

# THE ENERGY INDUSTRY TIMES

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# World on track to miss climate change targets, says IPCC report

Australia's Environment Minister Melissa Price believes IPCC report exaggerates threat of fossil fuels



The Intergovernmental Panel on Climate Change claims that the world is on course to miss the climate change targets set under the Paris Agreement but not all will act on the report's recommendations. **Junior Isles**

A report from 91 scientists convened by the UN's Intergovernmental Panel on Climate Change (IPCC) has concluded that the global temperature has risen by 1°C since pre-industrial times and is likely to rise by a further 2°C by the turn of the century, based on current policies.

This means the world is on course to exceed the targets of the Paris climate agreement and warm by 3°C by the end of the century, a level that would disrupt life on Earth. The report was commissioned by the Paris signatories

to help them understand the vastly different implications of 1.5°C of warming – the target they agreed to move towards – and the 2°C they committed to stay below.

In producing the report, IPCC scientists used over 6000 scientific studies to produce a comprehensive report on how to limit climate change to manageable levels. The report stressed that climate change must be limited to 1.5°C of warming to avoid the worst impacts of climate change and that the world needs to decarbonise as much

as possible and as fast as possible, including halving global emissions by 2030 and reaching net zero by 2050.

To help achieve this, the report insists that the use of coal for power generation would have to fall to between zero and two per cent of current usage.

Not all however, are prepared to act on the IPCC's recommendations. While Republicans in the US doubted the organisation's findings, Australia rejected the call by scientists to phase-out coal use by 2050.

Australia, which is among the highest greenhouse gas emitters per capita and is the world's biggest coal exporter, said it would be "irresponsible" to comply with the recommendation by the IPCC to stop using coal to generate electricity.

Australia's Environment Minister Melissa Price believes the IPCC report exaggerates the threat posed by fossil fuel.

"Coal forms a very important part of the Australian energy mix and we

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## Bioenergy to lead renewable resources, says IEA

Renewables will continue their expansion in the next five years, covering 40 per cent of global energy consumption growth, according to the International Energy Agency's (IEA's) recent 'Renewables 2018' market analysis and forecast report.

Notably, the report says that while the growth in solar PV and wind is set to continue in the electricity sector, bioenergy remains the largest source of renewable energy. This is due to its widespread use in heat and transport, sectors in which other renewables currently play a much smaller role.

"Modern bioenergy is the overlooked giant of the renewable energy field," said Dr Fatih Birol, the IEA's Executive Director. "Its share in the world's total renewables consumption is about 50 per cent today, in other words as much as hydro, wind, solar and all other renewables combined. We expect modern bioenergy will continue to lead the field, and has

huge prospects for further growth. But the right policies and rigorous sustainability regulations will be essential to meet its full potential."

The focus on bioenergy is part of the IEA's analysis of "blind spots" of the energy system – issues that are critical to the evolution of the energy sector but receive less attention than they deserve – such as the impact of air conditioners on electricity demand, or the growing impact of petrochemicals on global oil demand. Assuming strong sustainability measures are in force, the report identifies additional untapped potential for bioenergy to "green" and diversify energy usage in the industry and transport sectors.

According to the IEA, the use of renewables continues to increase most rapidly in the electricity sector, and will account for almost a third of total world electricity generation in 2023. Because of weaker policy support and additional barriers to deployment, use

of renewables expands far more slowly in the transport and heat sectors.

China leads global growth in renewable energy as a result of policies to decarbonise all sectors and reduce harmful local air pollution, and becomes the largest consumer of renewable energy, surpassing the European Union by 2023. Of the world's largest energy consumers, Brazil has the highest share of renewables by far – almost 45 per cent of total final energy consumption in 2023, driven by significant contribution of bioenergy and hydropower.

Meanwhile, solar PV dominates renewable electricity capacity expansion. Renewable capacity additions of 178 GW in 2017 broke another record, accounting for more than two-thirds of global net electricity capacity growth for the first time. Solar PV capacity is forecast to expand by almost 600 GW – more than all other renewable power technologies

combined, reaching 1 TW by the end of the forecast period.

Wind remains the second largest contributor to renewable capacity growth, while hydropower remains the largest renewable electricity source by 2023. Similar to last year's forecast, wind capacity is expected to expand by 60 per cent.

Despite the rapid expansion however, Paolo Frankl, Head of the IEA's Renewable Energy Division said renewables penetration must accelerate in all sectors to meet long-term sustainability goals.

According to the IEA's 2017 Sustainable Development Scenario (SDS), which is in line with Paris climate goals, the organisation says that if progress continues at the forecast pace, the share of renewables in final energy consumption would be around 18 per cent by 2040. This is significantly lower than the SDS target of 28 per cent.



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Australia's Environment Minister Melissa Price believes the IPCC report exaggerates the threat posed by fossil fuel.

"Coal forms a very important part of the Australian energy mix and we make no apology for the fact that our focus at the moment is on getting electricity prices down," Price said. "Every year, there is new technology with respect to coal and what its contribution is to emissions. So, you know, to say that it has got to be phased out by 2050 is drawing a very long bow."

Australia's government welcomed the report but stood by coal fired power generation and defended the nation's record in meeting its international emissions reduction targets. "If we take coal out of our energy system, the lights will go out on the east coast of Australia – it's as simple as that," Treasurer Josh Frydenberg said.

The report also calls for annual investments of around \$2.4 trillion in the global energy system between 2016 and 2035. Proponents of carbon-free energy are hoping this will boost their sectors.

Responding to the report, Agneta Rising, Director General, World Nuclear Association, said: "The IPCC report makes clear the potential benefits of limiting climate change to 1.5°C, the urgency for action to achieve this and the necessity of nuclear energy as an important part of an effective global response."

She noted that nuclear generation increases, on average by around 2.5 times by 2050 in the 89 mitigation



**Birol says CO<sub>2</sub> emissions likely to keep growing in 2018**

scenarios considered by the IPCC.

The report comes at a time when global emissions, which had been flat in 2015 and 2016, have started to rise again.

Fatih Birol, Executive Director of the International Energy Agency, told the *Financial Times* that global carbon dioxide emissions were likely to keep growing in 2018, because of increasing consumption of coal, oil and natural gas.

"This will bring us further away from our climate goals," he said. "The growth in renewable energy seems to be not enough to reduce the trends."

The risk for failing to respond to climate change and making the needed transition to low-carbon energy also puts many industries at risk. In late September Moody's published a global heat map dissecting the environmental exposure of a wide range of industry sectors.

The study found that eleven industries with \$2.2 trillion in rated debt have elevated credit exposure to environmental risks. The two sectors facing the most immediate risk are unregulated utilities and power companies, and coal mining and coal terminals, accounting for a collective \$517 billion of rated debt.

Unregulated utilities and power companies, meanwhile, are directly exposed to policy pressure to cut emissions, which continues to disrupt business models and pressure margins in mature economies.

# 'Age of renewables' could be as soon as 2035

The convergence of renewables and electric vehicles could see the switch from the age of oil and gas to the 'age of renewables' arrive sooner than we think. **Junior Isles**

The sustainability tipping point – when the world shifts from the age of oil and gas to the age of renewables – is less than 18 years away, according to a new report from Wood Mackenzie.

The report notes the emergence of two drivers underpinning the pace of the global energy transition – renewables and the use of electric-based technologies in transportation – and says that by 2035, the convergence of the two will usher in 'the age of renewables'.

According to Wood Mackenzie's research, close to 20 per cent of global power needs will be met by solar or wind by 2035, displacing the equivalent of roughly 100 billion cubic feet

per day of gas demand. Similarly, upwards of 20 per cent of all miles travelled globally by cars, trucks, buses and bikes will use electric motors rather than gasoline or diesel. By 2040, oil demand displaced from electric vehicles (EVs) doubles to almost 6 million barrels per day.

"After 2035, we see adoption rates for renewable generation and electrified transport increasing rapidly, becoming the default choice across many energy systems around the world. So much so that we believe half of all new power plants constructed globally will be either solar or wind, or a hybrid combination with storage.

"On top of this, half of all additional miles travelled by road will use an electric vehicle. The convergence of other technologies embedded within grid-edge applications – autonomous and shared driving, for instance – facilitate this rapid uptick," said the company.

The report titled 'Thinking global energy transitions: The what, if, how and when' notes, however, that there are still obstacles to overcome. Battery prices may not come down as fast as hoped, slowing the adoption of EVs. Consumer acceptance of EVs and the development of charging infrastructure are also factors to watch.

The battery sector received a boost

at the end of September, with the news that the World Bank will invest \$1 billion into battery storage for developing countries. In addition to lending \$1 billion, the bank said it will draw in a further \$4 billion from public and private sector investors.

The goal of the Accelerating Battery Storage for Development programme is to finance 17.5 GWh of battery storage by 2025.

As of 2017, there were almost 400 GWh of battery capacity fitted into electric vehicles worldwide but only 11 GWh for stationary power uses. Of that, only about 4 GWh were installed in developing countries, with more than half in the developed world.

## GE moves to reverse flagging fortunes

General Electric is hoping that the appointment of Larry Culp will accelerate the turnaround in the company's flagging power division.

Following the news that its power business would take a \$23 billion hit, at the start of October it abruptly announced that Larry Culp would take over as CEO from John Flannery.

The news came as a surprise to the market and makes Flannery's time at the helm the shortest in the company's 126-year history. Since Flannery's appointment just over a year ago, GE has seen its share price fall by more than 50 per cent. GE Power was reporting declining profits while Jeff Immelt led the group in 2017, and has slipped further since then.

The conglomerate's worst problems

have been in the power division, largely due to difficulties in the large gas turbine market. Flannery warned in May that he expected the market for new gas turbines to be very challenging until 2020, but did not detail how the company would address the issue.

A problem with its latest HA technology gas turbine at a plant in Texas, USA, has not helped. The blade problem, reported in September, with the new machine is expected to affect other HA units elsewhere. News of the blade issue prompted a 10 per cent drop in share price.

GE's power division continues to be a drag on earnings. Profits at GE Power plunged during the second quarter as orders for gas turbines tumbled.

In early October the Boston-based

conglomerate said it expects to miss previous guidance for free cash flow and earnings per share for 2018 due to weaker performance in the power business. It also expects to take a \$23 billion charge related to that unit.

The company delayed the release of its third quarter earnings to October 30th, as *TEI Times* went to press. Culp is likely to say he will stick with the plan but will be expected to move with greater urgency in fixing the power business.

With the support of the board, in June Flannery launched a plan to turn GE into essentially a two-sector company, operating in aviation and the power industry. The healthcare division is to be spun off, and the controlling 62.5 per cent stake in Baker Hughes, the

oilfield services group, is to be sold.

In line with the restructuring plan, at the start of October, GE concluded the purchase of Alstom's stakes in three joint ventures focused on renewables, grid and nuclear power for €2.594 billion (\$2.99 billion) in cash.

The two companies formed the three joint ventures in 2015, when Alstom sold its power and grid businesses to GE. The plan was for one of the jointly-owned companies to be focused on offshore wind and hydropower.

The company received a significant boost in October with the award of a \$700 million contract to supply four turbine islands for the planned El Daba nuclear plant project through AAEM, its joint venture with Russia's Atomenergomash.

## Germany grapples with coal phase-out

Germany's newly established coal phase-out commission is set to provide a final report to the German government in December 2018 that includes a date for the exit of coal power generation in the market.

Although environmentalists hope the report will call for a rapid phase-out, it is likely to prove more difficult than many expect.

London, UK-based BMI Research said in a recent statement: "The potential phase-out of coal fired power generation in Germany will prove highly contentious, and register limited progress over the next decade, given its importance to energy security amid the impending nuclear phase-out."

It also noted that the socio-political

importance of coal to Germany's western region, coupled with the fact that retail electricity prices in the market are currently the highest in Europe, will also make an aggressive coal phase-out "politically and economically challenging".

"We maintain that coal will make up 31 per cent of total German power generation in 2027, a reduction from the 37 per cent we forecast for 2018. This highlights our cautious view on the government's ability to deliver on phase-out rhetoric in the near-term," it said.

In early October more than 50 000 people from across Europe gathered at the site of the controversial Hambach forest to show their opposition to coal and support for climate action

in Germany.

Campaigners had already scored one victory in the fight to protect Hambach forest, which has become the symbolic climate battleground for the fight against coal in Germany. Earlier a court ruled to stop the planned felling of trees by energy giant RWE to make way for the expansion of a giant open-pit lignite mine.

The protest comes as a government-appointed Coal Commission is considering a future for Germany's coal regions, how the country can meet its climate targets and when coal should be phased out.

Some, however, warn of the dangers of phasing out coal too quickly. Georg Kippels, a German lawmaker, who is a member of Chancellor Angela

Merkel's Christian Democrats and represents the area just west of Cologne, said: "If the government doesn't show it can carefully balance climate protection with affordable and secure power, it's going to be a big challenge keeping voters on board."

He added: "We need lignite. As long as we're years away from a clean-power economy, it's hard to see how we can do without it – not without causing unrest."

RWE said that winding down lignite too quickly could lead to acute electricity shortages.

London-based, Asia-focused bank Standard Chartered PLC has said it will no longer be providing financing for new coal fired power plants in any location worldwide.



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# US plans offshore wind boost

■ BOEM moves forward on development zones ■ Ørsted buys Deepwater Wind

Siân Crampsie

The US offshore wind energy pipeline looks set to grow after the country's Bureau of Ocean Energy Management (BOEM) issued three notices relating to capacity development on the east and west coasts.

BOEM announced in October that it will hold an auction for a development area of around 158 000 hectares off the coast of Massachusetts in mid-December, 2018. In addition, it plans to issue a Call for Information and Nominations for commercial wind energy leases in California, and is also moving forward with plans for the development of the 90 MW South Fork wind

farm off the coast of Rhode Island.

According to US Secretary of the Interior Ryan Zinke, the area to be auctioned in December could accommodate around 4.1 GW if fully developed. A total of 19 companies have qualified to take part in the process.

In California, the Call for Information and Nominations will identify companies interested in commercial wind energy leases in California. The call concerns three areas off the central and northern part of the state, including 85 whole Outer Continental Shelf blocks and 573 partial blocks. Together, they comprise some 2779 km<sup>2</sup>, and the process could result in the development of the first offshore

wind farm off the west coast.

BOEM said last month that it will issue a Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Construction and Operations Plan (COP) for the 90 MW South Fork wind project. If the plan is cleared, the developer, Deepwater Wind, will be able to erect up to 15 turbines and connect them to a grid in East Hampton, New York. A 20-year pay-for-performance power purchase agreement (PPA) for this particular project was approved by the Board of Trustees of the Long Island Power Authority (LIPA) in January 2017.

"I'm very bullish on offshore wind, and harnessing this renewable

resource is a big part of the Trump Administration's 'made in America' energy strategy," Zinke stated.

The offshore wind energy industry currently has a development pipeline of around 25.46 GW. There is just one operating offshore wind farm in the USA—the 30 MW Block Island project off Rhode Island.

Last month, European renewable energy developer Ørsted said it would buy Deepwater Wind for \$510 million as part of its strategy to expand in the USA.

Deepwater Wind has a development portfolio with a capacity of around 3.3 GW, while Ørsted's US portfolio stands at 5.5 GW.

"With this transaction we're creating the number one offshore wind platform in North America," Ørsted's offshore wind chief Martin Neubert said in a statement.

Ørsted also recently acquired US onshore wind developer Lincoln Clean Energy in order to boost its presence in the US renewable energy market.

In September, Iberdrola announced plans to expand its renewable capacity in the USA by about 50 per cent over four years. The company expects to spend about \$15 billion in the USA on its transmission and distribution system and increase its renewable generation to around 10 000 MW by the end of 2022.

