to improve profitability following its launch on the stock market.

Junior Isles

Siemens Energy's listing on the Frankfurt Stock Exchange at the end of September marks the start of a "new, important era" for the company and a clear focus on profitability.

Commenting on the separation of the energy business, which is a key milestone in implementing its Vision 2020, Christian Bruch, CEO of Siemens Energy, said: "Our listing marks the start of a new, important era in the company's history. As an independent company, we now have the entrepreneurial flexibility we need to help shape the global transformation of the energy markets in a sustainable and economically successful manner.

"We are also aware of the responsibility this brings with it, because with listing we are not only committed to society, but also to our shareholders."

At the start of September during a virtual Capital Markets day, Siemens Energy, laid out its post-spin-off strategy, saying it is aiming for accelerated profitable growth. Management aims to achieve an Adjusted EBITA margin before Special Items of 6.5 per cent to 8.5 per cent for fiscal 2023.

In the first strategy phase, the focus for Siemens Energy's Gas and Power segment is on increasing profitability and cash flow until fiscal year 2023.

Ahead of the Capital Markets day Bruch told journalists: "We have to improve the profitability of the company. I am not satisfied with where we are. There is room for improvement."

Among the most important levers for operational excellence, the company is evaluating a leaner cost structure, optimised logistics, centralised purchasing and the reduction of non-conformance costs. As an example, Siemens Energy recently streamlined its offering of aeroderivative gas turbines. Furthermore, Siemens Energy is currently reviewing a potential phase out of its business with CO^2-intensive coal fired power generation.

Another lever in the Gas and Power segment will be a rigorous focus on project selection and better execution. Projects with a negative lifecycle margin will be phased out, bidding processes will be more selective to improve the margin in the project business. The organisation is currently evaluating operational excellence initiatives targeting more than €300 million additional annual gross global cost savings on top of the already announced €1 billion savings target until fiscal year 2023, when compared to the cost base of fiscal year 2018.

At the core of the future value creation of Siemens Energy is its service business. The company said its service business is highly resilient and, based on its large installed fleet and long-dated service contracts, generated revenues of €9.5 billion in 2019. In fiscal year 2019, 51 per cent of revenue of the Generation division was linked to service, in Industrial Applications revenue contribution was even higher at around 60 per cent. In Transmission, service comes from a low base but is growing. All in all, the service backlog of the Siemens Energy Group's segments was equal to €48 billion as of June 30, 2020.

During the Capital Markets day the company also stressed that Siemens Gamesa Renewable Energy (SGRE) would capture growth opportunities in its profitable Offshore and Services businesses and drive a turnaround in Onshore. SGRE said that a refreshed corporate strategy would prioritise: profitability over volume; cash generation; as well as efficiency and productivity in all operations.

OEMs continue to target hydrogen market

- ABB and Hydrogen Optimized sign MOU
- Mitsubishi Power launches standard packages for green hydrogen integration

Junior Isles

The future potential of hydrogen to decarbonise energy across multiple sector is playing a growing part in the activities of original equipment manufacturers (OEMs) and energy solution solution providers.

Last month, ABB and Hydrogen Optimized signed a Memorandum of Understanding (MOU) to make green hydrogen a financially feasible option for customers across industries.

Hydrogen Optimized has ambitions to use its high current water electrolysis technology at scale to produce green hydrogen for emerging clean applications across industries, including chemical, utility and transportation. ABB's hydrogen research team will explore electrical power supply optimisation through projects involving ABB high power rectifier (HPR) systems.

The MoU signed by the companies formalises the agreement to explore the implementation of a demonstration system as well as the preparation of a 100 MW plant design and commercialisation strategies.

In a separate move, Mitsubishi Power announced it is accelerating the path toward 100 per cent carbon-free power generation by launching the world's first standard packages for green hydrogen integration.

The company says its standard packages – the Hydaptive package and the Hystore package – "cut through the complexity power generators and grid operators encounter" when integrating renewable power, gas turbines, green hydrogen and other energy storage technologies.

The first packages were recently ordered for three gas fired plants in the US that are preparing to convert to hydrogen.

Mitsubishi Power, a major subsidiary of the Mitsubishi Heavy Industries (MHI) Group, officially changed its corporate name from Mitsubishi Hitachi Power Systems at the start of September. The company said the rebranding signals the next stage in the company's journey to grow as an energy solutions provider leading the decarbonisation, digitisation and delivery of reliable power globally.

Mitsubishi Power says that it will work even more closely with its sister companies to tap new verticals and build on investments in digital solutions, hydrogen, ammonia, battery energy storage systems and solar power.

GE to exit coal

GE is planning to exit the new build coal power market, subject to applicable consultation requirements.

Last month the company said GE's Steam Power business will work with customers on existing obligations as it pursues this exit, which may include divestitures, site closings, job impacts and appropriate considerations for publicly held subsidiaries.

The company says it will continue to focus on and invest in its core renewable energy and power generation businesses, working to make electricity more affordable, reliable, accessible, and sustainable. GE Steam Power will continue to deliver turbine islands for the nuclear market and service existing nuclear and coal power plants.

Russell Stokes, GE Senior Vice President and President & CEO of GE Power Portfolio, said: "With the continued transformation of GE, we are focused on power generation businesses that have attractive economics and a growth trajectory. As we pursue this exit from the new build coal power market, we will continue to support our customers, helping them to keep their existing plants running in a cost-effective and efficient way with best-in-class technology and service expertise."

Last year, As You Sow, a non-profit organisation that promotes environmental and social corporate responsibility, filed a shareholder resolution focusing on GE's pursuit of new fossil fuel projects across the globe at a time when nations are striving to meet Paris Climate Agreement goals. The resolution was withdrawn after the company agreed to evaluate product emissions and set new greenhouse gas emission targets.

Prior, in 2018, As You Sow raised similar concerns in an investor letter to GE regarding its plans to construct a new coal plant in Kenya in spite of strong opposition.

Danielle Fugere, President of As You Sow, said in a statement: "We are pleased that GE has signaled meaningful change to its business by moving away from high-carbon technologies like coal projects. This important announcement recognises the fundamental truth that the world is transitioning away from high-carbon coal.

BP targets US as it ramps up renewables focus

The US looks set to be a key part of BP's plan to reach 50 GW of global renewable energy projects by 2030.

Last month the company formed a new strategic partnership with Equinor to develop offshore wind projects in the US. This includes the development of existing offshore wind leases on the US east coast and jointly pursuing further opportunities for offshore wind in the US.

As of 2019-end, the integrated energy major had 2.5 GW of energy generation capacity from renewables. The company has a development pipeline of roughly 20 GW of renewable power projects, of which 83 per cent will be solar energy, while the remaining 15 per cent and 2 per cent will be wind energy and biopower, respectively. Importantly, of the 20 GW of renewable projects that are in the pipeline, 7 GW will be in Europe while 9 GW will be located in the United States.

Commenting on the Equinor deal, Bernard Looney, BP's Chief Executive, said: "This is an important early step in the delivery of our new strategy and our pivot to truly becoming an integrated energy company. Offshore wind is growing at around 20 per cent a year globally and is recognised as being a core part of meeting the world's need to limit emissions. Equinor is a recognised sector leader and this partnership builds on a long history between our two companies. It will play a vital role in allowing us to deliver our aim of rapidly scaling up our renewable energy capacity, and in doing so help deliver the energy the world wants and needs."

As well as forming the new strategic partnership, BP will purchase a 50 per cent interest in both the Empire Wind and Beacon Wind assets from Equinor. BP has agreed to pay Equinor $1.1 billion.

- BP and Microsoft Corp. have agreed to collaborate as strategic partners to further digital transformation in energy systems and advance the net-zero carbon goals of both companies.

Americas

Vestas secures order for Guajira I

Vestas has won a contract to supply and install ten V100-2.0 MW turbines for the 20 MW Guajira I wind farm, located at Uribia, in La Guajira, Colombia. The contract also includes a 12-year Active Output Management 5000 (AOM 5000) service agreement for the operation and maintenance (O&M) of the wind farm. The order was placed by the Spain-based Elecnor, and Isagen, an important energy generator in Colombia.

Turbine delivery is expected by the second quarter of 2021, and commissioning is scheduled for the fourth quarter of 2021.