## Petrobras examines offshore wind opportunities



Oil firm Petrobras is looking at opportunities for exploiting Brazil's offshore wind farm capacity after signing a deal with Norwegian energy company Equinor.

The two companies have signed a Memorandum of Understanding to evaluate a joint business development in offshore wind. They said they will work together for the next three years, but have not disclosed specific development or investment plans.

The announcement comes after Petrobras released plans for Brazil's first offshore wind project, a pilot plant offshore from Rio Grande do Norte state that should begin operations in 2022 and produce about 6 to 10 MW.

Nelson Silva, director of Strategy, Organization and Management System of Petrobras, said that Brazil has "huge" wind energy potential and that Equinor was a suitable partner because of its experience in the offshore wind sector.

Equinor operates three wind farms along the coast of the United Kingdom and is involved in the development of other offshore wind projects in the

United Kingdom, Germany and the USA.

Offshore wind capacity development would mark a new phase in Brazil's rapidly-growing renewable energy sector, which is largely focused on onshore wind and solar energy development. The Brazilian government estimates that installed wind energy capacity in Brazil will reach 28.5 GW by 2026.

In 2017, Brazil's wind generation record was broken with 10 and 11 per cent of national electricity demand met by wind power in August and September, respectively. Overall, wind accounts for around seven per cent of electricity consumption.

■ Brazil's Ceara state government has launched a competitive process for selecting a contractor for 45 MWp of solar distributed generation projects. The projects will have a maximum capacity of 5 MWp each. Of the overall combined capacity, 25 MWp will be deployed to supply Ceara's Water Resources Management Company (Cogerh), while the remaining 20 MWp will be used by the state's Water and Sewage Company (Cagece).

## Nuclear industry praises Vogtle vote

Development of the Vogtle nuclear power plant in the USA is set to continue after all four of the project's owners voted to continue construction.

Georgia Power, Oglethorpe Power, MEAG Power and Dalton Utilities made the "unanimous" decision to move forward with the only nuclear power plant construction project in the USA, whose future was called into question in the wake of financial problems at Westinghouse.

"We are all pleased to have reached an agreement and to move forward with the construction of Vogtle Units 3 & 4 which is critical to Georgia's energy future," said the co-owners. "While there have been and will be challenges throughout this process, we remain committed to a constructive relationship with each other and are focused on reducing project risk and fulfilling our commitment to our

member-consumers."

The AP1000 units at Vogtle 3 & 4 are expected to start operating in November 2021 and November 2022, respectively.

The Nuclear Energy Institute (NEI) said that continuing the Vogtle project would keep "the United States on a path to stay competitive in the global nuclear technology market" and applauded the decision as a "forward-looking affirmation of the need for reliable and clean new electricity generation".

The Vogtle 3 & 4 project is about two-thirds complete. NEI added in a statement that successful completion of the project would bolster the USA's nuclear energy sector "and help confront the clear strategic challenge to the United States as nations around the world leverage their commercial nuclear programmes as tools of geopolitical influence".

Maria Korsnick, NEI President and Chief Executive Officer of NEI, said: "The risks to US national security and its global interests are serious if Russia and China remain unchallenged in their efforts to dominate global civil nuclear energy markets."

The US Department of Energy has so far issued \$5.6 billion of \$8.3 billion in loan guarantees for the Vogtle project, and also commended the decision to continue construction. In a statement, it said: "This historic project will be the first large-scale nuclear utility project completed in the United States in over 30 years and will reaffirm America's international leadership in nuclear technology and provide a reliable, clean power source for decades to come. DOE hopes the successful completion of this project will mark the beginning of a nuclear renaissance in America."

## Enel sells Mexico portfolio

Enel has sold its majority stake in a portfolio of Mexican renewable energy project as part of wider plans to reduce debt.

The Italian energy firm's renewable energy subsidiary, Enel Green Power (EGP) has sold 80 per cent of the 1.8 GW portfolio to Caisse de depot et placement du Quebec (CDPQ) and an investment vehicle of CKD Infraestructura Mexico (CKD IM) for \$2.6 billion.

The assets are owned by eight special purpose vehicles (SPVs) and include

three operable plants with a capacity of 429 MW, three recently-connected plants with a capacity of 1.089 GW and two projects under construction with a capacity of 300 MW.

EGP will continue to operate the plants and will complete those that are still under construction through two newly-formed subsidiaries. EGP added that it may contribute or transfer additional projects from 2020, increasing its indirect stake in the SPVs.

Enel said that the sale would reduce

its net debt by \$2.4 billion and is part of the company's strategic plan. It was conducted under a 'build-sell-operate' model used by Enel to monetise its pipeline of renewable energy projects more quickly.

■ A recent study by Mexico's Business Coordinating Council (CCE) indicates that investment in renewable energy in the country will contribute \$29 billion to GDP by 2032. The study says that Mexico will add 32 GW of renewable energy capacity to the grid between 2018 and 2032.



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# China leads the charge in e-mobility and battery storage

■ Lithium Werks to open 8 GWh factory ■ EV sales to hit nearly 11 million by 2027

Syed Ali

China is demonstrating its determination to lead the race to transform to a low carbon economy. In a significant move to shift away from the use of fossil fuels in both power generation and transport, the country announced that it is to open its domestic battery market to foreign investment.

At the start of October, Lithium Werks, a Dutch battery company, said it will invest €1.6 billion to build a factory in the Yangtze River delta. The 60 ha (600 000m<sup>2</sup>) factory, which will be built with local state-owned company Zhejiang Jiashan Economic and Technological Development Zone Industry

Corp, will produce 8 GWh of batteries a year – enough to power hundreds of thousands of vehicles.

Foreign battery makers have struggled to expand in China over the past few years due to rules that encouraged local car companies to use Chinese-manufactured batteries.

The news comes as recent findings from BMI Research show that China will emerge as the fastest expanding EV market globally by some margin over the next decade.

“Given the country’s wind and solar power integration issues, coupled with vast grid investments, we expect the market to aim to leverage vehicle-to-grid (V2G) technology over the

coming decade,” said the London-based research firm.

V2G entails a two-way flow of electricity between electric vehicles and the grid, with EVs helping to balance power supply and demand by charging during peak supply, and selling power back to the grid during peak demand.

According to the group, coal generation overcapacity will mean that V2G deployment will be of less acute importance to energy security in China than for example in Western Europe, where baseload capacity is going offline at a rapid pace.

The upside risk to this scenario, it says, is that air pollution reduction efforts will ramp up more than expected,

with EV storage playing an active role in integrating intermittent wind and solar power supplies.

“According to our Autos Team, China will be by far the fastest expanding EV market over the coming decade,” it stated. “In fact, we expect China to have a Battery Electric Vehicle (BEV) fleet of almost 11 million vehicles by 2027, compared to 3.4 million vehicles in Europe and 1.4 million vehicles in the United States. This will in turn mean that China will be able to harness its substantial EV fleet to support the integration of increasing volumes of intermittent wind and solar power.”

BMI Research says that China’s surging EV segment will mean that the

country will be able to scale up V2G solutions before any other market, and at a scale unrivalled over the coming decade. With BEV and plug-in-electric vehicles (PHEV) totalling 13.4 million vehicles – China will in theory have access to 1138 GWh by 2027. This is compared to 295 GWh in the United States, and 459 GWh in Europe.

■ Westinghouse Electric Company and its customers, China State Nuclear Power Technology Corporation (SNPTC) and CNNC Sanmen Nuclear Power Company Limited (SMNPC) have announced that the world’s first AP1000 plant located in Sanmen, Zhejiang Province, China, is fully operational.

## India will fall short of renewables target

India is likely to meet three quarters of its target to install 175 GW of renewable capacity by 2022, according to a report by Wood Mackenzie.

According to the company, the country faces a myriad of challenges in the renewables industry. Wood Mackenzie’s solar analyst Rishab Shrestha said: “The recent cancellation of auctions risks jeopardising investor confidence. Various duties on equipment and the associated uncertainty have led to a short-term uptick in solar prices. This leads to a knock-on effect on already cash-strapped state distribution

companies who are showing an unwillingness to greenlight high priced solar projects.”

He noted, however, that the government’s commitment and support towards renewables remain strong, stressing that it has been “swift and adaptable” at responding to various industry hurdles and helping reduce project risks. “As a result, renewable prices continue to remain competitive,” he said.

“Combined wind and solar capacity have almost doubled from 2014 levels to 61 GW this year. Driving this

growth is the significant cost decline that auctions continue to deliver. In the next five years, capital costs are expected to decline by 23 per cent for wind and 31 per cent for solar. This trend will only continue as new generation technologies replace old ones. We expect non-hydro renewables to make up 13 per cent of the power generation mix by 2023.”

Even with significant cost declines, Wood Mackenzie expects about 76 per cent of the target to be met by 2022 and says this would “still be a noteworthy achievement”.

Over the longer-term horizon of 2040, India is forecasted to increase its non-hydro renewable capacity by around seven times to 384 GW. This share will be driven by diverse sub-segments, which include offshore wind, hybrid projects, floating solar and distributed solar.

In the meantime, calls for more solar capacity continue apace. In mid-October Rewa Ultra Mega Solar Ltd, the developer of the 750 MW Rewa solar park in Madhya Pradesh, launched three tenders for a total of 1500 MW of solar PV capacity. The deadline for

submitting proposals is December 10, 2018.

Also in October, Indian utility Gujarat Urja Vikas Nigam Ltd (GUVNL) announced that it is seeking proposals for 700 MW of grid-connected solar PV capacity within the Raghnesda solar complex.

■ Two of India’s coal giants will develop 3 GW of solar capacity in the country through a new joint venture company. NLC India and Coal India will invest around \$1.6 billion to install the new capacity within the next 15 months.

## Vietnam ready for market competition

Vietnam’s Competitive electricity generation market programme will be fully operational from January 1, 2019, following a successful year-long pilot period.

The development of a competitive electricity market is a long-term plan for Vietnam’s electricity sector as mandated in the 2004 Electricity Law. The details of the plan were specified in the Prime Minister’s Decision 63/QD-TTg in 2013, which laid out the conditions and structure of the new market.

The marketplace was to be developed in three distinct parts: the electricity generation market, the wholesale market and the retail market. The generation market started in 2012, and the wholesale market is expected to open next year. The final stage will be the development of the retail market.

The Electricity Regulatory Author-

ity of Vietnam (ERAV), under the Ministry of Industry and Trade, reported that 87 power plants have entered the electricity generation market over the past five years, with a total capacity of nearly 23 000 MW.

ERAV representative Le Hong Hai said the market has already increased its transparency and helped create a system that investors can trust to integrate their new power plants into the national electric grid.

Vietnam is slowly transforming its electricity sector from a system based on state-owned, large centralised fossil fuel generation to a more competitive set-up that includes an increasing amount of clean renewables.

In early October, Electricity of Vietnam (EVN) said it has to-date signed 35 power purchase agreements (PPAs) with private solar power firms

that have a combined generating capacity of 2271 MW.

Most notable is the agreement inked with the 35 MW Phong Dien solar power plant in Phong Dien district, in the central province of Thua-Thien Hue, which was the first solar project with access to the national grid.

The southern province of Tay Ninh attracted nearly VND20 trillion (\$858 million) from eight investors to implement 10 solar power projects with a combined capacity of 808 MW by the end of September. Nine of them are under construction and expected to begin generating electricity before June 2019.

■ B Grimm Power (BGRIM) has clinched an agreement to supply electricity from its 257 MW solar photovoltaic (PV) farm in Phu Yen Province, Vietnam, to EVN.



## Philippines moves on biomass

Diversified San Miguel Corp. (SMC) is converting all of its coal fired facilities into biomass power plants, as part of its bold move to transition to renewable and sustainable energy generation.

SMC’s energy unit is planning to replace coal with rice husks to help boost farmers’ income while pursuing plans to use cleaner technology and reduce emissions.

Power subsidiary SMC Global Power Holdings Inc. operates two new coal fired facilities in Limay, Bataan

and in Malita, Davao, with capacities of 600 MW and 300 MW, respectively. These facilities utilise CFB combustion technology, which has the ability to burn a variety of fuels, including coal, biomass and waste, while minimising emissions.

“Instead of burning or dumping rice husks, we want to fully utilise this agricultural waste product both as an energy source for our power plants and income source for our rice farmers,” SMC President and COO Ramon Ang said.



# Permit problems hold back onshore wind in Germany

Permitting issues in Germany's wind sector have skewed the results of the country's latest renewable energy auctions in favour of solar.

The German Federal Network Agency, BNetzA, said last month that 363 MW of onshore wind capacity won contracts in the latest auction, while a separate tender for solar capacity awarded 192 MW.

In the wind auction, 670 MW of capacity was on offer, but only 400 MW of bids were received. The solar tender was three times oversubscribed, however, with 551 MW of bids received for the 182 MW on offer.

According to WindEurope, over 900 MW of wind energy projects were pre-approved for the auction and had a

permit. Only one-third of these projects actually bid, however, because many of them face legal challenges to their permits and wanted to avoid being exposed to penalties due to non-delivery.

The German government changed the design of its onshore wind auctions this year, so that projects now need a permit in order to bid. However, it now takes more than twice as long to obtain a permit compared to two years ago – around 700 days, according to WindEurope. In addition, projects are exposed to legal challenges.

WindEurope CEO Giles Dickson said: "The German government were right to change their auction rules so that wind farms now need a permit

before they can bid. But it's got harder to get a permit. And even when you get one, you're exposed to legal challenge because the regional siting plans are not robust enough. Germany needs to address this. Otherwise the auctions will continue to be under-subscribed like this last one. And the prices will be higher than they should be.

"This adds to the uncertainty already facing wind in Germany, with the coalition failing still to define the auction volumes for the coming years. The wind industry is already laying people off in Germany. The government have got to sort things out fast."

In the last German auction, the average bid for onshore wind energy projects was €62.6/MWh – higher than the

€57/MWh achieved in the last auction in May. The top three regions for wind capacity secured in this tender were Bavaria with 69 MW, Brandenburg with 63 MW and Lower Saxony with 42 MW. The list of successful bidders included Juwi, Enercon and Abo Wind, among others. Of the 57 awards, nine were for community wind projects.

Solar projects achieved an average price of €46.9/MWh, slightly higher than the average bid price of €49.6/MWh achieved in the previous auction. Bavaria and Brandenburg were the most popular regions for solar power projects with a total of 21 successful bids, out of the 37 awarded in the tender.

The BNetzA has launched another tender for November 2018 in which onshore wind and solar will compete against each other for some 200 MW of capacity.

In Germany's last mixed tender, held in April 2018, solar projects won all of the capacity.

■ Holland is to launch a tender for 700 MW of offshore wind energy capacity for sites III and IV of the Hollandse Kust Zuid zone by the end of 2018, the government has announced. As with the tender for sites I and II of the Hollandse Kust Zuid zone, the government will accept bids without subsidies. If there are no acceptable bids, a tender including subsidies will be initiated.

## UK boosts storage capacity

Enel has commissioned its first stand-alone battery energy storage facility in the UK, adding to the UK's growing battery storage capacity. The company says it has invested €20 million in the 25 MW/12.5 MWh Tynemouth plant, which uses lithium-ion batteries.

"The commissioning of Tynemouth is an important milestone for Enel since it is the group's first utility-scale, stand-alone battery energy storage system,

showing the potential of this promising solution in addressing the challenges of the energy transition," Enrico Viale, Enel's global thermal generation's head said.