Elsewhere, Elecnor has been selected to build a $28.8 million 56 MW wind power project in Baja California Sur, Mexico. Elecnor was selected by Japan's Eurus Energy, a joint venture between Toyota Tsusho Corp and Tokyo Electric Power Co Holding, which has a branch in San Diego, California. According to Elecnor, the total investment in the Coromuel project is around $100 million, with Eurus Energy and the Development Bank of Japan sharing the financing equally.

The Coromuel wind farm will be located close to La Paz, the state capital of Baja California Sur. It will feature 20 GE turbines each of 2.8 MW, two substations, and related infrastructure.

Siemens to build 900 MW CCGT in Alberta

Siemens Energy has won a contract to provide gas turbine technology and services to the planned 900 MW Cascade Power Plant to be located near Edson, Alberta, Canada. The contract was awarded by Kineticor, with the end user being the Cascade Power Project Limited Partnership. The order value is in excess of €330 million. The plant is scheduled to start operating in 2023.

Siemens Energy will provide two SGT6-8000H gas turbines in single-shaft combined cycle configurations, steam turbines, HRSGs, as well as long-term services.

The project supports the decarbonisation of Alberta's power supply by switching from coal to natural gas. Once operational, the plant will reduce Alberta's carbon emissions by up to 5 per cent. In the power sector, Alberta contributes over 50 per cent of Canada's greenhouse gas emissions. As a result, the Cascade Power Plant is one of the largest emissions reduction opportunities in Canada's electricity sector.

Asia-Pacific

MHI Vestas selects Hitachi ABB transformers

Hitachi ABB Power Grids has signed a purchase agreement with MHI Vestas Offshore Wind (MHI Vestas) to deliver WindSTAR transformers to MHI Vestas' offshore wind projects in Taiwan. The transformers will be used in the country's fast-growing offshore wind electricity generation sector, which expects 5.5 GW of new offshore wind power by 2025. The systems will increase electricity generated by the offshore wind farms to 66 kV to assist in transmission to shore.

Hitachi ABB Power Grids said that this agreement represents a breakthrough for the company's entry into the offshore wind market in Taiwan. It has established a local partnership with Shihlin Electric & Engineering Facility to supply key components for the WindSTAR transformers.

The transformers will be used on the Changfang (Phase 2) and Xidao, and Zhong Neng projects. The first deliveries of transformers will take place in 2022.

Wärtsilä to maintain 200 MW Phnom Penh plant

Wärtsilä has signed a five-year optimised maintenance agreement for the Electricite du Cambodge (EDC) C7 power plant, located close to Phnom Penh in Cambodia. The agreement is with SchneiTec, the company responsible for maintenance of the power plant.

The aim of the agreement is to support the availability, performance, and reliability of the 12 Wärtsilä 50DF dual-fuel engines that generate a total of 200 MW. Wärtsilä will supply spare parts as required, as well as providing maintenance planning, remote asset diagnostics, guidance, and troubleshooting in the event of unplanned shutdowns or emergencies.

TPC awards 6500 MW of CCGT projects to GE

Taiwan Power Company (TPC) has selected GE as the successful bidder for the 6500 MW Hsinta and Taichung combined cycle power plants. GE will work with its local consortium partner CTCI Corporation to engineer, manufacture, and commission the combined cycle blocks.

GE will deploy the 7HA.03 gas turbine, with matching steam turbine, generators, and HRSG at both sites. As part of the project scope, GE will supply ten 7HA.03 gas turbines, five steam turbines, 15 generators, ten HRSGs, and additional balance-of-plant equipment.

The new generating units will commence operations in phases from 2024, gradually replacing coal fired power generating units, in line with Taiwan's Renewable Energy Development Act (REDA) energy policy that seeks to increase the gas fired power ratio to 50 per cent by year 2025.

Cook Island opts for Rolls-Royce battery

Rolls-Royce has been awarded a contract to supply three MTU-brand battery containers for a microgrid on the Pacific island of Rarotonga. The MTU EnergyPacks will be integrated by Vector Powersmart into an existing power plant run by Te Aponga Uira, the local utility.

The battery containers have a combined storage capacity of 4268 kWh and a power output of 4800 kVA. They will act as a power reserve, grid support, and enable the increased use of renewable energy.

The microgrid, which supplies the approximately 11 000 inhabitants of the remote Cook Island with electricity, consists of photovoltaic systems, diesel generators and battery containers. The archipelago has set itself the goal of covering its energy needs completely from renewable energies in the near future, contributing to the reduction of greenhouse gas emissions.

GE wins 60 MW wind turbine orders in Vietnam

GE Renewable Energy has won two contracts to supply turbines for the Quoc Vinh Soc Trang and Lac Hoa Soc Trang wind farms in the Mekong Delta in Vietnam.

Under the deal, GE will supply 12 of its 5MW-158 Cypress wind turbines for the wind farms, each of which has a capacity of 30 MW. PowerChina Huadong Engineering is the EPC contractor for the projects. The two facilities are scheduled to start operations by Q3 2022.

Europe

Valmet

Valmet and Viridor to service UK WTE plants

and Viridor have signed a three-year service agreement for six waste-to-energy (WTE) plants in the UK. The agreement covers maintenance and technical support, cybersecurity services, and lifecycle services and upgrades for the plant automation systems.

Valmet has previously supplied Valmet DNA distributed control systems and services to Viridor's WTE in Ardley, Beddington, Cardiff, Dunbar, Peterborough, and Runcorn. The agreements and services associated with each site have been unified with one service agreement covering all the plants.

Dave Field, Director of Engineering (Energy) for Viridor, said: "We selected Valmet for a new three-year, multi-site service agreement of the distributed control systems within our Energy Recovery Facilities. This is based upon the positive experience we have had with Valmet's expertise and support across our fleet since the completion of our very first waste-to-energy plant."

Iberdrola picks Voith to modernise pump turbines

Voith has won an order from Iberdrola of Spain to supply five new pump turbines and associated components for the Torrejón and Valdencañas hydropower plants in Spain.

Voith will deliver a hydraulically optimised turbine design that increases the delivery head of the pump turbines for the Torrejón hydropower plant. Voith will supply two 43 MW semi-axial pump turbines. The scope of supply includes the runners, guide vanes, turbine covers, shafts and bearings, as well as hydraulic and digital governors. The plant will be converted to variable speed operation.

Voith will supply three Deriaz 83 MW pump turbines for the Valdencañas hydropower plant. The scope of supply for this project includes the runners, parts of the control systems, and the hydraulic governors. In addition, both projects contain model acceptance tests, installation supervision, and full commissioning of the turbines.

The first runners for the plants are scheduled for delivery in the second half of 2022 and the last runners in mid-2024. Commissioning of the plants is scheduled for early 2025.

GHS electrolysers for Danish wind-to-H_2 project

Danish alkaline electrolyser manufacturer Green Hydrogen Systems (GHS) has been selected by Siemens Gamesa Renewable Energy (SGRE) as a supplier for a wind-to-hydrogen project in Denmark.

As part of the project, a 3 MW SGRE wind turbine will power a GHS electrolyser, which will split water into hydrogen and oxygen. Hydrogen will be stored for later use in hydrogen-powered vehicles, while oxygen will be released into the atmosphere.

GHS will supply a single unit of its HyProvide A-Series electrolysers. GHS said its containerised 400 kW system is designed to accommodate fluctuating wind turbine output and ensure high efficiency.

The turbine will not be linked to the grid, but will operate in island mode. The facility is expected to start hydrogen production in January 2021.

Cypress wind turbines for Austria

GE Renewable Energy has been selected by PÜSPÖK Group to supply two wind farms located in the Burgenland region in Austria. The 157 MW project will use 30 GE Cypress onshore wind turbine units. The deal includes a multi-year service contract, and GE will establish a service organisation in Austria next year.

PÜSPÖK will operate the Cypress turbines at 5.5 MW, with a rotor diameter of 158 m and two-piece blades provided by LM Wind Power, a GE Renewable Energy business.

Installation of the wind turbines at the project site will start in Q1 2021, and the turbines will be operational by the end of 2021.

Hanwha Q Cells to build solar + storage in Portugal

Solar cell and module manufacturer Hanwha Q Cells of South Korea will build a solar power plant backed by its own energy storage system in Portugal.

The 315 MW project is part of a 700 MW solar power plant complex Portugal is building in the Alentejo and Algarve regions. Construction is expected to be completed by 2024.

It is the company's largest project in the country. "Europe is the leading renewable energy market," said Hanwha Q Cells president Kim Heecheol. "We will actively prepare for the rapid growth of the global renewable energy market based on know-how accumulated from the module business."