"Battery energy storage systems provide a solution for flexible and fast services to ensure the stability of electricity power systems, while, when coupled to existing power plants, allow for optimisation of performance and

an increase in plant flexibility. The utility-scale BESS market shows great potential for growth, which is why Enel is developing a portfolio of such projects in some of the sector's most promising countries worldwide."

Earlier in June, Highview Power officially launched operations at a 5 MW/15 MWh liquid air energy storage (LAES) plant in the UK. It is the first grid-scale facility of its kind in the

world and will demonstrate the ability of the technology to provide a number of reserve, grid balancing and regulation services. Demand aggregator KiWi Power will draw energy from the LAES plant to fulfil its demand response obligations.

KiWi Power recently announced the completion of a 2 MW, behind-the-meter (BTM) battery storage solution in southwest England. This project is

part of an extensive roll-out of BTM projects at large energy use sites in the UK by KiWi.

Elsewhere in the UK, UK Power Networks has created London's first virtual power plant, consisting of solar panels and batteries at domestic residences. Thrive Renewables and Aura Power have also announced a joint venture to install and operate batteries for medium and large energy users.

## UK energy companies face technology disruption

- Investment in new technologies creates challenges
- No deal Brexit creating risk

Siân Crampsie

The surge in investment in renewable energy, coupled with the growth in other disruptive technologies and increased customer engagement are changing the face of the energy sector in the UK, according to a new report.

Recent analysis from global law firm Addleshaw Goddard shows that between 2013 and 2017 nearly £82 billion was invested in renewable generation assets in the UK. This trend, coupled with growth in technologies such as electric vehicles (EVs) and energy storage devices, poses challenges as well as opportunities.

The decentralised nature of renewable generators is indicative of a growing trend within the energy market, which puts pressure on a system originally designed around the concept of centralised energy generation, notes Addleshaw Goddard in its report, entitled 'Disruption in Great Britain's Energy Market'.

However, the report suggests a move towards a less centralised system – precipitated by the growth of renewables, electric vehicle infrastructure, remote energy storage, demand driven smart metres and blockchain – poses an opportunity for disruptors to address the energy trilemma – the balance between affordable, secure

and sustainable energy generation.

"The government faces a significant challenge in creating a dynamic energy market that can successfully move the country away from a top-down centralised system and fully accommodate the spectrum of green and disruptive technologies into the energy generation mix," said Paul Dight, energy partner at Addleshaw Goddard.

"If this is going to be achieved, innovative disruptors in the market have a key role to play. In much the same way technology and innovation has had a transformative effect on sectors such as retail, so it can have a similar effect in the energy sector. Indeed, it must do if we are to tackle the trilemma of providing the affordable, secure and sustainable energy generation the country needs."

The report indicates that reform of the government's 20-year old energy regulation would help to achieve a more flexible energy market conducive to disruptive businesses. Such businesses include those specialising in energy storage, which could hold excess renewable energy generated to then release at peak times, and EV charging technologies.

The UK government's Road to Zero strategy, which aims to ban the sale of petrol and diesel cars by 2040, is also expected to drive significant growth in

the electric vehicle market – with major players set to enter the market for electric vehicle infrastructure. It has already spurred large energy companies such as SSE and BP, to invest in vehicle to grid (V2G) and EV technologies.

Big data and the growing use of smart meters across Britain is outlined in the report as a significant development in the sector – and the use of decentralised ledger technology such as blockchain is mooted as the next step for the sector, bringing with it the ability to create the coordinated trading marketplace required by decentralised energy generation assets.

Other challenges faced by energy suppliers in the UK include Brexit and the threat of a 'no deal exit' from the EU.

In the latest batch of technical notices issued to prepare UK businesses for no deal, the government warned that an arrangement might not be reached to maintain the Single Electricity Market. It also says that there may be barriers to electricity trading, as well as uncertainties for the energy supply chain.

In the event of a no deal, electricity supplies in Northern Ireland could be affected, forcing the government to introduce sweeping legal measures to curb electricity demand and boost supply to ensure "adequate generation capacity is in place".

## Acciona turns to blockchain to certify RO

Acciona Energia has become the first company to apply blockchain technology to certify the 100 per cent renewable origin of energy being fed into the grid.

The Spanish energy firm says that blockchain technology was successfully integrated into its solar plant in Tudela and its wind power plant in Barsoain, both located in Navarre, Spain.

Use of the blockchain technology means Acciona's clients and other

stakeholders are guaranteed that the energy supplied from battery storage facilities comes exclusively from renewable sources that are free of greenhouse gas emissions.

Certifying the renewable origin of energy is increasingly widespread, associated with the growth of the corporate procurement of green energy, and blockchain technology can therefore play an important role for energy companies operating renewable energy facilities.

## Kriegers Flak CGS delayed

The commissioning of the 400 MW Kriegers Flak Combined Grid Solution (CGS) between Germany and Denmark has been delayed for a second time.

According to Danish grid operator Energinet, the construction work at the conversion station has been delayed primarily due to a heated German labour market, which brought a postponement in the completion of the onshore converter station near Rostock.

The commissioning of the offshore grid link was initially planned for the end of 2018 and was already delayed once to the first quarter of 2019.

It has now been delayed until May 2019.

In July, two offshore cables of the CGS were installed, connecting the platform of the Danish 605 MW Kriegers Flak project with the platform at the German 288 MW Baltic 2 offshore wind farm.

The CGS is the world's first offshore transmission grid interconnector. It connects the electricity networks of Denmark and Germany via two offshore wind farms in the Baltic Sea. The interconnector will allow electricity to be traded in both directions – from Denmark to Germany and from Germany to Denmark.



# Iraq prepares to develop power infrastructure

Iraq is laying the ground for further development of its electricity sector infrastructure with preliminary agreements with GE and Siemens that could lead to major equipment and services contracts worth billions.

**Sian Crampsie and Junior Isles**

Iraq's electricity ministry confirmed last month that the country's incoming government has signed Memoranda of Understanding (MOUs) with both GE and Siemens covering work to repair, rebuild and expand the country's electricity generation and transmission networks.

The agreements follow separate efforts by the rival OEMs to identify urgent and long-term investment needs in Iraq's electricity sector. Media outlets have reported that Siemens was set to

win the majority of the contracts until the Iraqi government came under pressure from US President Donald Trump.

Siemens presented a reconstruction plan for Iraq in September 2017, proposing a series of short, medium and long-term plans to meet reconstruction goals and support economic development. Its plan would add 11 GW to Iraq's generating capacity.

Speaking on the sidelines of a press visit to the Beni Suef power plant in Egypt just after the announcement,

Karim Amin, Head of Global Power and Gas Sales at Siemens told journalists: "We have a comprehensive MoU, part of which covers new installations, and part that is related to our own fleet. The country needs a lot of rehabilitation, as a lot of facilities were destroyed during the war. They have lost 50 per cent of their capacity. There is also a lot of work to be done on transmission and distribution.

"Every company is looking at its plan [to address the situation]; the

Iraqi government needs to see which way to go, how fast and how much it can afford because at the end of the day, there is a budget."

GE has proposed a 14 GW power capacity plan, including the addition of 1.5 GW by 2019 by upgrading existing plant sites.

Securing major contracts in Iraq would be a major boost for both OEMs' businesses, which have struggled amid a declining market for gas and steam turbines.

Siemens CEO Joe Kaeser wrote on Twitter that the Iraqi MoU represents a "landmark" agreement for the company, which undertook a 12-month study to gauge a viable redevelopment plan that highlighted the provinces most in need of rehabilitation.

The World Bank says that rebuilding Iraq's infrastructure will require \$150 billion. The government has prioritised the utility sector because it believes that poor power supplies played a key role in civil unrest over the summer.

## Ukraine boosts renewables

- GE, Trina supply new renewables projects
- 3 GW of renewables on-line by 2019

Sian Crampsie

Energy firm DTEK is ramping up development of renewable energy capacity in Ukraine.

The company has signed deals with major international suppliers in pursuit of the development of wind energy and solar photovoltaic (PV) capacity.

Last month Trina Solar announced that it had delivered 123 MW of PV modules to DTEK for installation at Ukraine's largest solar power plant. Located near Nikopol, Dnepropetrovsk Oblast in central Ukraine, the project has a planned capacity of 246 MW.

In addition, DTEK has signed a deal with GE Renewable Energy for the procurement, installation and maintenance of 26 wind turbines for stage 1 of the 200 MW Primorskaya wind power plant in the Zaporizhia Region

of Ukraine.

GE will provide its 3 MW hardware for the Primorskaya wind farm, construction of which is scheduled to be completed at the end of 2018. The Primorskaya wind farm will be developed in two phases, with a second 100 MW phase due to be operating by 2020.

DTEK has a 1 GW renewable energy project portfolio and said in a statement that it was engaging foreign investors and equipment manufacturers capable of bringing the most innovative and advanced technologies to Ukraine. "The new wind park will strengthen Ukraine's position on its way towards modernisation of its energy sector, energy independence, and diversification of energy sources," said DTEK CEO Maksym Timchenko.

China Machinery Engineering Corporation (CMEC) is the main con-

tractor at the Nikopol solar energy plant, which is expected to be completed in early 2019 and connected to the grid in March.

Last year Ukraine approved a national emissions reduction plan, and also set a target of increasing the share of renewable energy generation in the generating mix to 11 per cent by 2020. Currently the country's energy supplies are heavily reliant on fossil fuels and nuclear energy.

The number of licenses for producing renewable energy delivered in Ukraine grew from 131 in 2015 to 163 and 230 in the following years, according to the Ukrainian Association of Renewable Energy (UARE). State-run power company Ukrenergo expects the country's renewable energy capacity to go from the current 1.5 GW to 3 GW in 2019.

## Eskom ahead of schedule with Medupi

South African utility Eskom says that its Medupi coal fired power plant is coming closer to full commercial operation following the grid synchronisation of its fifth unit.

Eskom and its partner, GE, said that Medupi Unit 2 was synchronised to the grid in early October, eight months ahead of schedule. With five of the plant's six units now synchronised, the plant's capacity has reached 4000 MW.

Abram Masango, Eskom's Group Executive for Group Capital, said: "The achievement of Unit 2 first synchronisation, eight months ahead of the June 2019 schedule, marks a key milestone towards full commercial operation of the unit. Lessons learnt on previous units were implemented on Unit 2, leading to the swiftness in delivering first power. This is an amazing achievement, taking us closer to completing the entire Medupi project, as we will be left with one unit."

Eskom said that Unit 2 would be delivering power to the grid intermittently over the next few weeks during

a testing and optimisation phase.

Once completed, Medupi will be the fourth largest coal fired power plant and the largest dry-cooled power station in the world.

It will consist of six units with an installed capacity of 4764 MW, adding significantly to Eskom's generating capacity.

Eskom, however, is currently attempting to negotiate a raft of new coal supply contracts following financial difficulties at a major supplier.

The company announced in September that coal supplies at ten of its power plants were running low and that it was attempting to secure new contracts with other companies as well as move coal stocks around to ensure that power plants could be kept on-line.

Eskom is required to keep at least 20 days' worth of coal supplies in stock. The situation has once again put its generating system under pressure as the utility approaches peak summer demand season.

## Oman launches privatisation drive

Oman has launched its electricity sector privatisation plan as part of a wider drive to attract investment and boost its economy.

The Gulf state is looking to sell off strategic stakes in five electricity transmission and distribution companies.

The process will start with the sale of up to 49 per cent of shares in Oman Electricity Transmission Company, which has assets of \$2.2 billion, and up to 70 per cent of shares in Muscat Electricity Distribution Company, with assets of about \$1 billion.

In 2019 up to 70 per cent of shares in three other companies will follow: Majan Electricity Distribution Company, Mazoon Electricity Distribution Company and Dhofar Power Company.

The privatisations are the latest step in Oman's electricity sector reform process, which aims to boost the efficiency of the sector and attract overseas investment. Last year the government removed subsidies on electricity supplies to commercial customers with

annual consumption needs of more than 150 000 kWh.

Oman is also continuing to boost its electricity generating capacity.

Last month a report from Oman's Implementation Support & Follow-up Unit (ISFU) said that the country's plans to build 1600 MW of solar energy capacity over the next five years would attract investments of around RO 616 million (\$1.6 billion).

According to ISFU, four utility-scale solar projects totalling 1600 MW will be built in the next five years.

The first - known as Ibri IPP (Independent Power Project) - is sized at around 500 MW and will be operational by 2022. This will be followed by Solar 2022 and Solar 2023, each with 500 MW of capacity, and due to come on stream by 2022 and 2023 respectively.

In addition, Petroleum Development Oman (PDO) is procuring a 100 MW solar power plant at Amin in the south of its concession. The project is scheduled to launch by 2020, the report said.

## World Bank refuses Kosovo coal plant

- Renewables a cheaper option
- USA a possible finance source

The future of a new coal fired power plant in Kosovo is in doubt after the World Bank refused to provide financial backing for the project.

The 500 MW lignite fired Kosovo C power plant is the country's first major energy project for 20 years and a key part of the government's plans to enhance energy security.

World Bank President Jim Yong Kim said last month, however, that the bank would not provide funding for the plant because renewable energy would be a cheaper alternative. "We have made a very firm decision not to go forward with the coal power plant because we are required by our

by-laws to go with the lowest cost option, and renewables have now come below the cost of coal," said Dr. Kim at a meeting in Bali, Indonesia.

Kosovo signed a deal in 2017 with London-listed power generator ContourGlobal to build the lignite fired plant at a cost of around €1 billion euros (\$1.15 billion). It had asked the World Bank to provide partial risk guarantees to help unlock cheaper loans for the project.

According to local media Kosovo's Minister of Economic Development, Valdrin Lluka, said the government will continue working with ContourGlobal on the project. *Climate Home*

News reported that Kosovo's government has turned to the Trump administration to secure financing.

Environment pressure group Sierra Club praised the World Bank's decision. "We applaud the Bank's decision," said John Coequet, Sierra Club's Global Climate Policy director. "This decision by the World Bank recognises several key truths. First, the public doesn't want dirty coal. Second, coal is a bad investment, because clean energy is cheaper than coal in places all over the world. Third, if we want to curb the most catastrophic effects of the climate crisis, we have to move off coal immediately."





# First 50 Hz HL for Keadby

The first power plant to use Siemens' SGT5-9000HL advanced gas turbine is to be built at Keadby in the UK. The project indicates there is still room for highly efficient and flexible large gas fired combined cycle power plants in a market that is being increasingly dominated by renewables.

**Junior Isles**

The last few years have been very challenging for Europe's gas turbine market, with very few sales of large machines anywhere in the region. Yet a recent order for what is currently among the largest and most advanced gas turbines on the market perhaps shows that there is still scope to deploy these large units under the right market conditions.

At the end of August, energy company SSE plc announced that it was planning to build a new 840 MW combined cycle project based on Siemens' SGT5-9000HL gas turbine at Keadby in Lincolnshire, UK. Notably, it represents the first order for a 50 Hz version of the new machine, endorsing the value of the turbine's high efficiency and flexibility in the UK market.

Andreas Senzel, Project Director at Siemens Energy and Project Execution Lead for Keadby noted that the machine's unique combination of flexibility, efficiency and large capacity was a key reason behind its selection for Keadby 2.

"In the UK, generators rely on several revenue streams. The Capacity Market, established four years ago, helps to cover one part of the business case. With Capacity Market payments going down, it is helpful if a plant operator can also participate in the traditional energy market and offer flexibility for 'balancing services'. The HL combines all three – 840 MW net output and approximately 63 per cent [electrical] efficiency. It will have the highest efficiency in the UK, putting it firmly at the top of the merit order," he said. "In addition, the HL is a very flexible machine with a ramp rate comparable to smaller engines."

Yet some industry observers argue that even this – combined with the flexibility of gas fired power plants and their resulting ability to complement intermittent wind and solar – might not be enough to guarantee the recovery of the market. Their thinking is that renewables plus storage is the way forward.

Steve Scrimshaw, UK Country

Lead for the Power and Gas and Power Services divisions at Siemens plc, however, is not convinced. "You need large synchronous capacity to be able to handle the big swings in frequency, etc. Being entirely reliant on storage or wind doesn't give you that flexibility. There is a role in the energy mix for renewables, storage and small reciprocating gas engines. But there will also be a role to play for large, efficient, gas fired plant, so that when the wind is not blowing, you have synchronous generating capability on the grid."

Commenting on its thinking behind the project, Martin Pibworth, SSE's Wholesale Director, said: "Its highly efficient technology, not previously seen in the UK, will provide firm, reliable power from the early 2020s at half the carbon emissions of the coal generation it is replacing. New CCGT complements SSE's ambitions to develop more offshore and onshore wind as CCGTs remain well-placed to provide flexible, grid-scale back up to complement the large volumes of renewables the UK needs to meet its low carbon targets."

Scrimshaw added: "The proliferation of low carbon renewable technologies in the UK has had a consequential impact on the more traditional market. The Capacity Auction, where capacity is bought for years ahead, surprised many people last year with a low clearing price of £8.40/kW. We think that was mainly due to the reduced capacity requirement, which could mostly be met by interconnectors and existing generating plants. It didn't leave much room in the energy mix for new plant, including CCGTs."

But even though the Capacity Market has been quite disappointing, Siemens has played an important role in the capacity auctions in recent years, winning contracts to build King's Lynn and Spalding, and now Keadby 2. It puts this down to the suitability of its technology in meeting both the market and its customers' needs.

"We have the view that we only win

if our customers win," said Scrimshaw, "and we both saw that there is probably a place for highly efficient, flexible combined cycle power plants in the future energy mix."

Scrimshaw believes that having this common objective – combined with a long-standing relationship with SSE, which has seen the two companies work together on projects in both generation and transmission and distribution, is what helped secure the deal.

"If you look at the objectives of both parties – for us it was to secure a deal to enable market entry of the new 50 Hz, 9000HL gas turbine. And, we think, for SSE, it was having a plant that would be top of the merit order – one that could compete in the market in the future," he said.

But securing the deal is just one element. Siemens now has to work hard on the manufacturing and testing of the new gas turbine, and then construction and commissioning of the plant.

"Gas turbine technology has been around for a century, but several developments come together in this new machine to give a step-change in performance. Computer modelling allows us to understand more, new materials give us new properties to work with, and additive manufacturing allows us to make new shapes and test prototypes faster than before," said Scrimshaw.

The SGT5-9000HL is the heart of Keadby 2. Essentially, it has been designed to be a very good complement for fluctuating renewables, as well as a highly efficient base load system. It is designed to have a simple cycle power output of 567 MW and a simple cycle efficiency of 42.6 per cent, and more than 63 per cent electrical efficiency in combined cycle.

Its design draws heavily from the proven H-class design. Like the H-class machine, the HL is air-cooled and has the same single tie-bolt rotor concept with interlocked discs using Hirth serration couplings. It also uses Hydraulic Clearance Optimisation to minimise the clearance between the

turbine case and blade tips during operation for increased efficiency. As with the H machine, all blades can be replaced without lifting the rotor from the engine.

The improvements in the efficiency and flexibility come from five key technologies – the compressor, combustion system, internal cooling features, thermal barrier coating and the turbine 4th stage blade.

The compressor is the third generation of the design – originally introduced in the SGT6-5000F and then further developed for the H-class family. The new compressor makes use of advanced 3D blades, for improved aerodynamic efficiency. This has enabled Siemens engineers to increase the compression ratio (from 21:1 in the H-class machine to 24:1), with one less compressor stage compared with the H. The HL-class has a 12-stage compressor compared with 13 in the H-machines.

For reduced complexity, the HL also has one inlet guide vane (IGV) and two variable guide vanes (VGVs). The H has one IGV and three VGVs.

A similar can-annular combustion system is also retained but is modified to improve fuel/oxygen mixing.

The advanced combustion system for high efficiency has a pilot burner that is surrounded by a higher number of pre-mix burners than in the H-machines – increased from eight to 25. This allows the firing temperature to be increased by around 100 K, while maintaining low NOx levels at part-load. It is designed to go down to 35 per cent part-load, which serves a market that has more renewable energy.

In addition to higher efficiency, Siemens says the combustor design is a key contributor to the turbine's improved ramp rate and part-load capability.

Thermal barrier coating (TBC) is used for the first seven airfoils, compared with the first six in the SGT-8000H series. In the HL-turbines, TBC is used on row vane 1 to row vane 4 and blade row 1 to blade row 3. The last stage blade 4 is not coated.



## Special Project Supplement

Notably, special attention is given to the first row vane 1.

In terms of blade coating, an easy way to improve blade protection is to simply increase the thickness of the TBC. However, the ceramic TBC has a different thermal behaviour to the base metal material of the actual blade and therefore experiences thermal stresses during start-up and shut-down. Siemens says it has therefore developed a technology that increases the thickness of the TBC while minimising these stresses.

It uses a technique called laser engraving to cut very thin squares on the TBC of vane 1. This helps to reduce thermal stresses in the TBC by avoiding spallation, which is the biggest cause of damage to TBC.

A second root cause of spallation – a process in which fragments of material (spall) are ejected from a body due to impact or stress – occurs during commissioning. This is due to abradable metallic seals on the compressor side. During commissioning, operators perform a controlled run of the compressor which causes small metallic fragments or dust created during manufacturing to melt and stick to the TBC of vane 1. This changes the thermal behaviour of the TBC and causes spallation.

Siemens engineers noticed that there is spallation during the first couple hundred operating hours before disappearing. It therefore introduced a sacrificial layer on vane 1. The metal dust deposited on the sacrificial layer disappears after the first couple hundred operating hours to leave the original TBC layer below so the vane remains protected.

In addition to better TBC, higher firing temperature can be achieved by improved blade cooling. However, blade cooling should be achieved without using more cooling air, which reduces turbine efficiency since less air would be available for combustion. Siemens says it has been able to do this through better blade design.

In a major departure from the SGT-8000H design, the last-stage turbine blade is also internally cooled. This is needed for the higher exhaust gas temperature, which is increased from nearly 640°C in the H-class to about 680°C for the HL. This in turn has a positive impact on the bottoming steam cycle, delivering higher combined cycle efficiency.

This last-stage blade is a free-standing blade, which reduces exit losses and thus improves overall combined cycle efficiency.

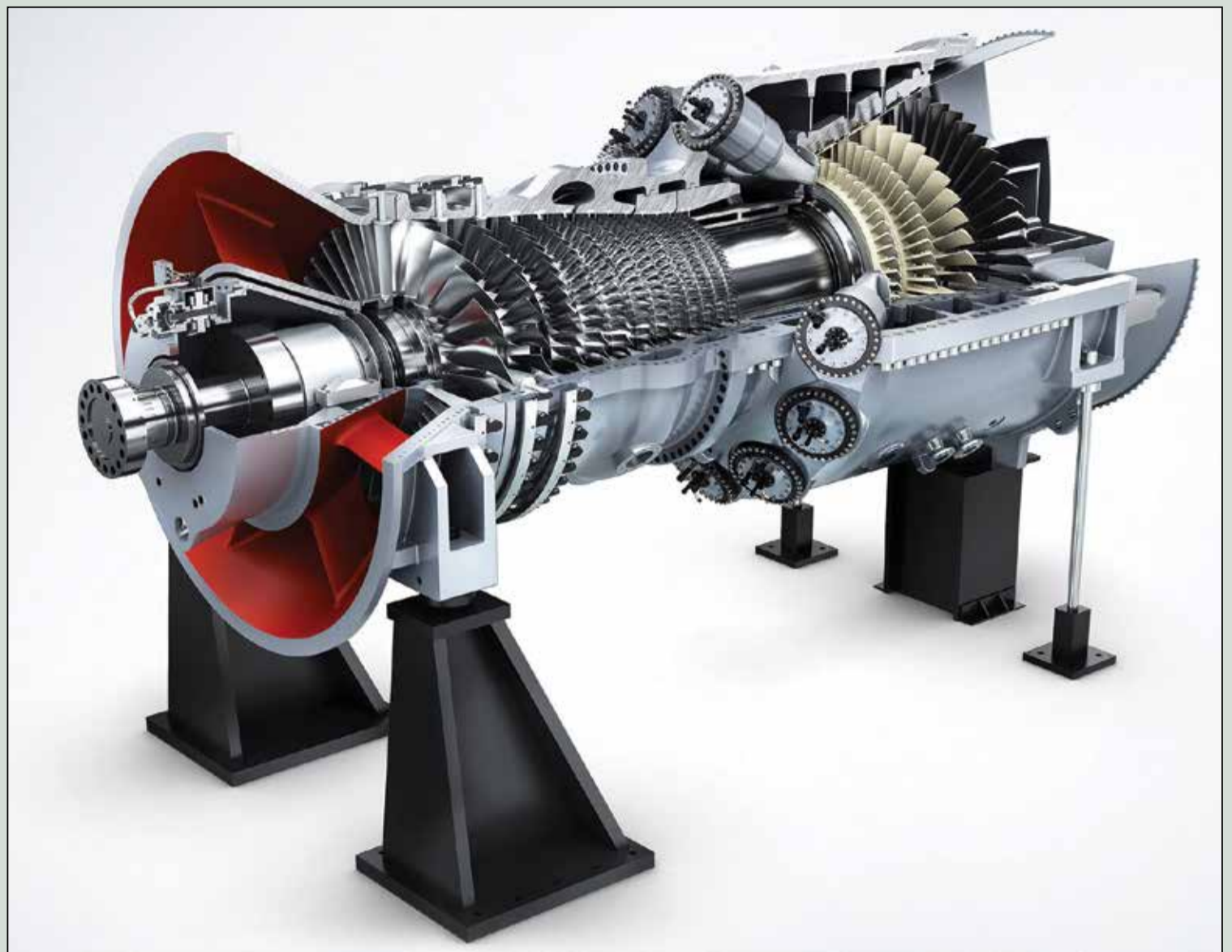
Testing of the five core technologies began in 2014, with much of the testing having already been carried out in Berlin. The company is taking a step-wise approach to testing and validation, as it did with the SGT-8000H series.

The programme started with component testing on the rig at Siemens' Clean Energy Centre (CEC). Here, all combustion parts can be tested.

Kolja Schwarz, Head of HL-class Portfolio Management, Siemens AG commented: "We have the capability there to install all of the combustion system into a rig and test all parameters. We can also set up rigs next to this so we can install blades and vanes to perform simulations. Here, we can make use of 3D printing and rapid prototyping so that we can test different designs very fast."

This technique allowed engineers to, for example, design and test different blade types in Berlin. Siemens has different test rigs around the world for developing and testing different components.

"We have our own compressor rigs, turbine rigs, combustion rigs, etc., for testing all the main components – as well as shared facilities at Universities," said Schwarz. "Once rig testing is successful, we bring them to our



engine test facility, also in Berlin, where we install them on an 8000H base engine for full-load, off-grid testing."

The third and final stage in the development test programme is to install the new technologies into operating 8000H fleets. "This means that in total we have several thousand hours of operating experience on the technologies because we are running and operating them in 8000H and 4000F engines around the globe already," noted Schwarz.

Results have so far been promising. Since initial launch data was announced, design performance has been increased as a direct result of the testing.

Schwarz said: "The results are all going in the direction that we want them." He added: "But tests don't always go in the way they're predicted so we are always designing several components in parallel. For example, we had three designs for turbine blade 4 and tested them all before deciding that two of them were not suitable."

Siemens says the HL engine is a "continuous development", where the different test phases are ongoing and will start again with the next generation of components.

With combined cycle efficiency already in the 63 per cent range, Siemens says the mid-term goal is to push this to 65 per cent. This will be achieved through the use of additive manufacturing, which will, for example, allow better component designs for improved cooling and thus higher firing temperature. There will also be improvements in the water steam cycle.

But for now, engine production for both 50 Hz and 60 Hz machines is in full swing. Parts are now coming in to the manufacturing area in Berlin and Charlotte, USA, and engine assembly has started.

Testing and validation of the first

HL in a commercial setting will begin in 2020 at Duke Energy's Lincoln power plant in North Carolina, USA. After four years, ownership of the new unit will be handed over to Duke Energy for full commercial operation.

Schwarz explained: "We have a four-year time window at Duke for testing and validation to enable us to implement our latest developments. This is why we call the HL-class a technology carrier, because we see this as just a starting point."

Both the projects in the UK and in the USA will allow Siemens to collect a huge amount of data, thanks to the several thousands of sensors connected to the two units. A dedicated testing team will be in charge of the data collection and analysis in order to stream live data to all of its engineering hubs globally.

The Keadby plant will have a testing and validation phase of several months. Since the unit is expected to go into commercial operation in 2022, its early test results will be used to gather experience to be transferred to all following projects.

How Keadby operates, and more specifically its flexibility, will be crucial to its commercial success in the UK and indeed other competitive markets.

The HL has two start-up modes from cold – normal and fast. In the normal start-up mode, the machine can be ramped up at 15 MW/min and 35 MW in fast start mode. When the turbine reaches hot conditions, it is designed to ramp up and down at 85 MW/min. This means that full combined cycle output can be achieved in 30 minutes.

Andreas Senzel, Project Director at Siemens Energy and Project Execution Lead for Keadby said: "The 30 minutes is normal, as with the other F and H frames, but the difference is the amount of power. The time remains the same but now we can bring the

840 MW on line in the same timeframe as the smaller output engines."

The turbine at Keadby will be arranged in a 1-on-1 configuration, i.e. the gas turbine and generator will be housed in a gas turbine building and the steam turbine and its associated generator in a separate steam turbine building.

Hot gas from the turbine is exhausted to a vertical, triple-pressure, heat recovery steam generator (HRSG). The boiler is a reheat HRSG where the high-pressure (HP) section has a Benson-type design. HP steam is generated at 170 bar and 600°C; steam flow is 156 kg/s. In the intermediate-pressure (IP) section, steam flow is 166 kg/s at 40.7 bar and 610°C. Low-pressure (LP) steam is generated at 4.9 bar and 296°C with a steam flow of 182 kg/s.

The plant will be a purely condensing plant as there is no heat extraction. Senzel, noted: "Heat extraction is possible; this is what the consent requested but the primary design is not for steam, so it will be a condensing plant."

The condenser is cooled, with the main cooling water passing through a hybrid cooling tower. The hybrid cooling tower receives makeup water from a channel connected to the River Trent.

According to Senzel, this arrangement is the first-of-a-kind. "This is an optimal arrangement that we developed with the gas turbine. We will use it as a reference for HL-class plants."

In order to meet contracted emission levels, Keadby 2 will use selective catalytic reduction (SCR). This will cut NOx to 22 ppmv, CO to 80 ppmv and 5 ppmv for NH<sub>3</sub>, which is slip-page from the SCR. "These are the guaranteed values at all levels of power," noted Senzel. "Keadby 2 will have up to a nominal load of 840 MW (net) and can be turned down to a minimum load of 360 MW (net)."

**Cutaway model of the HL turbine: improvements in efficiency and flexibility come from five key technologies the compressor, combustion system, internal cooling features, thermal barrier coating and the turbine 4th stage blade**



## Special Project Supplement



**Like the H-class machine, the HL is air-cooled and has the same single tie-bolt rotor concept. It also uses Hydraulic Clearance Optimisation to minimise the clearance between the turbine case and blade tips during operation for increased efficiency**

Keadby 2 represents a £350 million investment. It will be constructed as a full turnkey solution by Siemens, which will also provide plant servicing under a 15-year contract.