International

GE Renewable Energy wind turbines for Taza

GE Renewable Energy has been selected by EDF RE and Mitsui & Co to supply equipment for the 87 MW Taza onshore wind farm. GE Renewable Energy will supply 27 of its 3.2-85 onshore wind turbines for the Taza project in the north of Morocco.

The project is part of Morocco's energy strategy, which has a goal of producing 52 per cent of its installed electric power from renewable energy by 2030.

The Taza project is expected to start operations at the beginning of 2022.

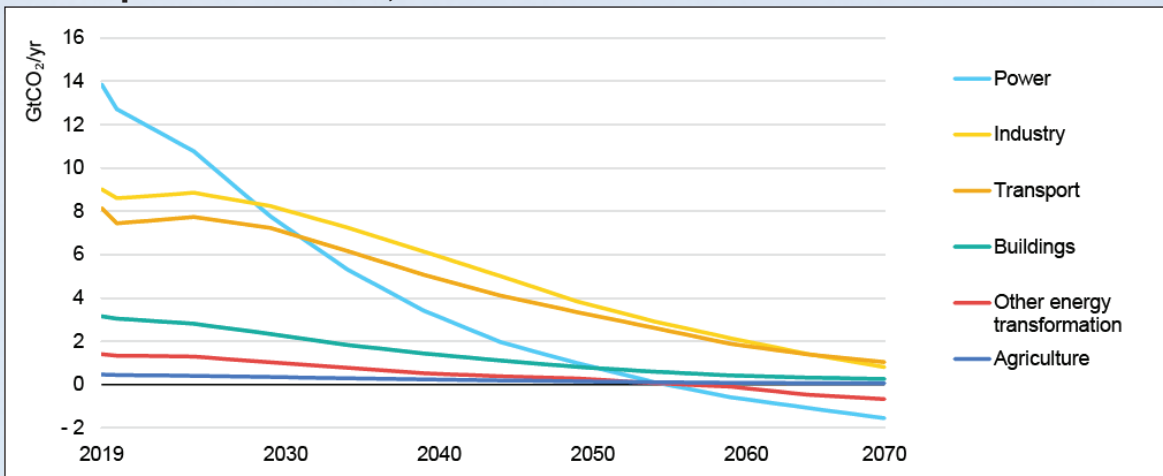
GE wins HA gas turbine order in Russia

GE has won an order to expand the Zainskaya State District Power Plant in Tatarstan, Russia. The new 858 MW combined cycle plant will be designed and built by the Turkish EPC company, as part of the modernisation projects of one of the largest power plants in Tatarstan.

GE will supply its 9HA.02 gas turbine, as well as a STF-D650 steam turbine, one triple-pressure HRSG with reheat and H78 and A78 generators. As a result, the CCGT power plant will be capable of reaching over 64 per cent net combined cycle efficiency.

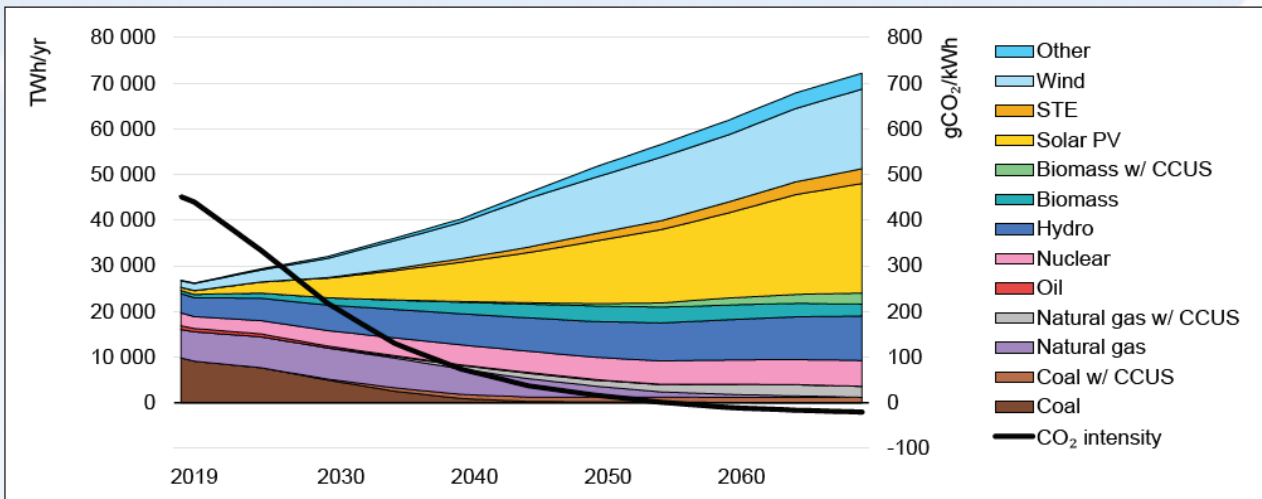
Zainskaya SDPP is one of the largest CHP plants in Russia, with a current capacity of 2.2 GW. The plant connects Russia's European energy system with the energy systems in the Urals and Siberia regions, generating around 25 per cent of the power consumed in Tatarstan.

Global energy sector CO2 emissions by sector in the Sustainable Development Scenario, 2019-70



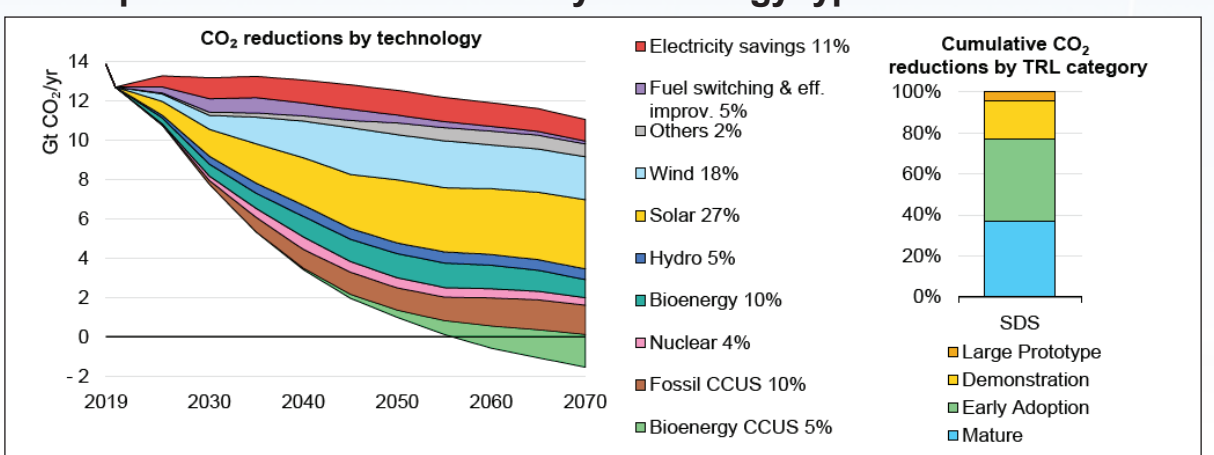
Notes: $GtCO_2$ = gigatonnes of carbon dioxide. Power includes heat generation. Other energy transformation includes coal mining, oil and gas extraction, oil refining, coal and gas transformation and liquefaction, production of hydrogen and hydrogen-based fuels, biofuels production with and without CCUS. Agriculture includes forestry and fishing.

Global power generation by fuel/technology in the Sustainable Development Scenario, 2019-70



Notes: TWh = terawatt-hours; gCO_2/kWh = grammes of CO_2 per kilowatt-hour; STE = solar thermal electricity; PV = photovoltaic; CCUS = carbon capture, utilisation storage. Other includes geothermal power, ocean energy and hydrogen.

Global CO2 emissions in the power sector by scenario and decomposition of the difference by technology type



Notes: TRL = technology readiness level; eff. improv. = efficiency improvements; STE = solar thermal electricity. Others include geothermal and marine energy as well as hydrogen. Electricity savings refer to electricity demand reductions in end-use sectors through more efficient end uses of electricity, leading to emissions reduction in the power sector. The percentages in the labels indicate the contribution of each technology type to cumulative overall emissions savings by 2070. See Box 2.6 in Chapter 2 for the definition of the TRL categories *large prototype*, *demonstration*, *early adoption* and *mature*.

For more information, please contact:

International Energy Agency
9, rue de la Fédération
75739 Paris Cedex 15
France.

Email: bookshop@iea.org
website: www.iea.org

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Hydrogen

Germany signs hydrogen study plan with Australia, French-German cooperation planned

- Germany and Australia to study development of hydrogen supply chain
- France and Germany to cooperate in hydrogen research and production

Gary Lakes

Research into hydrogen energy is picking up steam as important industrial producers begin to acknowledge the benefits of cooperation meant to drive economic recovery from the coronavirus downturn with investment in hydrogen energy. The EU has unveiled its plan to attach its energy future to renewables, especially hydrogen, in an effort to greatly reduce carbon dioxide and other greenhouse gas emissions by 2030 and thereafter.

EU-leader Germany and Australia signed a letter of intent in early September agreeing to launch a joint feasibility study into the development of a hydrogen supply chain between the two countries.

Germany is a strong advocate of hydrogen energy and is targeting a cut in its own emissions by 55 per cent by 2030 and to be completely carbon neutral by 2050. Australia has the resources to become a major hydrogen producer and exporter. Canberra has already signed pro-hydrogen agreements with Japan and South Korea in anticipation of developing a hydrogen-production industry.

"Exploring opportunities for future collaboration on commercial-scale operations and investments in hydrogen production is vital if Australia is to realise the significant economic benefits and job creation opportunity that hydrogen brings," Simon Birmingham, Australia's Trade Minister said at the signing ceremony.

The partnership with Germany was "critical" for Australia's efforts to development of a hydrogen industry, he said, adding that "Australia's future [is] as a powerhouse in clean energy exports." The study could lead to billions of dollars in export earnings and job creation, Birmingham said.

A number of German government departments are funding the 24-month study, which will ascertain the benefits of a German-Australian supply chain for green hydrogen – hydrogen that is produced through electrolysis with electricity produced by renewable energies. The process produces only hydrogen and oxygen in comparison to blue hydrogen, which is hydrogen extracted from natural gas, using electricity supplied by gas. That process produces hydrogen and carbon dioxide, which would need to be captured.

Germany's Federal Research Minister Anja Karliczek commented during the signing that Berlin is pleased to be working with Australia on this project, which will "promote the development of the global green economy".

"It is important… that Germany now sets course for international green hydrogen partnerships, that German companies open the doors to sales markets for hydrogen technologies 'Made in Germany' at an early stage," she said.

Australia's Minister for Resources, Water and Northern Australia, Keith Pitt, said: "As a fuel for the energy transition, clean hydrogen can be used to drive vehicles, generate heat and electricity, and as a chemical raw material for important industrial applications. Australia is ideally placed to play a leading role in the production and export of hydrogen worldwide, enabling us to help our trading partners reduce their emissions."

Australia, which has huge reserves of natural gas and is a major exporter of LNG, already has a number of hydrogen projects located around the country, including Tasmania and Queensland, that are designed to add hydrogen to the energy mix.

France has also expressed its plans to cooperate with Germany in research and production in hydrogen. Both countries have committed large sums of money to develop clean hydrogen and introduce it into their economies.

Last month during a conference in Berlin on hydrogen, French Finance Minister Bruno Le Maire said France is looking to collaborate with Germany in a joint hydrogen project. "I hope that we will manage to find a joint Franco-German and then a European project for hydrogen," he told French media.

Le Maire had said earlier that France would invest one-third of its €100 million coronavirus recovery package on green energy policies, stating that €7 billion would go towards developing carbon-free [green] hydrogen for transport and industries by 2030.

Green hydrogen can also be produced with electricity from nuclear power plants, which France uses to generate 70 per cent of its power. Germany is, however, phasing out its nuclear power sector.

"France is convinced that carbon-free hydrogen will be one of the great revolutions of our century," Le Maire stated. "For the decarbonisation of the industrial sector, to develop and deploy emission-free mobility solutions, to store energy and provide additional responses to the intermittency of renewable energies,"

The French government has stated its intention to install 6.5 GW of clean hydrogen production capacity by 2030 and begin the construction of electrolyser factories by 2021. The investment will cut the country's CO_2 output by 6 million tons, the equivalent of Paris' annual emissions.

For its part, Germany will invest €9 billion in expanding hydrogen production as part of its €130 billion economic stimulus programme with the target of boosting hydrogen capacity to 5 GW by 2030 and 10 GW by 2040.

Gas

Egypt gas sector revival puts country on promising track

With gas production reaching record levels, Egypt is positioning itself to become the East Mediterranean gas hub.

Gary Lakes

Over the last five years, Egypt has seen a complete turnaround in its natural gas sector. After a number of serious policy steps that liberalised the market, slashed subsidies, and paid investors the arrears owed – plus a $12 billion loan and guidance from the International Monetary Fund (IMF) – Egypt is now pumping natural gas at record capacity levels and positioning itself to become a regional energy leader as the East Mediterranean gas hub.

During the general assembly meeting of the Egyptian Natural Gas Holding Company (EGAS) in Cairo in mid-September CEO Magdy Galal reported that gas production had reached 7.2 billion cubic feet (bcf)/day. The drilling activity was primarily designed to compensate for the decline in output from existing wells, and much of it resulted in new discoveries. But the real plus is the Zohr gas field, discovered in 2015 by Italy's Eni.

Egypt's gas sector has been making a comeback since 2018 after the Zohr field came on-stream the year before. By January 2019 Egypt could see its way open to taking a leading role in the East Mediterranean. It invited the energy ministers of Cyprus, Greece, Israel, Jordan, Italy, and the Palestinian Authority to Cairo to participate in the creation of the East Mediterranean Gas Forum (EMGF). The group has gathered every six months since then and on September 22nd, the energy ministers from the seven states signed a charter via a virtual online conference, making the EMGF a legal international entity.

The purpose of the EMGF as an intergovernmental organisation is to discuss infrastructure projects and boost exports from the region. Speculation about future prices and demand are relevant to East Mediterranean gas exports, but members believe opportunities will return once a recovery from the coronavirus begins to take hold.

Egypt's success has prompted it to open up the western territory in its East Mediterranean exclusive economic zone (EEZ). This summer it was announced that a number of blocks had been allocated to major international oil companies (IOCs) along the coast west of the Nile Delta. ExxonMobil, Chevron, Shell, BP and Total are among the major firms that will be exploring in the region, which is considered to be highly promising.

Egypt's turnaround was sparked by government reforms and the Zohr discovery, which came as reforms were taking effect and investors were again busy in the country's gas fields, particularly the East Mediterranean offshore. Zohr, with a resource estimated at 30 trillion cubic feet (850 bcm) and located near the maritime border with Cyprus, prompted a great deal of excitement, encouraging new bidding rounds and drilling in Cyprus and Israel.

Zohr's contribution to Egypt is significant, currently it accounts for 40 per cent of its 7.2 bcf/day of production, and Egypt's neighbours, Cyprus, Israel and Lebanon, are keen to see a similar discovery although it will likely be late 2021 before exploration activity picks up.

Momentum in the East Mediterranean was gathering until the onset of Covid-19. That brought a shutdown to most offshore exploration in the region, but crews in Egypt have continued to work and report successes.

Reports of new discoveries are frequent. In mid-September Eni and BP announced a gas discovery at the Nidoco NW-1 well in the Abu Madi West concession in the Nile Delta Basin. The discovery is in the 'Greater Nooros Area' and boosts resource estimates to 4 trillion m^3, up from the previous 3 trillion m^3.

Meanwhile, BP in early September reported that production from its offshore Atoll field rose by 28 per cent to 320 mcf/day from 250 mcf/day during the 2019-2020 fiscal year. Optimum output is planned at 350 mcf/day and 10 000 b/d of condensate.

Egypt is now self-sufficient in natural gas supply and looking to resume exports that were halted in the mid-2010s when domestic output fell to some 40 bcm/year compared to 64.9 bcm in 2019. Furthermore, it plans to import gas from Israel and Cyprus for re-export. Israel gas has already started to supply some Egyptian industries.

In 2015-17, Egypt was having to import gas in the form on LNG while its two LNG plants on the Mediterranean coast sat idle. Some LNG shipments from the Idku LNG facility resumed last year, but they were stopped again this spring when the price of LNG dropped to a point that it became uneconomical to export. The LNG facility at Damietta has yet to reopen, waiting for the resolution of a legal agreement between Egypt and the plant's owners. Meanwhile, Egypt restarted small volumes of gas to Jordan via the Arab Gas Pipeline.