Siemens received the Notice-to-Proceed on May 31, 2018, and immediately began work at the site. Demolition works of the existing underground structures from a former coal fired plant site is currently under way and the underground is being prepared in the site installation and plant areas in preparation for installation of the new plant.

"It is the site of a former coal fired plant and there are still existing foundations," said Senzel. "In order to prepare the piling for the new plant, we have to remove the existing foundations."

This work will continue to around the start of December, at which time the first test piling activities for the new plant will be carried out before full piling begins in January. Piling work will continue to around May 2019. Construction of the main foundations of the steam turbine building is expected to begin one month after this and on the gas turbine building foundations a month after that. Steel structure works for these buildings should then proceed in the autumn and the main steel structure for the boiler will begin in December 2019.

Most of the big components are scheduled to arrive at site during the first three months of 2020. "The main

transformer will arrive at the end of January 2020. The gas turbine generator will arrive February/March and the gas turbine will be placed on March/April," said Senzel.

Mechanical erection will begin once all the main components are on site and the team will work towards first firing of the gas turbine in December 2020. This marks the start of hot commissioning and what Siemens calls "primary validation".

As it will be the first-of-a-kind, the plant will undergo an extensive commissioning programme.

Senzel explained: "We will go load level-by-load level first to validate the machine and then to execute the normal commissioning activities at load level. Then we will carry out all commissioning activities for the combined cycle plant and present all the characteristics to the client and to the grid."

"After that, we will have a period starting around April-May 2021 where the plant can be operated by the client but under our control. This is so we can observe the machine for what will be approximately 2500 hours."

During this time the machine will still be fitted with thousands of sensors so that engineers and operators can see more closely how the turbine is behaving far beyond the normal validation period. This means that from first fire to the end of commissioning, the turbine will be closely monitored and data collected by Siemens for several thousand hours.

At the end of commissioning a hot gas path inspection will be performed where the machine will be opened and the instrumented parts removed and evaluated along with the rest of the machine. The turbine will then be re-assembled, re-commissioned and put through a 30-day trial run before handover to SSE for commercial operation in January, 2022.

Schwarz noted: "It's an extensive [commissioning] period but I think it is a wise decision to look at the machine longer. We're following the path that we did at Irsching for the 8000H, where we had perfect results in terms of validation and bringing an engine to market."

Siemens is confident Keadby 2, along with Duke, is just the start of things to come for its HL technology. The company says it is in contact with customers around the globe and has established itself as preferred bidder or been technically selected for several projects.

"We have more in the US, South America, further engines in Europe as well as in the Asian region, where the market is quite active," Schwarz said. "We've seen all kinds of interest; we've had customers looking at base load and customers like Duke, which is installing the engine for simple cycle and plans to operate it for peak load."

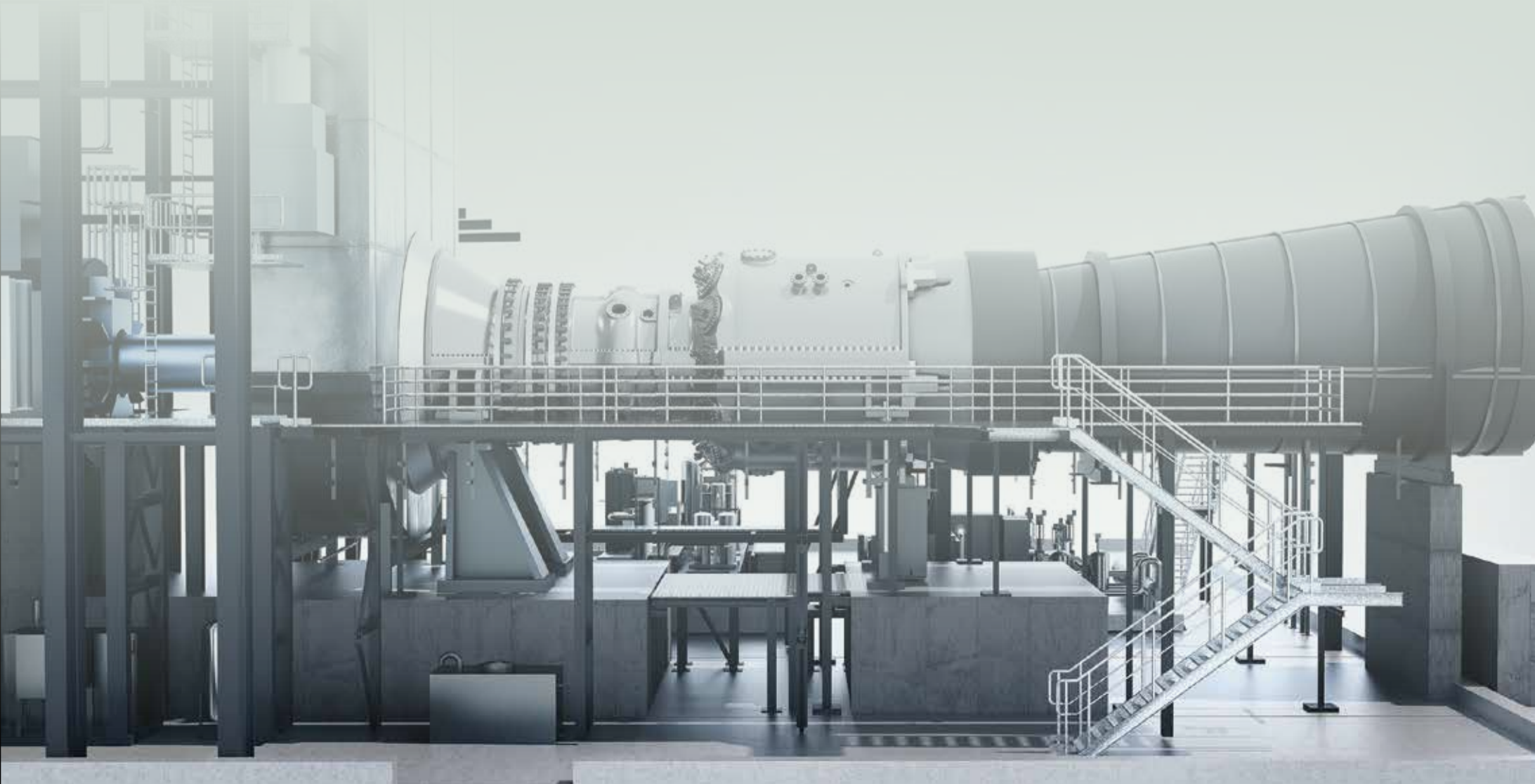
It is this flexibility to operate under different conditions according to market needs that Siemens believes will bring many opportunities for the HL machine.

Although gas turbines sales are not what OEMs have been used to in the past, the company believes the interest is still high and it is a matter of decision-making in the energy market, as demonstrated at Keadby.

"We have been developing this for quite some time, working together with the customer. It takes more time to really understand the business case and define the best solution for the need. This is the best way to implement such an engine into the future energy mix," said Schwarz.

In conclusion, Scrimshaw added: "I think that people who would normally bid in the capacity auction will probably think a little bit more about what the future might hold and their strategies because of the Keadby project."

Model of an installed HL gas turbine








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A technology carrier to the next level with a combined cycle efficiency beyond 63 percent and a clear roadmap to 65 percent. Meet the future of gas turbines with new Siemens HL-class.

[siemens.com/hl-gasturbines](https://www.siemens.com/hl-gasturbines)



## Companies News

# EDF launches EV plan

■ Plan Mobilité Electrique founded on strategic partnerships ■ EDF to be leading EV energy company by 2022

Siân Crampsie

French electricity firm EDF is furthering its push into alternative energies with a drive to take a lead in the electric vehicle (EV) sector.

EDF Group has launched a plan to become the largest e-mobility energy company in its four main European markets by 2022.

The initiative follows the company's launch of similar strategies in the solar and energy storage markets in the last 12 months. It will rely on a number of new partnerships between EDF and existing EV industry firms, including start-ups such as Nuvve and vehicle giants such as Renault.

EDF believes that it can play a major

role in the electrification and decarbonisation of the transport sector, which is the largest contributor to greenhouse gas emissions in Europe, because of its low-carbon electricity generating portfolio.

"Already a standard-bearer and pioneer of electric mobility, the EDF Group is stepping up the pace with its Plan Mobilité Electrique," commented Jean-Bernard Lévy, EDF Chairman and CEO. "Thanks to its low-carbon energy mix, EDF will substantially contribute to the fight against global warming by supporting municipalities, businesses and residential customers with the development of clean mobility everywhere and for everyone.

He added: "In order to achieve this goal, EDF is building an ecosystem of innovative players by forming strategic partnerships for the large-scale roll-out of the best technologies to support our customers."

In the Plan Mobilité Electrique, EDF is aiming to become the leading power supplier for electric vehicles, the largest charging network operator, and the smart charging leader in the UK, France, Italy and Belgium. Its goal is to have 30 per cent of the market share in electric vehicle charging by 2022 and to have some 75 000 charging stations in place by that date.

EDF believes that EVs will make up around 30 per cent of new vehicle sales in the four markets by 2035.

From 2019, it will present each of these markets with a fully integrated range of offerings including low carbon electricity, a charging solution for all its customers with access to a parking space, and services geared towards optimised charging and use of the vehicle's battery.

Through its subsidiary Sodem, EDF is aiming to deploy 75 000 charging points and provide its customers in Europe with access to 250 000 interoperable terminals by 2022. EDF will also be developing novel charging solutions for all customers without access to a parking space, in particular through collaborative innovation initiated by EDF New Business and EDF R&D.

EDF said it has formed a partnership with Renault to develop shared offerings and to experiment with electric mobility solutions in isolated regions and big cities.

It also has a partnership with Nissan International to develop shared offerings in the areas of electric mobility, smart charging, second-life battery use, energy storage and renewable energy sources.

EDF has also signed a strategic partnership with Nuvve, a California-based start-up in which EDF Renewables North America holds a minority interest, and with Ubitricity, a Germany-based start-up that has developed an innovative solution to convert streetlights into charging points.

## Valmet buys Enertechnix

Valmet says it will be able to enhance its product offerings to customers following the acquisition of Enertechnix, a high-tech combustion diagnostics and monitoring technology company based in Washington, USA.

Enertechnix develops innovative technologies for boiler imaging and temperature measuring, and holds a leading position on the US market.

The acquisition is in line with Valmet's strategy and complements Valmet's automation offering for the pulp and paper, and energy industries, Valmet said in a statement. It added that it would be able to "offer more comprehensive solutions to improve the efficiency, availability and safety of recovery and power boilers".

"Enertechnix's combustion diagnostics and monitoring systems meet well the needs of today's recovery and power boiler operators.

"We are especially excited about the

comprehensive imaging and high-temperature measurement solutions as well as the many opportunities they provide in opening a whole new window into the boiler process," said Sami Riekkola, Business Line President, Automation, Valmet.

Enertechnix said that its products, technologies and business would be further developed at Valmet.

Its range includes: high-resolution infra-red (IR) camera systems with diagnostics software to provide superior online visibility and temperature analysis; an acoustic pyrometer that obtains highly accurate instantaneous gas temperature profile in any area of a boiler; as well as a visible wavelength, lightweight, fully digital imaging system that provides high-resolution HD video quality and provides unprecedented operational views of extreme high-temperature processes.

## Rolls-Royce expands microgrid position

Rolls-Royce is adding turnkey microgrids to its portfolio following the acquisition of a stake in Berlin-based start-up firm Qinous GmbH.

Qinous is a global provider of innovative energy storage and control systems and Rolls-Royce says that its position as a strategic investor in the firm will enable it to develop innovative energy storage solutions for its customers.

Qinous has gained considerable experience in the integration of battery storage and energy systems in microgrids in more than 30 projects worldwide and has already integrated MTU Onsite Energy systems from Rolls-Royce in such projects. The investment made by Rolls-Royce is to be used to expand the existing product portfolio and strengthen global sales and marketing activities.

Andreas Schell, CEO of Rolls-Royce Power Systems, said that the investment would strengthen Rolls-Royce's position as a provider of innovative power solutions able to supply customers with microgrid systems tailored to specific requirements.

"We have identified our customers' needs in terms of autonomous energy supply systems that are efficient, reliable and environmentally friendly," said Schell. "For this reason, we are now adding turnkey microgrids to our current portfolio.

"In addition to the diesel and gas gensets supplied by MTU Onsite Energy, together with our partners like Qinous we will now offer battery containers, include renewable power generation plants, and combine that with intelligent control."



Iberdrola's sale of ScottishPower's hydro and gas fired power plants to Drax will make the UK utility the first major energy company in the country to generate all of its electricity from wind.

ScottishPower's Spanish parent company sold 2566 MW of generating capacity to Drax for £702 million in cash last month. The sale is part of Iberdrola's plan to become carbon neutral by 2050, and also signals a shift in strategy for Drax, the owner of the 4 GW Drax power station in northern England.

The sale includes four CCGT plants in England and three hydropower schemes in Scotland and leaves ScottishPower with 2700 MW of wind energy either operating or under construction in the UK.

ScottishPower says it has a pipeline of projects that will add a further 3000 MW to its portfolio, and plans to invest £5.2 billion in renewables and smart grids over the next four years. It said in a statement that it was "closely following" the proposals by the Crown Estate "with ambitions to secure

additional development areas in the next round of offshore wind leases throughout the UK".

"This is a pivotal shift for ScottishPower as we realise a long-term ambition," said Keith Anderson, CEO of ScottishPower. "We are leaving carbon generation behind for a renewable future powered by cheaper green energy. We have closed coal, sold gas and built enough wind to power 1.2 million homes.

"From today we can focus solely on making energy generation cheaper, cutting carbon quicker, building smart grids and connecting customers to renewable electric future for transportation and heating."

Ignacio Galán, Chairman and Chief Executive of Iberdrola, said: "Energy companies must be part of the solution to climate change. Iberdrola is acting now to cut carbon emissions 30 per cent by 2020 and be carbon neutral by 2050. The sale of these generation assets is consistent with our strategy."

Drax said that the purchase of assets from Iberdrola held a "compelling strategic rationale" as it would help

the company to expand and diversify its portfolio with flexible and low carbon power generating capacity.

"I am excited by the opportunity to acquire this unique and complementary portfolio of flexible, low-carbon and renewable generation assets," said Will Gardiner, CEO of Drax. "It's a critical time in the UK power sector. As the system transitions towards renewable technologies, the demand for flexible, secure energy sources is set to grow.

"We believe there is a compelling logic in our move to add further flexible sources of power to our offering, accelerating our strategic vision to deliver a lower-carbon, lower-cost energy future for the UK."

■ UK energy firm SSE has agreed a deal to buy a 50 per cent stake in Seagreen Wind Energy from Fluor for £118 million (\$150 million), making it the sole owner of the offshore wind energy development firm. Seagreen is set to build up to 1.5 GW of new capacity in an offshore development zone in the Firth of Forth off the coast of Scotland.

## Blackstone creates new firm for MENA energy projects

Equity fund manager Blackstone is planning a new drive into the energy markets of the Middle East and North Africa (MENA) with the creation of a new project development company.

Blackstone has set up Zarou, a stand-alone company that will invest in the construction and operation of thermal and renewable power projects, as well as oil & gas midstream and water

assets. It will examine the opportunities created in the region by rising electricity demand and a drive for sustainable development, and will be led by Sameh Shenouda, the former Head of Infrastructure Equity Investments at CDC Group.