According to BP's Statistical Review of World Energy 2020, Egypt has total proven gas reserves of 75.5 trillion cubic feet. BP data shows that Egypt is beginning to use less gas for domestic consumption because reforms and other steps were introduced. Consumption fell during 2019 to 58.9 bcm, compared to 59.6 bcm in 2018. Gas consumption is expected to fall further as the country implements improved power generation systems and makes more use of renewables, setting Egypt up for more gas to export.

A random walk through the energy transition

A number of oil and gas majors are now grappling with making a significant shift into renewables.
Aspen Technology's **Ron Beck** discusses the technologies that will help in what will be a difficult transition for them to make.

Several oil and gas majors have made clear their plans to shift strategic focus. Just recently BP, for example, in the face of a massive fall in oil prices, said it will invest tens of billions of dollars over the next decade to meet its target of becoming one of the world's largest renewable power generators and achieve net-zero in its operations by 2050.

But the energy transition will be complicated for these companies to navigate. There are many factors at play that make this more complex than it may appear. So how to rise above the crowd in these next few years? Technology is proving to be a valuable tool in navigating and thriving during the energy transition and will help companies be leaders.

Global energy demand will continue to rise, according to most predictions. There are two factors driving these forecasts: population and standards of living. The Energy Information Administration (EIA) forecasts global energy demand to grow by almost 50 per cent between 2020 and 2050. This will continue to drive the need for energy – the question is which energy sources? And therefore the "energy transition" required as the sustainability movement drives the globe towards "greener" energy sources.

The challenge, of course, is the formidable reality of global energy mathematics. The numbers are so high, that no matter what the rate of adoption of renewable energy sources, hydrocarbons will remain a crucial element of the world energy picture for decades.

So how can technology help adapt hydrocarbon use to achieve better sustainability results? Let's look at a few levers the industry has and the key role technology will play.

Natural gas is emerging as an important future energy source, often seen as a 'bridge fuel" to reduce carbon. To make natural gas transportable, though, requires the energy-intensive and complicated liquefaction (LNG) process. Technology is playing a key role in improving the costs and reliability of natural gas supply. Digital twin models and advanced control have already proven to be crucial in the reduction of energy use during LNG processing.

Much more use of technology will be necessary here, as the producers, driven by both economic reality and sustainability needs, are embracing these proven approaches beyond the initial successful adopters of these tools. Each implementation of this technology further advances the 'green-ness' of natural gas.

Huge capital has been tied up in these projects, and so utilisation rates of these capital-intensive LNG plants is crucial. There, the prescriptive maintenance technology, which embeds machine learning and advanced AI analytics in solutions which alert operators to conditions that create risk of degradation of the high-capital compressors and cold boxes, are now beginning to have an important impact. The confidence of owners and developers in this technology will enable several large development projects to proceed quickly.

For highly complex and demanding assets, such as LNG plants, the self-optimising plant, a future vision for industry in which data and AI contribute to make these investments self-learning, self-adapting, and self-sustaining, will be important.

To achieve the aggressive targets of global players, who are pledging to reach "zero carbon" operations by dates ranging from 2030 to 2050, increasing the pace of developing renewable power assets is viewed as crucial. These technologies, though, are still relatively new in terms of the maturity curve. Utility scale wind and solar arrays are just now beginning to reach the operational phase where maintenance and uptime become concerns.

Again, as is being applied for LNG capital assets, wind farms have already begun successfully adopting prescriptive maintenance solutions, which provide asset health alerts to maximise the availability and utilisation of these large assets, which have not yet established a long-term reliability and maintainability record. This advanced digitalisation technology will be crucial in monitoring the health of equipment which is inherently installed remotely, under environmental stresses, and requires maximum uptime to be reliable in the energy mix.

An interesting analysis compiled by global political thinker Peter Zeihan, looks at the distribution of land across the globe that is suited for utility-scale renewable electricity production. Interestingly, Zeihan shows that roughly half of the world's population is located in Eastern and Southeastern Asia, which has low potential for solar and wind farms. Perhaps as a consequence of that, Southeast Asia has pursued a path of exploitation of palm oil plantations as a potential source of bio-energy and bio-chemicals. The balance of that ledger, however, is not clear, as clearing of rainforest in favour of palm oil farms, is arguably a net negative on the sustainability scale.

Bioenergy conversion approaches, including bioethanol, biodiesel, waste-to-energy pyrolysis, algae conversion, and biochemicals, have gained acceptance at least partially through the benefit of subsidies and government policy. Process modeling technology continues to be crucial, although not widely enough used, in improving the performance of these processes. These processes are hamstrung by the high energy consumption of currently accepted technology.

In order to contribute effectively to sustainability and energy transition, advanced modeling and optimisation is needed to achieve fundamental improvement. Dr. Eric Dunlop, a specialist in large-scale biochemical engineering projects and the algae business, has pioneered these approaches in some groundbreaking work on algae-to-fuels.

New startups continue to innovate with novel new technologies to improve bio-energy conversion, and the new generation of hybrid modeling, which combine AI analytics with rigorous process modeling (such as AspenTech's innovative AI model builder), will be playing a big role here in improving the technical pace of innovation and commercialisation opportunities.

Reducing energy use is another key area. Energy is consumed inefficiently in the conversion of hydrocarbons, synthesis of chemicals and the supply chain. Technology will play a key role in helping the industry navigate a drive towards carbon neutrality. In addition to improving energy efficiency, optimisation technologies can contribute to increasing the production efficiency of oil and chemical operations. Both digital twin monitoring systems and dynamic optimisation solutions can together save 5-15 per cent energy use, reducing carbon emissions a proportional amount.

Another great technology weapon is utility supply optimisation. As power plants looks to minimise carbon emissions, the choices between oil, gas, biofuels, and renewables can be made on a sophisticated basis. The choices can be made minute-by-minute, or at any longer interval. The technology can model the interplay between multiple plants, and multiple utility sources, for example choosing between a wind energy source, natural gas-based electricity, or diesel combustion at the plant, taking into account dollar cost, carbon costs, and reliability.

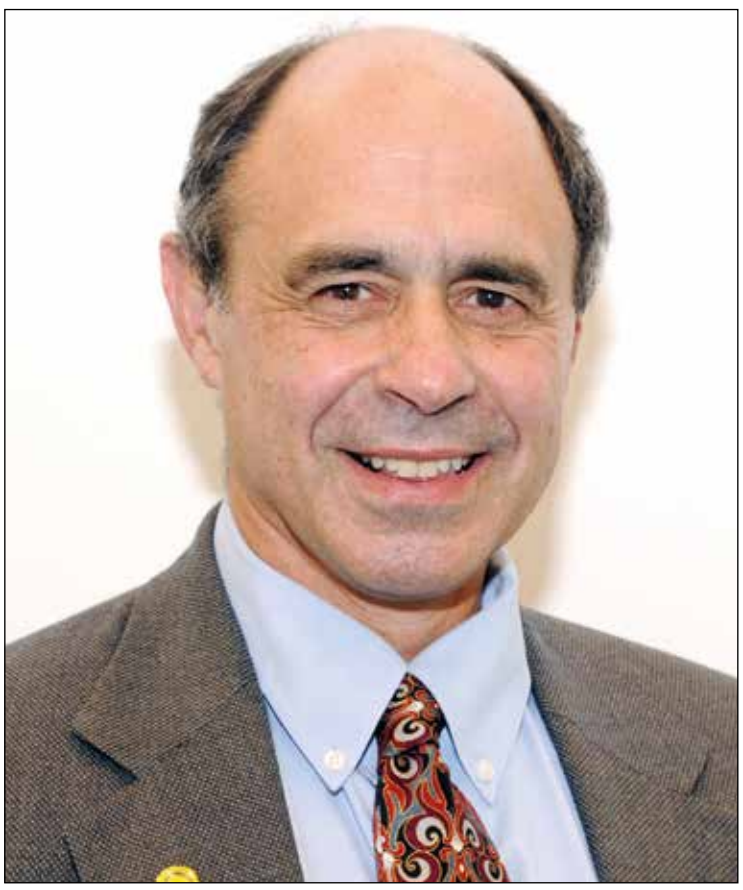
So what is the future path for oil and gas majors? Firstly, predicting peak oil demand is the forecaster's elusive gold star. Will it be 2025, 2030, 2040 or later?

This will depend on factors including global economic growth (only really forecasted to grow significantly in Asia), energy conservation (or "intensity") in different regions, a shift to electric power over combustion and others. The IEA in its most recent report has forecast peak oil demand will take place in the 2030s.