"We are thrilled to partner with investors of Blackstone's calibre and experience," said Shenouda, who will act

as CEO of Zarou. "They share our drive and enthusiasm to invest in and build projects across the MENA region. We have the flexibility to participate in projects throughout the development lifecycle, from concept stage through construction to operating stage, and I believe we are well-positioned to be a value-added partner in the region's energy sector."



## 10 | Tenders, Bids & Contracts

### Americas

#### Vestas repowers Marengo

PacifiCorp has placed an order with Vestas for turbine components to re-power the Marengo and Marengo II wind power projects in Washington, USA.

Vestas will provide its V100-2.0 MW hardware for the two wind farms, which were commissioned in 2007 and 2008, respectively, and which are currently equipped with V80-1.8 MW machines.

The order includes supply and commissioning of the turbines as well as a multi-year service agreement, designed to ensure optimised performance of the project. Turbine delivery will begin in 2Q 2019.

#### Sebewaing orders Jenbacher units

GE and Clarke Energy are to provide a turnkey combined heat and power (CHP) plant to municipal electricity utility Sebewaing Light & Water (SL&W) in Michigan, USA.

The project includes one each of GE's Jenbacher J624 and J620 gas engines, providing 4.4 MWe and 3.3 MWe, respectively, with a total output of 7.7 MWe. Clarke Energy will also install GE's Distributed Power's myPlant Asset Performance Management (APM) offering.

Shipment of the equipment to the site will take place in the fourth quarter of 2018. Commissioning will then follow to ensure the site is operational in the first quarter of 2019.

#### MHI Vestas preferred supplier for Nautilus

MHI Vestas will supply three V164-8.3 MW wind turbines for the Nautilus offshore wind farm in New Jersey, USA, after being selected by EDF Renewables North America as the preferred supplier.

The Nautilus wind farm will be the first offshore project in New Jersey and also marks the first project in the USA for MHI Vestas' V164 platform.

Nautilus offshore wind will be located in state waters and is already fully permitted. The project is currently under review by the New Jersey Board of Public Utilities for approval of an offshore renewable energy credit (OREC) agreement.

### Asia-Pacific

#### Downer wins Limondale contract

Australia-based Downer EDI Ltd has secured an order to build Innogy SE's 349 MWp Limondale solar park in New South Wales, Australia.

Innogy subsidiary Belectric Solar and Battery GmbH awarded the contract to Downer. Construction of the facility was set to begin in October, Innogy said when it took a final investment decision on the project in September.

Downer says it has already received Notice-to-Proceed on the contract. Construction is due to be completed in 2020.

The solar farm will be located near Balranald. Innogy bought the Limondale project from Overland Sun Farming earlier in 2018.

#### LM Wind scores with Goldwind

LM Wind Power has signed a 1.1 GW, three-year deal to supply wind turbine blades to Chinese wind turbine maker Xinjiang Goldwind Science & Technology.

The blades will be used in Goldwind's 3 MW-4 MW onshore platform for both international and

domestic markets. LM Wind will produce them at its factory in Qin Huang Dao, northeastern China, between 2018 and 2021.

The deal covers three blade types – the LM 66.9 P, LM 66.9 P2 and LM 69.0 P. It follows a 140 MW pre-agreement signed last year and is the largest between the companies since 2010.

The first variant of this blade series, the LM 66.9 P, was installed on Goldwind's 3 MW prototype in January last year.

#### Pöryr wins contract for Thai CCGT

Gulf Energy Development Co and Mitsui & Co have appointed Pöryr as Lenders Technical Advisor for a proposed 2500 MW combined cycle gas turbine power plant in Thailand.

The power plant will be located in Sriracha District, Chonburi Province. Pöryr will carry out technical due diligence, construction monitoring and operation monitoring. The anticipated lenders are leading international and local investment banks.

The power plant will consist of four 625 MW units, the first of which is expected to start operating in March 2021.

#### MAN boosts Bangladesh capacity

MAN Energy Solutions has won a contract to deliver the electricity generation technology for two power plants in Bangladesh.

The first project will expand an existing 58 MW power plant in the Manikganj district, part of the Dhaka administrative division, by 167 MW. The second project involves construction of a new power plant in Bhairab, 80 km northeast of Dhaka, with a capacity of 55 MW.

Both power plants will be operated by Doreen Power, a long-standing customer of MAN.

### Europe

#### Valmet to supply biomass boiler to Teixeira plant

Valmet will supply a biomass boiler to Greenalia's new Curtis-Teixeiro biomass power plant in Teixeira, Spain.

The order is included in Valmet's third quarter of 2018 orders received. It was placed by Acciona Industrial and Imasa, a Spanish EPC contractor joint venture for the plant. The biomass power plant's takeover is scheduled for January 2020.

The plant, which will burn forest biomass, mainly eucalyptus and pine wood, will encourage the collection of small-sized wood waste that is normally discarded for industrial use. It will increase the generation of energy from renewable sources to help reduce carbon dioxide emissions.

#### RES repowers wind farm in France

UK-based renewables developer Renewable Energy Systems Ltd (RES) is to re-power the first wind farm it built in France.

The 20.8 MW Souleilla-Corbieres wind farm in Aude county, southern France, currently uses 16 Bonus 1.3 MW turbines. The machines have been operational since 2001.

RES will partner with French turbine manufacturer PomaLeitwind to carry out the re-powering, which will increase the output of the wind farm to 24 MW.

#### CGN EE chooses Greenbyte Energy Cloud

CGN Europe Energy has chosen renewable energy management system Greenbyte Energy Cloud to manage its wind and solar PV farms.

Greenbyte will integrate CGN EE's wind and solar assets in Europe and Africa, amounting to 900 MW, as well as CGN's future renewable energy investments. The portfolio, which comprises 130 wind and solar farms in the UK, Ireland, France, the Netherlands, Senegal and Belgium, will be managed through Breeze and Bright, the two specialised components of Greenbyte Energy Cloud for wind and solar farms.

#### Ørsted signs VolkerInfra

UK-based extra high voltage cable system specialist VolkerInfra has signed a multi-million pound contract with Ørsted to install 360 km of high voltage onshore cables for the massive Hornsea 2 offshore wind farm off the coast of northeast England.

Hornsea 2 is in the early stages of construction and when complete in 2022 will be the biggest offshore wind farm in the world.

Having worked with Ørsted on the Burbo Bank Extension offshore wind farm project, VolkerInfra will install three 220 kV transmission circuits along the 39 km onshore cable route for Hornsea 2, which runs from Horseshoe Point in east of Tetney to the substation site in North Killingholme.

#### Siemens, AES JV wins 60 MW battery storage deal

Fluence Energy LLC will supply 60 MW of battery capacity for the second phase of UK Power Reserve's 120 MW energy storage portfolio in the UK.

Fluence, the energy storage specialist formed by Siemens AG (and AES Corp), was previously selected to supply batteries for the first 60 MW phase of the project. Both phases of the project will use the energy storage joint venture's (JV) Advancon platform.

The first phase, including three 20 MW of battery storage systems, is currently under construction at sites in the Midlands and North West. It is scheduled to become operational by the end of this winter. The full 120 MW capacity is to be switched on by the end of the summer of 2019, ahead of the winter 2020 deadline.

The storage capacity will help boost the flexibility and stability to the UK power grid as the volumes of renewable energy on it continue to grow.

#### Northwester cable contracts awarded

Nexans has been awarded a contract to design, manufacture and test the submarine power export cable for the Northwester 2 offshore wind farm.

Comprising 23 turbines, the 219 MW Northwester 2 project will be the seventh wind farm to be constructed off the Belgian coast. It will also be the first offshore wind farm to feature the world's most powerful wind turbine – the 9.5 MW V164 turbine manufactured by MHI Vestas.

The Northwester 2 wind farm is expected to be fully operational in the first half of 2020.

### International

#### Mapna to build gas fired plant in Syria

Iran's energy and infrastructure conglomerate Mapna has signed a contract to build a 540 MW gas fired

combined cycle power plant in Syria's western coastal province of Latakia.

The plant is expected to begin simple cycle operation at the end of next year and full combined cycle operation in 2021.

#### Vestas to equip SA projects

Enel Green Power has placed orders with Vestas for the supply of wind turbines to two projects in South Africa.

Vestas has won orders to supply, install and commission 70 of its V136-4.2 MW turbines, delivered in 4.2 MW Power Optimised Mode, for the 147 MW Karusa and Soetwater projects. It said it will procure locally produced towers to fulfill local content requirements, and that it expects to deliver and install the turbines in the second half of 2020.

The orders also include a five-year Active Output Management 5000 (AOM 5000) service agreement.

#### DTEK signs GE for Prymorsk phase 2

DTEK Renewables and GE Renewable Energy have signed an agreement for the construction of the second stage of the Prymorsk wind farm in the Ukraine.

The total planned investment cost of the second stage of Prymorsk wind power plant is about €150 million. It will be situated on the shore of the Sea of Azov in the Zaporizhzhia region of Ukraine. The construction works are expected to start in the fourth quarter of 2018 and end in late 2019.

GE will supply 26 wind turbines with a capacity of 3.8 MW each.

Tunisia has extended a deadline for tenders for the construction of 130 MW of wind energy capacity until December 18, 2018.

#### Tunisia extends wind deadline

Tunisia's Ministry of Industry and Small and Medium Enterprises extended the deadline for filing applications by two months. It has invited applications for 120 MW of wind power capacity with individual proposals of up to 30 MW, and, in a separate category, for an additional 10 MW with single projects of up to 5 MW.

Tunisia aims to generate 30 per cent of its electricity from renewables by 2030. That goal will be achieved through the addition of 1 GW of capacity in 2017-2020 and 1.25 GW in 2021-2030.

#### GE to supply turbine islands for El Dabaa

GE Power has won a contract to deliver the turbine island for the El Dabaa nuclear power plant project in Egypt.

The contract was secured through AAEM, GE Power's joint venture with Russian firm Atomenergomash. GE Power will supply the basic design of four conventional islands, supply four nuclear turbine generator sets, including the Arabelle half-speed steam turbines, and provide technical expertise for the on-site installation and commissioning.

Electricity demand in Egypt has increased rapidly as a result of a growing population and increasing industrial activity. It is estimated that an additional 1.5 GW of new capacity will be needed each year until 2022.

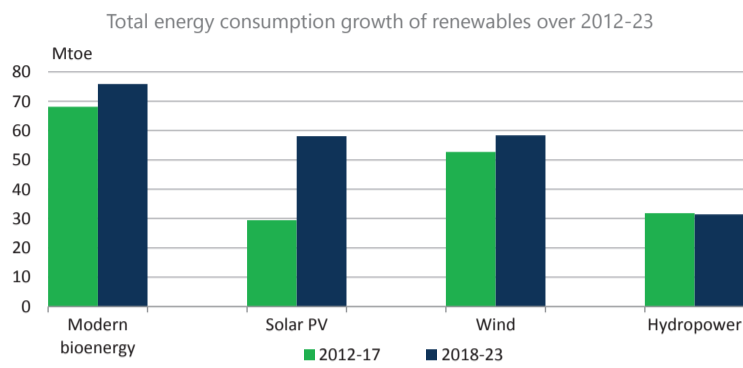
To support this increasing demand, Egypt has an ambitious energy plan which includes diversifying its installed base. The El Dabaa nuclear power plant will help deliver on that plan by stabilising the Egyptian grid with dependable, CO<sub>2</sub>-free energy. Once in operation, El Dabaa will produce 4.8 GW.





## IEA Renewables 2018 highlights

### Modern bioenergy set to lead renewables growth



Total renewable energy consumption is expected to increase by almost 30% over 2018-2023, covering 40% of global energy demand growth

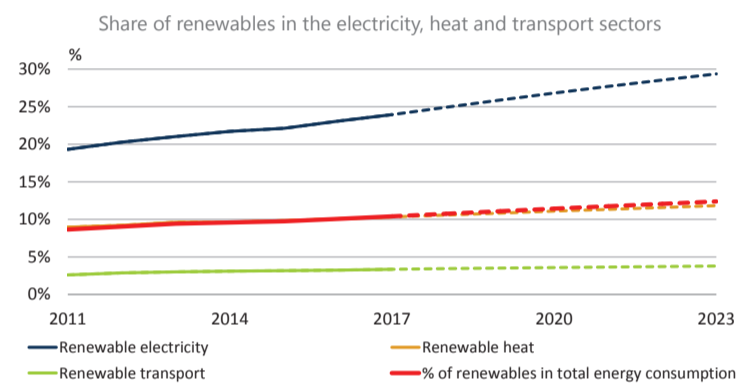
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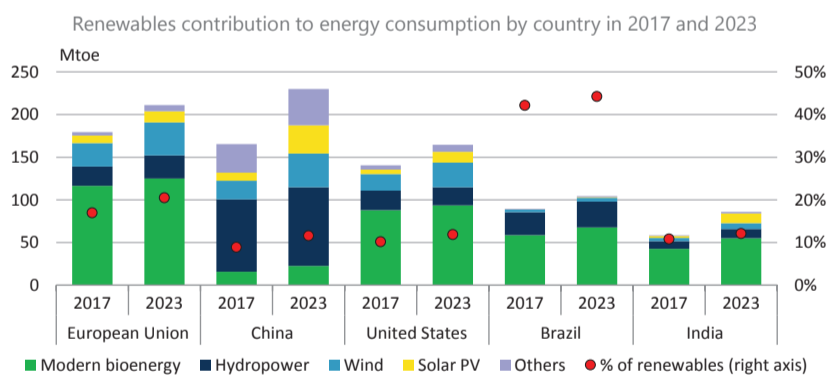
### Renewables share of energy consumption increases by one-fifth



Electricity contributes two-thirds of renewables growth  
But electricity accounts for less than 20% of total final energy consumption

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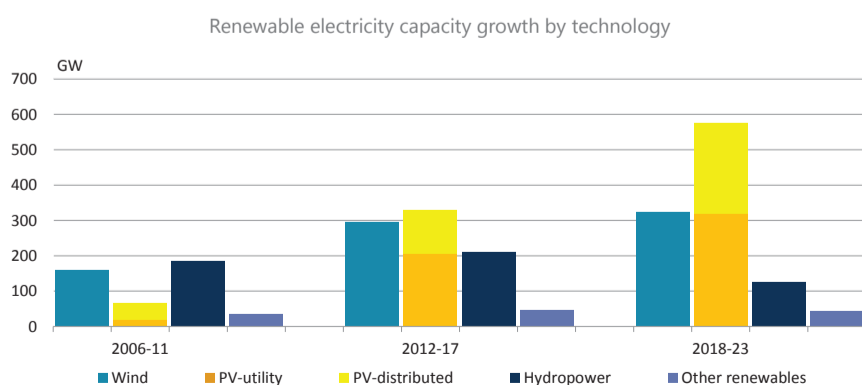
### China becomes the largest RE consumer, Brazil has the highest share



China accounts for the largest absolute growth over the forecast period surpassing the EU, while renewable energy consumption in India increases by 50%

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### Solar PV expansion in electricity larger than all renewables combined



China remains the absolute solar PV leader by far, holding almost 40% of global installed PV capacity in 2023. The US remains the second-largest growth market for solar PV, followed by India, whose capacity quadruples

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## Oil

# IPCC report carries little weight with oil industry

- The era of oil and gas “is far from over”
- Demand for oil and gas will grow by 40 per cent by 2040

Mark Goetz

Some of us recall that the former Saudi Arabian Oil Minister Ahmed Zaki Yamani is famous (among other things) for saying: “The Stone Age didn’t end because we ran out of stones.” His comments were taken at the time (1973) as a prediction that one day oil would be obsolete in a world that had developed cheaper and more efficient forms of energy.