Corporations globally have acknowledged the onset of the energy transition. Some have chosen to reflect this through their investments and their actions. An IHS Markit analysis shows that Total, Shell, BP and Equinor have made at least 66 acquisitions in the past several years to diversify their energy portfolios. Others have chosen to focus on innovation in use of capital and on operational excellence to build a resilient market position.

As the industry navigates the energy transition, technology will be a key partner as organisations and their executives make strategic moves to improve their agility and competitive positions into the future. Those companies who adopt some or all of the technology opportunities mentioned will be bound to have an advantage.

Ron Beck is Marketing Strategy Director at Aspen Technology.



Beck: As is being applied for LNG capital assets, wind farms have already begun successfully adopting prescriptive maintenance solutions

A mirror to the future

Digital twins are an exciting technology with incredible potential. **Junior Isles** catches up with GE Digital's Colin Parris for his take on some of the benefits they bring and a glimpse of what's to come.

Digitalisation has opened up all kinds of possibilities in the power sector. Yet there is one area of digitalisation that can make a profound difference – the concept of the digital twin, a mirror of the physical world.

The digital twin is most commonly defined as a software representation of a physical asset, system or process designed to detect, prevent, predict and optimise through real-time analytics to deliver business value. The technology has been around for some time but with the Internet and progress in technologies such as artificial intelligence (AI) and machine learning, digital twins are entering a new phase, bringing new possibilities to owners and operators of power assets.

Colin Parris, Senior Vice President and Chief Technology Officer, GE Digital, has seen the technology grow from its infancy to become an important tool in GE Digital's arsenal to better serve its customers' efforts to improve the operation and value of their assets – whether in power generation or transmission and distribution.

He said: "The digital twin actually came out of aviation and in particular the military, perhaps a decade or more ago. The Navy was looking at how to understand the readiness of an aircraft sitting on one of its carriers. It's not like a plane at an airport; if you don't plan for parts or service, the aircraft doesn't fly and the mission is compromised.

"So the notion was: can I have a digital model that can tell me the state of readiness of an aircraft…? GE then began thinking about how it could do something like that, initially for its Aviation business. And because we also have turbines running everywhere for the electricity and energy sectors – where typically we had to give suppliers six or seven months lead-time before the parts were needed – it made sense to have digital twins."

GE Digital then began to investigate what else a twin might be able to do. "Because we have engines that are in the air, engines that are producing electricity or engines that are pumping oil out of the ground, we began to see a pattern of what customers wanted to do.

"First, they want an early warning of a problem; with a jet engine you need an early warning about failure. In the energy sector, you want to be warned about any anomalies – it's much better to fix a bearing or blade early rather than to get to a point where there is damage that can cause an engine to be out for six months. The second is continuous predictions on the remaining life of a part, to understand what parts I need in my inventory for when it has to be replaced. And the third thing is optimisation: optimising a turbine for highest energy delivery and lowest fuel cost."

GE Digital then moved to see how this could be expanded across an electricity network, looking at all the components on the grid to optimise the maximum amount of generation for the lowest cost. This was then extended to processes, such as smelting in order to consume the least amount of electricity and least amount and materials.

The digital twins that are increasingly being adopted today are not like the static models of the past that were used to perhaps predict the behaviour of a network at a given moment in time. Today's digital twins are what Parris calls "living, learning models" that take in a steady stream of data to continuously update their models.

He said: "While there is widespread use of things we call twins, which just give insights from data coming in, we are now moving into combining the physics and AI to give us deeper and deeper insights into what's happening. There are twins in generation, transmission and distribution and there are especially new twins for what is going with distributed energy resources. People are wondering how to model all of the electric vehicles and battery sources that are coming on line – with all the volatility it creates, you need twins and analytics to help you."

GE Digital is focused on how digital twins can help its customers across three core areas: assets, networks and processes.

Addressing the power generation sector, the company's Asset Performance Management (APM) software solution creates digital twins based on operational/fleet data of: components such as pumps or compressors; critical assets, like turbines; or systems of assets such as an entire power station. This type of digital twin is an increasingly common tool for operators of large equipment to optimise their maintenance schedules and to predict and avoid unplanned downtime.

For transmission and distribution, its Advanced Distribution Management Solution (ADMS) and Geographic Information System (GIS) use operational data from across the network to create network digital twins that can create virtual models. These allow grid operators to better manage and optimise networks, for example, in the face of increasingly extreme weather, aging infrastructure, and the growing use of renewables on the grid. Such twins essentially provide a connected view of the end-to-end network of assets, based on real operational data.

Operators and owners can implement these digital twins in several ways: either they can purchase the relevant tools from GE Digital and build it themselves; or buy a twin from GE Digital's catalogue of twins and input their own data. "We have over 300 pre-built digital twins of components in our APM systems, so they can feed their data into the twin, which then learns about their system," said Parris. The third way, he notes, is for GE Digital to take the customer's data and build the twin.

One of the biggest challenges that companies often face, however, is to first collect the necessary data, and this to some degree is determining the prevalence of the technology in the various parts of the power sector.

Looking forward, Parris highlights a few key areas of advancement in digital twins and ways in which GE Digital is working to accelerate their use.

Although digital twins can bring value and deliver savings through early warning, prediction and optimisation, he noted that operators are often not comfortable with basing their strategies on twins to, for example, predict the lifetime of a $20 million sensor in a turbine.

"Getting people to adopt it is the hardest thing. So about three years ago we created something called Humble AI, which takes into account the zone of competency for a particular [digital] model; so you use the model inside the zone of competency, and when outside that zone you use a different model or human and feed that data back in so the AI system gets smarter. That's why it's humble; it knows what it doesn't know and it wants to learn."

The technology has already been developed for gas turbines and wind turbines and Parris notes that it is giving operators greater comfort in terms of reducing risk.

Another area that Parris says GE Digital is currently focusing on is how to put this "all into a process that people like". The company is therefore combining digital with Lean methodology.

He explained: "Lean takes any process you have and says: 'tell me what you are trying to solve.' In power, you might be trying to reduce the cost of maintenance or increase how much power you deliver at a certain fuel level. So there's a process behind it. Lean will call for a value map of the process, whereby all the data will be pooled from the experts. Lean is about pulling the data, and that same data is what a data scientist needs... to create a model for embedding in the process.

"Engineers like this combination of digital and Lean because they all know Lean, and now they can see Lean inside of digital. Lean helps focus on the amount of money you will save, or whatever it is you want to change, while digital does the digital transformation inside the process. This is allowing the technology to gain more traction in the industry."

So what is the future of the technology itself? Parris offered a glimpse of a few research projects he has been working on with investment from organisations such as the US Defense Advanced Research Projects Agency (DARPA) and the Intelligence Advanced Research Projects Activity (IARPA).

Over the last three years they have been investing money with GE Digital in an area called 'Emerging Languages'. About five years ago, GE Digital began exploring the idea of assets that could talk to each other and solve problems.

Parris explained: "What if one wind turbine could show another turbine its sensor readings, ask if it has seen these readings before and then ask: 'what was the problem?' And that turbine could respond, saying for example, I have seen these readings before and it was a bearing problem. And what if then, that asset could communicate with us and tell us what it thinks the problem is? This would be tremendously helpful. It would allow us to identify problems very early on."

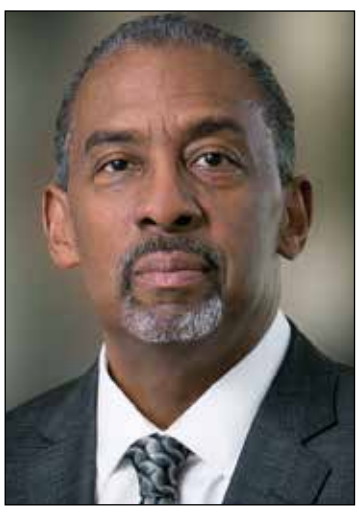
GE began developing a language between the turbines and has been experimenting for the last year, with "some interesting results".

Parris said: "It can communicate simple things like: there was a storm, damage to a blade, this sensor reading looks wrong and I think it's this. It's at an early stage but what begins to get me excited is the speed at which they communicate, and the things that they say is interesting.

"If you think about the next 4-5 years of this and get to a point where machines are diagnosing themselves, although humans will still be involved, it will all be a lot faster."

It's an exciting future. On a wider scale machines talking to each other in such a way offers an incredible opportunity in the fight against climate change.

Parris concluded: "It's especially relevant to me because of the decarbonisation problem. If you ever get to a point where these assets are going to have to work together to reduce carbon in the atmosphere, you want them working together in the most optimal way."



Parris: we are now moving into combining the physics and AI to give us deeper and deeper insights into what's happening

Smart meters: paving the way to cheaper, greener energy

Smart meters are a good starting point in greening the economy but their impact is limited because the rest of the energy system remains 'dumb'. Octopus Energy has developed a new cloud-based energy platform based on smart tariffs that is designed to deliver a smarter energy system. **Phil Steele** explains.

Digitalisation has swept through many industries, changing how we work, listen to music, watch films or book our holidays. Aided by technological transformation, industries – from banking, to entertainment, fitness, and transportation – have innovated and evolved to make mundane tasks quicker and our lives easier. There is one sector, however, that has remained relatively unchanged – energy.

Energy is arguably the most important sector in the world. Worth almost £2 trillion, it is necessary for almost everything we do and yet it remains relatively untouched by the tech revolution. That's not to say that changes haven't been made, we have seen an increase in renewables capability, and we are even starting to see the impact of technological transformation but it has been slow going. The smart meter roll-out, which started in the UK almost a decade ago, has yet to be completed, and the deadline has been pushed further and further back. As a sector, we have a lot of catching up to do before we can match the same level of smart integration as other industries.

The energy sector's potential is huge. While most technological advancements have followed the Silicon Valley ethos of finding a problem and solving it for the individual, smart energy can do much more than that: it can help households by lowering their energy bills, but it can also quite literally enable us to save the planet by allowing more renewable energy into the grid.

Smart meters enable customers to better understand their energy consumption by providing real-time energy usage data in a clear and easy to understand way, taking away the ambiguity of monthly meter readings. They are already helping thousands of households make cleaner, cheaper energy choices – imagine the potential for change if we could make the entire grid equally smart. Not only can we help grid operators such as the National Grid hit net-zero by 2050, we can also reduce reliance on fossil fuels and help facilitate the clean energy transition.

A smarter grid will unlock the true potential of renewable energy. One of the National Grid's biggest challenges is balancing the demand for energy with supply, an issue made more complicated during lockdown as patterns of energy usage changed with manufacturing going offline and the increased prevalence of working from home. Whilst we have significantly increased our renewable energy generation, reliability remains an issue and during peak times there often isn't enough renewable energy to meet demand, resulting in us reverting back to fossil fuels. But when the sun shines and the winds are strong, we can end up with an excess of renewables that are wasted because we aren't able to better manage consumer demand. Squaring this particular circle would allow us to unlock the clean energy transition and save both consumers and the National Grid considerable amounts of money.

So, what has this got to do with smart meters? Quite a lot. Smart meters are an industry game-changer. Thanks to them, it's much simpler for customers to make small changes in the way they use energy which can have a really positive impact on the grid. Smart meters make it so much easier for customers to stay on top of their energy usage by clearly displaying how much energy is being used at any one time. With use data automatically sent back to suppliers, smart meters have taken the uncertainty out of electricity bills and people pay for what they have actually used.

Going one step further, by monitoring their use and the price of energy, customers can understand how, when and where they could be saving money by making more energy-efficient choices. And going one step further than that, smart appliances can be integrated with the meter to enable smart homes with optimal energy use. These small changes in customer behaviour can lead to a reduction of energy use during peak times. This in turn can have a big impact on balancing the grid, thus making energy use as a whole greener.

Smart meters are a good starting point, but the impact is limited because the rest of the energy system remains 'dumb'. It is the smart grid as a whole that is critical in moving to greener energy affordably. By engineering a completely new, cloud-based energy platform called Kraken, Octopus Energy was able to create a system designed specifically to move towards delivering a smarter energy system.

Kraken, in turn, enabled the creation of smart tariffs which vary every half hour, so smart meter customers can benefit by using cheap electricity when the sun shines, the wind blows, and when the grid is "quiet" (typically 21 hours a day). Smart, flexible tariffs can provide cheap electricity for electric car owners to charge their batteries at night or pay customers for excess solar generation or "battery export" on a half-hourly metered basis. These smart tariffs base the variable prices on the wholesale price of energy. These prices then reward the customers who are able to monitor their use and shift their energy consumption to times when energy is cheaper, which often coincides with when energy generation is greener.

The general consensus used to be that because consumers don't necessarily take advantage of potential savings by switching, they won't respond to variable tariffs. But this is not what we found. Customers on our smart Agile Octopus tariff moved 25 per cent of their electricity usage into times when it was cheaper for them and greener for the grid.

Octopus Energy is dedicated to combining energy and technology. We wanted to see if we could take the price-motivated changes in demand patterns that we saw from our Agile Octopus tariff one step further to support grid optimisation and encourage even more behaviour change from our customers.

Nudge theory and behavioural economics demonstrate how even small incentives can shift behaviour – the 5p cost for a plastic bag is unlikely to price anyone out of their grocery shopping, but the payment itself discourages use and has resulted in an 86 per cent reduction in the uptake of single-use plastic bags. Using a similar model, we ran a customer trial in May which aimed to nudge customer behaviour by encouraging them to change their energy usage patterns. We actually paid customers to shift their energy use to times when there was a surge in renewable energy. Even with intentionally low rewards of 2p and 5p, the results were outstanding. The majority of customers who took part in the trial significantly shifted their energy use – a clear demonstration of the power of small changes in behaviour to reduce reliance on fossil fuels.

Empowering customers to take charge of the way they use energy doesn't stop here. The true potential of smart meters and tariffs are best unlocked through the integrations with other devices. By connecting smart products to a Home Energy Management System (HEMS), any appliance with smart integration could run automatically when it is cheapest and greenest to do so. This includes appliances such as Alexa which can tell Octopus Energy customers when energy prices are going to be at their lowest or how much energy they have already used. Smart integrations allow customers to save money and be greener, even when they are not at home. And as more and more products and appliances go smart, the benefits to smart energy users will only multiply.

By publishing our half-hourly Agile Octopus rates online for anyone to access and making it available as Open Application Interface (API), consumers are able to use the data to create new solutions that will make their homes and lives even smarter. The innovations that come out of open data have so much potential and we have seen many customers harness this to make their lives easier. For example, Kim Bauters created OctopusWatch, which is an app that takes all the data provided in the API and turns it into simple guidelines about when to turn on energy-intensive appliances leading to savings of up to 35 per cent.

The roll-out of smart meters still has a long way to go, but the potential benefits are boundless. With smart meters and smart tariffs, we can work together with consumers to create a greener, fairer, and cheaper energy system whilst also tackling climate change. It is through the combination of smart technology and the willingness and ability of customers to act that we will make real change and leverage the full potential of renewable energy sources through a better-balanced grid.

Phil Steele is Future Technologies Evangelist at Octopus Energy.

Steele: The roll-out of smart meters still has a long way to go, but the potential benefits are boundless

Junior Isles

Chasing the white rabbit

It's easy to get lost down the rabbit hole of focusing on renewables and new clean energy systems as we strive to reduce carbon emissions and halt climate change. Almost every online conference or webinar (and there have been way too many since the lockdowns have prevented physical gatherings) has in some way focused on renewables. Whether it's increasing the use of wind and solar, or energy storage to optimise the use of intermittent generation, or smart grids to accommodate fluctuating generation, or the decarbonisation of industry and transport through greater electrification using renewable sources – it almost always comes back to renewables.

Clearly the reasoning is born of necessity. In its recently published 'Energy Transition Outlook' (ETO), DNV GL stated that despite a fall in carbon dioxide emissions this year due to the pandemic, "we will still blow past the carbon budget for a 1.5°C future in 2028". It said the 2°C carbon budget would be exhausted by 2051.

It notes that the transition is happening at a fast pace, predicting that "within a generation", renewables and fossil fuels will have roughly an equal share of the energy mix compared to an approximately 20-80 split today. According to the company's projections, solar capacity will expand by 20 times and wind 10-fold by 2050 as costs plunge. Yet it will not be enough.

Policy levers are needed to stimulate other technologies that are vital to reduce energy use and emissions. DNV GL says that carbon capture and storage (CCS), for example, is a vital component in decarbonising natural gas, including the production of blue hydrogen, but notes that a lack of policy coordination means that by 2050 CCS will only capture 11 per cent of carbon emissions, despite the technology first appearing in the 1970s.