That day is drawing near as advances in alternatives to hydrocarbon energy are being made and new technology is enabling the world to see a time when oil markets are a thing of the past. The concept of a world running on renewable energy is beginning to sink into the imaginations of many governments, businesses and investors. But for the most part, oil will continue to dominate the energy industry for decades to come and this could pose a problem when considering the growing impact of fossil fuels

on the global environment.

If you take the recent report from the UN Intergovernmental Panel on Climate Change (IPCC) seriously, the sooner the world switches to cleaner and more efficient forms of energy, the better off the planet will be. According to the report, we (*homo sapiens*) have roughly a decade to change our energy mode of operation or we can kiss this comfortable consumer lifestyle goodbye as the impact of global warming takes hold.

Without doubt there is a large segment of the oil industry that believes the future will be one of business as usual until the rocks run out.

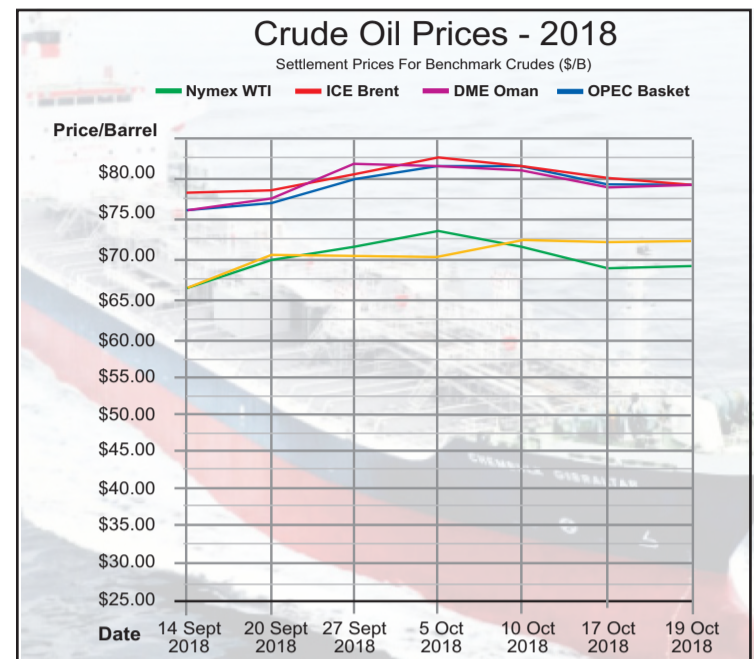
Speaking in late October at the Future Investment Initiative Conference in Riyadh, hosted by Saudi Arabia’s Crown Prince Mohammed Bin Salman (MBS), the UAE Minister of State and Group CEO of the Abu Dhabi National Oil Company (Adnoc), Dr. Sultan bin Ahmal Sultan Al Jaber, noted: “The era of oil and gas

is far from over. In fact, market trends point to robust growth in all segments.”

Demand for oil and gas will grow by 40 per cent by 2040 and petrochemicals will be the main market driver, Al Jaber said, adding that demand for petrochemicals will grow by 60 per cent over the next two decades to become the single-largest driver of oil demand growth by 2050, according to a report in the *Khaleej Times*.

“The global oil industry is about to break the historic milestone of consuming more than 100 million b/d of oil, and by 2040, we forecast that global consumption will climb by another 10 million per day, demonstrating that demand for hydrocarbons continues to gain strength amidst major market expansions and a rising global GDP.”

However, many oil companies, probably including Adnoc, are moving into the renewables industry. Abu Dhabi is after all building a totally



renewables-run city, Masdar, in the desert.

Despite the fact that its primary task is to keep track of oil in all its aspects, the International Energy Agency (IEA) is encouraging a reduction in carbon emissions. During a conference last month in Paris, IEA Executive Director Fatih Birol said his message was one of bad news and despair. He said the chances of reaching targets that will keep the Earth’s atmosphere from rising by 1.5-2.0°C were “weaker and weaker every month, every year.”

“Looking at data for the first nine months of this year, emissions this year will increase once again... global emissions will reach a record historical high,” Birol said, adding on

Twitter: “We need more renewables in all end-users – including more bio-energy – more energy efficiency and a range of other technologies and fuel sources to correct this course.”

All the world’s oil and gas companies and relevant organisations keep close track of what the IEA says, and they all too well know about the IPCC. But their businesses are worth billions and entrenched in a decided methodology, and the effort to change how global energy is produced and consumed is too daunting and certainly too costly.

The changes that the IPCC talks about would bring an end to the fabulous wealth that many countries and companies have come to know and consider themselves entitled.

## Gas

# Turkmen gas reappears with EU support of gas pipeline, new sales to Gazprom

The European Union is again expressing its support for the controversial Trans Caspian Gas Pipeline (TCGP), even as Gazprom announced it would resume importing Turkmen gas at the start of 2019.

David Gregory

Turkmenistan’s vast gas reserves have been a point of interest for international energy companies since the country became independent in 1991. But Ashgabat’s reluctance to allow foreign firms to operate inside the country, disputes among the Caspian Sea littoral states over how the region’s energy resources can be shared and developed, and its sheer geographical remoteness have prevented Turkmenistan from joining the ranks of the world’s major gas exporters.

But a convention on the legal status of the Caspian Sea signed in August by the five littoral states (Russia, Kazakhstan, Turkmenistan, Azerbaijan and Iran) establishes a legal framework for the Caspian and has thus created circumstances that could bring improvements for the beleaguered Turkmen economy through new gas sales and possibly see a new export route open to Europe through the nearly completed Southern Gas Corridor.

Last month Gazprom announced that it would resume importing Turkmen

gas at the start of 2019. Speaking in Ashgabat in early October, Gazprom CEO Aleksei Miller said Turkmenistan “is a traditional partner of Gazprom in the energy sector, and an intergovernmental agreement between the Russian Federation and Turkmenistan on cooperation in the gas sector until 2028 is currently in force,” according to Turkmen government news agency *Turkmen Dowllet Habarlary (TDH)*.

Meanwhile, the European Union is again expressing its support for the controversial Trans Caspian Gas Pipeline (TCGP), a project that could make Turkmenistan a significant energy partner and bring in considerable revenue.

Russia and Turkmenistan have indeed been traditional partners in the energy sector, but for much of that time, the partnership has not been entirely friendly. In the mid-2000s, Gazprom was buying tens of billions of cubic metres of gas from Turkmenistan, largely to supplement its own gas system and also to prevent Ashgabat from joining with Western energy companies in the so-called TCGP project and

committing exports to the Southern Gas Corridor.

Russia consistently demanded a low price for Turkmen gas and relations between Moscow and Ashgabat were frequently on edge. Relations took a turn for the worse in 2009 when a mysterious explosion occurred on a main export pipeline forcing a halt in shipments to Russia. Turkmen exports to Russia resumed in 2010 at 10 bcm/year, but Gazprom cut that to 4 bcm/year in 2015 and in 2016 stopped them altogether.

Last August, after negotiating the legal status of the Caspian for 20 years, the littoral states reached an historic legal agreement. The accord allows for subsea pipelines and cables along the bottom of the Caspian as long as their designs comply with environmental standards set by international agreements and only the parties involved in such projects will be involved in deciding the route. Theoretically, a gas pipeline running between Turkmenistan and Azerbaijan would be a matter solely for those two countries, provided the pipeline

meets environmental standards and the other terms of the convention.

The TCGP has been on the burner since the late 1990s, and has been opposed by Russia and Iran since it was first proposed. Political differences between Azerbaijan and Turkmenistan have also hindered the project and Ashgabat has always been coy with the Europeans and the companies that have backed the pipeline at various points in time.

On several occasions Turkmenistan has promised European delegations that it would do its part in moving the TCGP forward, but the pipeline remains a dream. Over the years, the European Union has continued to support the TCGP project, signing several accords designed to see it materialise.

With its economy in serious trouble, and the Caspian legal status seemingly in place, Turkmenistan appears ready to give the TCGP another go. At the UN General Assembly in September, Turkmen President Gurbanguly Berdimukhamedov invited interested parties to discuss energy projects. The TCGP will likely be top of the list.

Like all major energy producing countries, Turkmenistan’s economy has suffered with the collapse of oil prices, setting the economy on a downward spiral.

The proposed TAPI (Turkmenistan-Afghanistan-Pakistan-India) gas pipeline, a \$10 billion project designed to transport and distribute 33 billion cubic metres (bcm) annually of Turkmen gas to those partner countries, is reported to be making progress, but it is challenged by security concerns due to the continuing chaos in Afghanistan. Its future is in question. Turkmenistan had been exporting gas to Iran since the late 1990s, but these have been stopped due to a dispute over payments.

These circumstances have left Turkmenistan relying on exports to China that average around 30 bcm/year as its primary source of earnings for gas. New sales to Russia and access to new markets west of the Caspian would also serve to establish Turkmenistan as a key gas supplier. But this road has been travelled before, and it will be years before Turkmen gas makes any real impact.



# Intelligent energy transformation

On the cusp of the transition in how we create, distribute and consume energy, **Thierry Mortier**, assesses the practical applications of artificial intelligence in the power and utilities industry.

**A**rtificial intelligence (AI) is one of a suite of disruptive technologies that promises to transform our world.

Strip away all the techie-speak and AI becomes a very relatable concept, particularly if we apply it to something tangible, like an autonomous vehicle. A camera, embedded in the vehicle, detects the lines on the road; it uses logic to assess whether to turn left or right; and it initiates the action. It sounds plausible. But what can AI do in a sector that is all about pipes, wires, grids, call centres and customers?

In fact, the three principles that can be applied to autonomous vehicles, work for the power and energy sector too. As a technology, AI does three things: identifies patterns; applies logic and initiates an action.

AI is so-called because it incorporates an element of reasoning typically associated with living things. It enables tasks – usually repetitive, labour-intensive tasks – to be performed much more rapidly and accurately than a human being could ever do. So, in the power and utilities sector, it could feasibly sift through masses of data to identify patterns; it could apply logic that determines how to respond to anomalies and initiate the appropriate response. Far from replacing human ingenuity, it complements it.

Right now, there are three principle uses for AI in the power and utilities industry. These are:

■ **Efficiency savings.** EY recently undertook research that predicts that Europe and Australia have just three years until non-utility solar and battery systems reach cost and performance parity with grid-delivered energy. Between 2023 and 2025, electric vehicles (EVs) should achieve price and performance parity with combustion engines. And we have a decade or more before it becomes cheaper to generate and store electricity locally than to transport and distribute it. While

these projections are subject to geographic variations, two things are certain: (1) once these tipping points are reached, we will change how we produce, distribute and use energy forever, and (2) time is running out.

AI can help make existing ways of working more efficient, reducing costs and resources that could be better deployed in the energy transition. Many of the traditional ways of working are, indeed, ripe for an advanced technology intervention.

We might, for instance, use AI to empower chatbots in call centres, so that the first few steps of customer contact are fully automated, without compromising the experience of the end-user.

We could employ AI's "deep learning" capabilities – an artificial neural network that analyses different layers of information to make better predictions about the maintenance of network assets, so that intervention is timely but targeted. An AI solution that can identify, with 99 per cent certainty, when an overhead line warrants manual intervention, will generate significant efficiency savings.

Or we could use AI to identify patterns of behaviour that indicate customer dissatisfaction, enabling intervention and remediation to reduce churn.

■ **Enabling the energy transition.** We are fast approaching the point at which energy is neither created nor consumed centrally. Consumers that produce their own energy – "prosumers" – will connect their distributed energy resources to the grid, and "prosumption" will be dictated by variables such as weather conditions and household needs. Consumers will also connect their devices – including smart appliances – to the internet. Acceleration in technology take-up means AI can hive off data, pinpoint patterns of behaviour and make predictions on energy usage with greater accuracy in order to deliver an intelligent, stable and autonomous grid.

AI algorithms will, for instance, recognise patterns of behaviour on, say, a weekday evening in 2023, when millions of EV drivers arrive home and recharge their vehicles. By distinguishing between drivers who habitually use their cars overnight, and those who leave it charging until the following morning, the intelligent grid will ensure that the battery is sufficiently charged in time for the driver's next journey, without exerting simultaneous load on the grid where possible.

■ **Accessing new revenue streams.** AI also provides an opportunity for power and utilities companies to access new business models and revenue streams that will help them to remain relevant beyond the energy transition. They could, for instance, use AI to compress, analyse and monetise the huge swathes of data moving through the energy ecosystem, or follow the lead of technology start-ups by harnessing apps and other innovations to enhance

the networked and connected home.

Though AI artificially enhances capabilities, many of its limitations are the result of human trepidation.

For example, deep-learning AI algorithms train themselves by sifting through large volumes of data, and from this they learn to identify exceptions to the norm and to make reliable predictions. Utilities therefore need to ensure that they take steps to structure and evaluate the data before introducing AI. If they do not, there is a risk that the technology will be ready while the data is still being prepared. Ultimately, better data produces a better AI learning experience and improved outcomes.

Then there are issues relating to computer power – or rather the lack of it. Some utilities fight shy of migrating to cloud computing solutions, due to fears over data privacy and cost. It is, however, all but a prerequisite for AI, given the technology's extensive storage and processing needs.

Utilities also have to get to grips with data privacy. They need to understand who owns the data; which data is confidential; and how open data should be used and stored, if they are to optimise its potential and comply with relevant regulations.

There are exceptions. Some utilities recognise that training a deep-learning network takes dedicated input and collaboration from both the IT function and the business itself. Increasingly, at EY, there are engineers, shop floor workers, asset managers and programme managers working together on their AI capabilities. They jointly define and test a use case, and populate the system with relevant data – rather than draining the entire data pool – to deliver the right algorithm training.

AI is a big data game. At EY, we are working with organisations to define their data architecture, data management and data governance. By better understanding ownership of the data and how it can be shared and combined, meaningful algorithms can be developed to underpin trusted AI programs.

To make the most of AI's potential, boundaries are coming down – and not just between IT functions and other parts of the business.

While some utilities incubate their own AI solutions in isolation, EY is increasingly seeing evidence of a growing tendency for businesses to collaborate with other players – and, in particular, existing start-ups.

EY has also seen utilities collaborate with start-ups to access specialist capabilities – primarily in Germany, the UK, the US and the Middle East. Notably, many are working with omni-channel, intelligent customer support applications, which are essentially AI-powered chat solutions that understand customer conversations and automate repetitive processes – thereby reducing resource needs and costs.

Some start-ups even offer a platform architecture for storing, consuming and selling energy, while

others work with utilities to deliver predictive maintenance solutions. By reducing unnecessary system intervention, they enable timely remedial action too, ensuring costs and resources are focused in all the right places.

I would go as far as to say that collaboration or partnership is a must for any utility. Otherwise, they could struggle with the level of technology sophistication and specialisation that more nimble start-ups readily achieve.

So how far can AI go? Frankly, it's slow off the mark for some utilities; others show varying degrees of AI maturity.

Time is pressing. While there is no need to invest huge sums right now, start-ups will begin to erode utilities' business models by developing AI-enabled solutions that are smart – and which customers like.

In conjunction with the Internet of Things (which offers a virtual environment through which distributed energy resources can be connected) and blockchain (which facilitates trusted transactions between buyers and sellers of home-grown electrons, without the intervention of a central authority) – AI has the potential to reinvent energy delivery. Meanwhile, quantum computing – which is still some way off but attracting lots of investment – could be the big game changer for AI. It will make deep-learning networks faster, more powerful and able to solve the trickiest challenges, all while storing even larger bodies of data.