Launching the ETO 2020, Remi Eriksen, Group President and CEO of DNV GL, said: "We can't empty the airliners twice, so we need all hands on deck to find practical solutions to the climate crisis – now. The rapid rise of solar PV, wind and battery technologies in recent years gives me hope that humanity has solutions at hand. However the so-called hard to abate sectors need strong policy incentive to move the needle on decarbonisation. Decarbonised natural gas, including hydrogen, will play a key role in the transition to the energy future humanity wants and needs."

Similar observations were made by the International Energy Agency in its recent Energy Technologies Perspective (ETP) 2020 – the first core ETP report for three years following a revamp of the series.

The report analyses more than 800 different technology options to assess what would need to happen to reach net zero emissions by 2070. The blistering pace of technological transformation that would be necessary for the world to reach net zero emissions by 2050 is explored in the report's 'Faster Innovation Case'. It finds that to meet the huge increase in demand for electricity, additions of renewable power capacity every year through 2050 would need to average around four times the current annual record, which was achieved in 2019.

The report stresses that energy innovation will be crucial but sees "reason for optimism", despite the disruption and uncertainty caused by the pandemic. Dr Fatih Birol, the IEA's Executive Director stated: "Investment in clean energy start-ups by venture capital funds and companies rose to a new record in 2019. And governments and businesses are finally putting serious resources into the clean energy potential of hydrogen, which this report makes clear will be critical for reaching net zero emissions."

But his most important takeaway from the report is the major challenge of how to tackle emissions from the vast amount of existing energy-related infrastructure around the world.

"Personally, the most important blind spot in the climate change debate today is the overwhelming focus on what we are going to build – the new power plants, new factories, new cars – and that they should be clean and sustainable," said Dr Birol. "Yes they should be, and we should focus on them but there's a big issue: we have built power plants, steel and cement factories for years and years and they will be with us for several decades to come. Without addressing emissions from the world's existing infrastructure, we will have no chance whatsoever of meeting our energy and climate goals."

According to the IEA, if no action is taken, today's existing infrastructure will emit about 750 Gt of CO_2 over the next five decades. The bulk of cumulative emissions from existing infrastructure is expected to come from the power (55 per cent) and heavy industry (26 per cent) sectors, reflecting their large shares of emissions today and the long lifetimes of the assets, e.g. power stations and manufacturing facilities.

Timur Gül, the IEA's Head of Technology Policy and director of the report, said there would be no chance of fully decarbonising the energy sector by 2050 unless "we find a way to address emissions from these existing assets".

How each country tackles the problem will depend on its individual circumstances and the age of the different facilities. Some may opt for retrofitting or modernisation, and some may go for early retirement. In Asia for example, 80 per cent of existing coal fired generating capacity was built in the last 20 years – retiring these early will be hard to justify economically.

The existing coal plant fleet, along with emissions from industry are particularly tough nuts to crack. Green hydrogen is attracting increasing interest as a way of decarbonising industry and transport (alongside electric vehicles). CCS and CCUS (carbon capture utilisation and storage) has been promoted for some time as a way to address the existing coal, and to a lesser extent gas, power generation fleet but the economics still do not stack up. There could be a case for industrial settings and there has been some progress here, but the uptake of CCS/CCUS in the power sector has been woeful.

Gül commented: "Progress with CCS technology has been somewhat behind expectation over the last decade but it is a technology that we will ultimately need in certain applications such as cement [production]; to produce synthetic fuels; and to remove CO_2 emissions from the atmosphere."

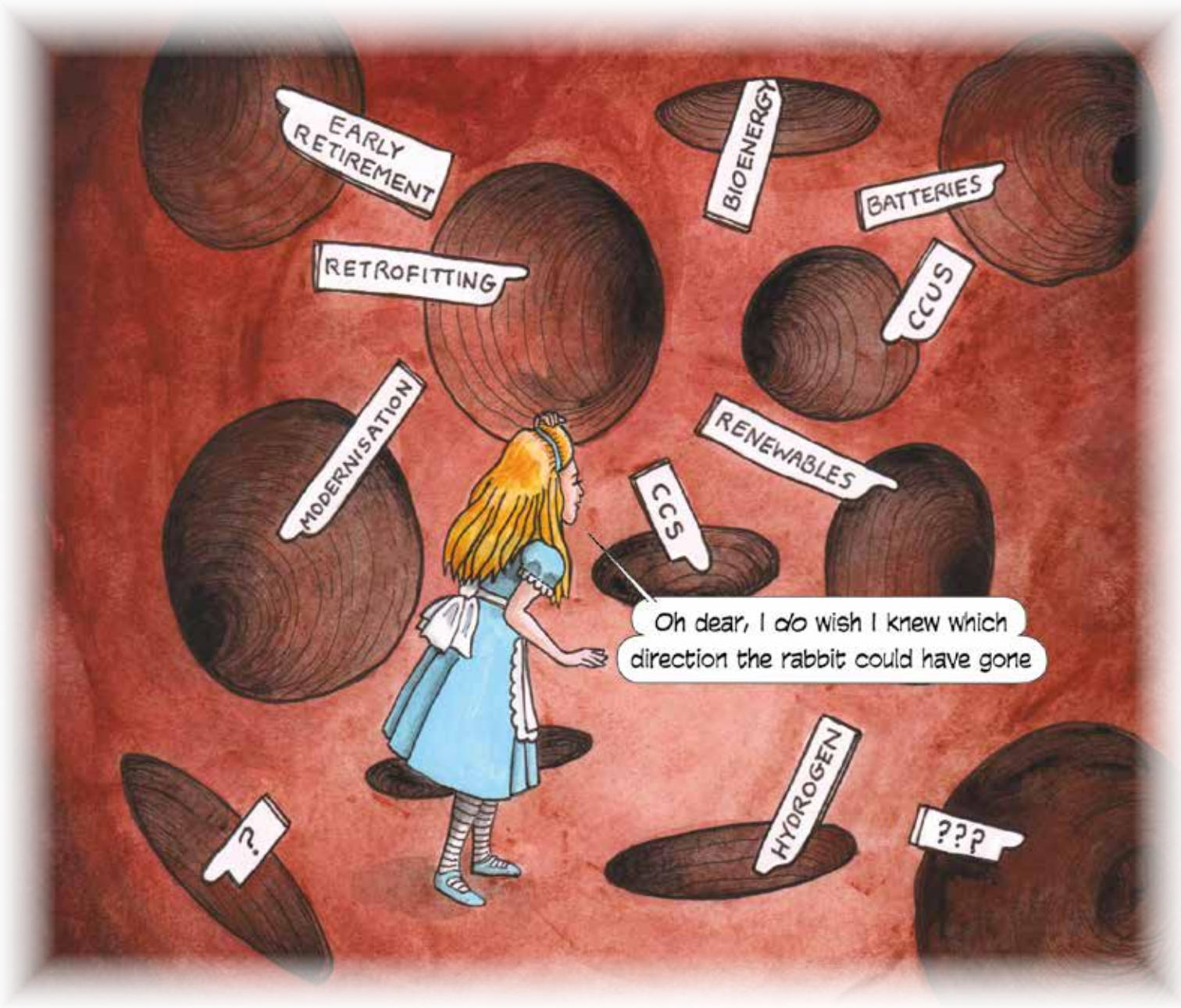
According to Dr Birol, of the 800 technology options covered by the report, CCUS, hydrogen, batteries and bioenergy, "appear to be the frontrunners today" and are "the game-changing technologies that are ready for the big time". But with regards to CCUS, he also concedes that although "the technology has been with us for a long time, we have still not seen a major breakthrough yet".

Still, he maintains it is a necessity. "In my view, we don't have many options to have a bridge between our huge fossil fuel assets and our climate goals."

That may be so but the economics will have to change and this can only come with a big policy push to drive the price of carbon.

In the meantime, the world will likely continue to focus on how it can increasingly utilise renewable energy sources, which are becoming cheaper and cheaper. Renewables in power generation and greater electrification of industry and transport can do much in navigating the road to net zero but it is difficult to see how they can get us there alone, and by 2050.

Like Alice in Wonderland, we will have to go further down the rabbit hole – pursuing maximum use of renewables going forward without losing sight of the technologies that are needed for the fossil fuel and industrial installations of today. It is a complex journey but let us hope that chasing zero emissions is not as chaotic as chasing Alice's white rabbit.



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