But even before all of these technologies reach maturity, utilities that are not riding the wave of technology innovation now risk losing some or all of their business to competitors. So, if they are to push ahead with AI, they need to:

■ Define their AI strategy – an absolute must  
 ■ Engage their business around how they are going to achieve AI transformation  
 ■ Start experimenting with AI as early as possible, either by working with start-ups or through in-house innovation and acceleration endeavours  
 ■ Run pilots and test cases to understand what AI is and what it could do for their business.

AI has a sixth sense, which enables people to do things smarter and eliminate repetitive tasks, in turn reducing costs and improving efficiency. Of course, questions remain around how far AI can go in the power and utilities sector, and its long-term impact on human resources. But those businesses that take the initiative to start adapting and testing the technology now will certainly gain the competitive edge.

*Thierry Mortier is Global Power & Utilities Innovation Leader at EY. The views reflected in this article are the views of the author and do not necessarily reflect the views of the global EY organisation or its member firms.*



**Mortier: AI is a big data game. At EY, we are working with organisations to define their data architecture, data management and data governance**



# The energy transition and the future of storage

DNV GL's 'Energy Transition Outlook 2018' forecasts that renewables will drive rapid electrification across several sectors and predicts a key role for energy storage.

Paul Gardner



Gardner: Compared with grid investments, battery storage options have the advantage that they can in principle be moved

global electricity production will be powered by renewable sources accounting for an estimated 80 per cent of global electricity production in 2050. As the costs for wind and solar continue to fall, those two energy sources are set to meet most of the electricity demand, with solar PV delivering 40 per cent of electricity generation and wind energy 29 per cent. To cope with these variable renewables, we'll see a very significant growth in installed electricity storage capacity, around 50 TWh by 2050.

In the transport sector, the uptake of electric vehicles (EVs) will continue to escalate rapidly. This uptake will accelerate as electric vehicles reach cost parity with internal combustion cars in six years' time. By 2027, we forecast that 50 per cent of all new cars in Europe will be EVs. The uptake of EVs will then follow an S-curve pattern, associated with the speed of adoption of innovation.

The increase in EVs means that home-charging of an EV may become a household's dominant load, which could be used to provide services to the energy supplier and to the electricity network operators. We could also see business models for EV charging evolve to incorporate a household's electricity supply, including behind-the-meter solar PV and storage. Total volumes of EVs are likely to provide substantial flexibility benefits to aid integration of renewables but it will be important to establish how these benefits can or will be made available by the vehicle users.

Based on current industry experience, the Energy Transition Outlook forecast assumes that batteries will provide all new storage capacity, such as the example set by the Hornsdale Power Reserve lithium-ion battery installation in Australia, which was installed in 2017 to address concerns about stability of the South Australian electricity system amid increasing penetration of wind and solar.

Compared to the 50 TWh of installed battery capacity to cope with variable renewables, the Energy Transition Outlook forecasts that global EV battery capacity will be around twice that come mid-century.

The additional battery capacity which will be needed to deal with variable renewables is very sensitive to how much of the capacity from EV batteries can or will be made

available.

System operators are increasingly being faced with the decision of whether to invest in storage technologies or grid infrastructure.

In the decades ahead, Distribution System Operators (DSOs) in many countries will need to invest heavily in medium voltage (MV) grids and associated medium voltage/low voltage (MV/LV) distribution substations to cope with the increased share of dispersed and distributed renewable generation. However, issues including demand response, distributed energy storage, and greater availability of operational data may delay or prevent grid investments altogether.

Compared with grid investments, battery-storage options have the advantage that they can in principle be moved. Batteries can be, and have been, installed in substations to avoid actual or forecast overloads of transformers; for example, to delay the need for reinforcement. This is particularly attractive for city-centre locations where land costs are high, space is restricted, and permitting processes may be prone to substantial delays. When the reinforcement is eventually implemented, the battery can then be removed relatively easily and used in another location.

One UK DSO has pointed out that a significant benefit of this approach is that the need for an expensive reinforcement can then be clearly demonstrated to a sceptical regulator by using recorded demand data. A further advantage of battery storage in comparison to grid investments is that it can often be installed much faster.

There is a fundamental issue with DSOs owning storage, however. The actions of network operators can influence electricity markets, including ancillary services markets. Therefore, they are usually not allowed to own or operate electricity generators and suppliers who may trade in those markets. Storage can be seen as 'infrastructure', just like network reinforcement; but it can also be operated as a generator or electricity supplier, trading energy, and services. One emerging solution for this issue appears to be that DSOs can obtain all the services that storage devices can provide, through competitive market mechanisms, but cannot own the storage devices directly. This approach is being adopted within the EU.

While energy storage may be suggested as the obvious solution to the challenge of variable renewables, it is important to realise, however, that there are several competing options. Until recently, pumped-hydro storage was by far the dominant source of energy storage on electricity systems. Other technologies such as batteries, flywheels and compressed-air storage in caverns were insignificant in comparison. However, developments in new battery chemistries and other technologies such as liquid air energy storage have changed this picture.

Another option is flexible demand through demand-side response (DSR), which is already provided by

industrial or commercial consumers with loads they can avoid or defer for a short time, such as air-conditioning, or refrigeration in distribution centres. Digitalisation and the Internet of Things are lowering the costs of providing DSR from a wide range of loads. EV charging is a major new source of DSR and there is substantial competition in some countries to establish new business models and gain a customer base of residential EV owners.

Lastly, the 'flexibility option' is often overlooked but is important. There are many examples of cases where traditional market rules or regulatory requirements have unintended consequences which have been barriers to flexible operation of power systems. An example arose in Germany, where each of the four Transmission System Operators (TSOs) was required to balance generation and demand across its own service area. This produced higher costs than if the net imbalance across all Germany had been the only target: the impact was small until wind capacity in the north of Germany became significant.

We are now seeing significant growth in batteries being used in conjunction with solar PV to smooth the mid-day peak in solar production into the evenings. The greatest challenge to flexibility providers is seasonal variability in demand, and in wind and solar production. Storing surplus solar production in summer for use in winter is unfeasible by battery. In addition to hydro reservoirs, credible options presently include power-to-gas or liquid fuels and long-term heat storage for use as heat, such as in district heating systems. Both options can be regarded as examples of 'sector coupling', connecting electricity markets to gas, fuel, and heat markets.

It is clear that storage has a significant role to play when it comes to supporting the rise of renewable energy and ultimately lowering our dependence on fossil fuels. Despite the substantial progress being made, the transition we forecast will not be fast enough to meet the goal of the Paris Agreement to hold the global temperature to substantially less than 2°C above pre-industrial levels. Extraordinary effort and behavioural change is required, along with a mix of solutions, including more energy efficiency, higher penetration of renewables, and more carbon capture and storage.

To encourage the higher uptake of cleaner technology, regulators and politicians will need to re-think electricity market mechanisms. Regulators will need to make decisions about the optimum allocation of the risks and associated costs of stranded assets. And market-based price signals will be crucial to incentivise innovation and encourage investment in renewables, grids and energy storage.

Paul Gardner Global Segment is Leader of Energy Storage at DNV GL.

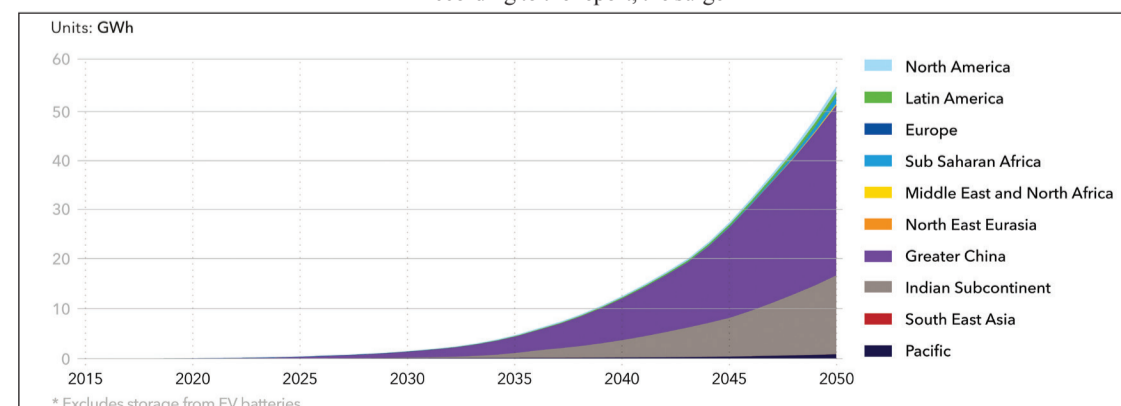
Decades of rapid and extensive change lie ahead for the world's energy systems. Rapid electrification of energy demand and the rise of energy from wind and solar sources will lead to massive growth of the world's electricity transmission and distribution systems.

This is one of the main conclusions of DNV GL's 'Energy Transition Outlook 2018', a forecast of what lies ahead for the global energy landscape up to 2050, and the important industry implications that our changing energy future has in store.

The Energy Transition Outlook forecasts continuing rapid electrification, with electricity's share of global energy demand expected to more than double to 45 per cent in 2050. This will be driven by substantial electrification in the transport, buildings, and manufacturing sectors.

According to the report, the surge in

Battery storage required for power sector, excluding flexibility contribution from EVs





## Technology

Utilities of the future will sell less energy. It's a scary thought, but some are already embracing change with the help of IoT platforms and a whole new approach to their business.

**Siân Crampsie**

# Platform for change

Photo courtesy of Greencom

The Stegerwaldsiedlung was built as the first large post-war settlement of Cologne, Germany, but has its sights set firmly on the future.

Built in 1953, the suburb is playing host to an advanced energy Internet of Things (IoT) demonstration, with 700 apartments participating in an initiative aimed at helping Cologne to reduce emissions and increase the role of consumers in energy supply.

Under the initiative, the apartments have been refurbished and equipped with a multitude of decentralised energy assets that allow householders to produce their own energy. Crucially, however, the devices and their energy flows are managed by the local utility, Rheinenergie.

The project has enabled Rheinenergie to cut its customer's emissions by 60 per cent by optimising energy flows. The utility has also been able to improve grid stability by utilising the flexibility of the energy devices, which include solar photovoltaic (PV) panels, heat pumps, battery storage capacity, heat blade capacity and district heating. It has achieved this because the decentralised assets are connected by an IoT platform supplied by GreenCom Energy.

According to GreenCom, the project has also increased the energy independence of Rheinenergie's customers with 70 per cent of energy supplies originating from local sources. Although this means that the utility is selling less energy, customer satisfaction and retention has

improved because the consumers are more involved in the energy value chain. Rheinenergie, while selling fewer kilowatt-hours, is selling more services.

The initiative is a close approximation of what the utility industry will look like in the future, and how energy utilities need to adjust their business models, GreenCom notes. The Germany-based company, which grew out of expertise in energy, telecoms, IT and electric mobility, says that Rheinenergie is one of a small handful of utilities that have taken a bold first step.

"[The Rheinenergie project] shows that the utility wants to seize what is happening in the marketplace and understand their business case and future role in a world where consumers don't want to consume as much energy from the grid," says Peter Müller-Brühl, GreenCom COO. "It understands that in the future it will need to become an operator and manager of decentralised energy devices installed behind the meter." Consumers will require less energy from the grid, Müller-Brühl adds, but will demand more complex services from utilities.

GreenCom's IoT platform is known as the Energy Information Brokerage Platform (EIBP). It allows equipment, such as PV panels, electric vehicles (EVs) and heat pumps, that usually work autonomously, to be linked up digitally and controlled remotely. The technology allows utilities to optimise energy flows to improve energy efficiency and maximise the flexibility and storage capacity offered by devices such as EVs and batteries.

The devices in the home are connected to EIBP using a gateway device – similar to a cable TV set-top box – that can be easily plugged in and once activated, will auto-discover relevant energy devices connected to the home area network. This means that the gateway devices are cheap to install, and that the EIBP is very scalable. Once installed, utilities can not only gain control of the connected devices, but also put the vast amounts of data coming from homes to good use.

"The platform is capable of managing gateway devices in homes behind the firewall and has all the bells and whistles to collect the data those devices produce and pull it into our central platform," says Müller-Brühl. "Utilities can then apply products and services based on that data using our applications."

Such services could include device upselling, maintenance and repair of devices, or flexibility trading, for example. However, the application of the technology is so new to the energy sector that nobody knows yet what services will be in demand, GreenCom says.

"Products will be the result of the combination and recombination of data streams and smart meters plus behind the meter assets and external data flows," says Müller-Brühl. "That data needs to be combined on the fly to look for new services, and utilities need to try out different ideas to see what people really want."

To this end, GreenCom has built internally a test bed of 50 connected houses so that utilities can see what a future 'energy community' might look like. The firm invites utilities to use this so-called open innovation lab to develop and test new products and services using real data and systems. It can help them to visualise how the industry might change in the future and what business cases might work, notes Müller-Brühl.

GreenCom believes that the energy community built on its open innovation lab is probably the first time that various types of equipment such as PV panels battery storage devices, heat pumps and EVs have been fully integrated; it is intended to be a "living blueprint" for how energy might be produced, used and traded in the future, the company says.

GreenCom currently has around five utility clients working with its EIBP suite of products. These companies understand the need to change and that there is an advantage in being innovative, GreenCom says. "These utilities are early movers that have understood that they need to sell less energy and more services and they are willing to get their feet wet," says Müller-Brühl.

Feedback from these clients has been clear, adds Müller-Brühl: they do not believe that they could have achieved the changes they have implemented without GreenCom's understanding of the disruption in the marketplace and the impact that will have on the utility sector. In particular, utilities don't realise the importance of data.

"Utilities have been professionalising forgetting data for a long time," says Müller-Brühl. "They think in 15-minute intervals because in the past receiving and storing large amounts of data was expensive. Their philosophy is to forget as much data as possible and if that is what you have been doing for the last 100 years it is hard to look at the world differently. We are like Google – catch all the data and see what you can do with it later."

"That is what those utilities like us for because they don't have that capability within. Normally they define a project, scope it for two years and then go live; we are getting them to get projects off the ground in three months."

GreenCom looked closely at the open source frameworks of telecoms firms and social media platforms

when creating EIBP because those platforms handle very large amounts of streamed heterogenous data. "We looked at their tech framework and spent time 'utilifying' them, i.e., adding relevant functionality," says Müller-Brühl. Social media platforms also scale very well, he adds.

GreenCom's message is that ultimately, utility firms need to change. It believes that the industry is currently where the telecoms sector was 20 years ago, but is undergoing a faster and more disruptive change brought about by digitisation and the rise of renewable energy technologies.

"In the telecoms sector, companies used to charge customers per minute, now we all pay a flat rate and buy data," says Müller-Brühl. "Energy will cost zero in the future but customers will be willing to pay for services."

"If you make that move from selling energy to an end-point to selling services you have to become the manager of energy flows in behind-the-meter assets. You can charge a fee for that."

GreenCom believes that the pace of change in the sector is currently slow because utilities are reluctant to tell customers that they don't need to buy as much energy as they used to. "We need visionary CEOs with long term contracts willing to see revenues go down and then back up over a long period of time as that's what happens when you go through a disruptive digitisation of the industry," says Müller-Brühl.

Müller-Brühl adds that the pressure is on for change, however, as more companies from outside the utility sector are starting to offer energy services as a way of making money around a core product. For example, heat pump manufacturers, in the face of competition from Chinese firms, have started selling heat and service contracts to housing companies. "They are *de facto* utilities as it's a regulated business, but they don't have to make money on selling energy – it's a service contract model and a means to continue selling heat pumps," notes Müller-Brühl.

Based on numbers from Bloomberg New Energy Finance, GreenCom estimates that there are around 100 million distributed energy devices worldwide that are not connected, 40 million of which are in Europe. In ten years these numbers will triple, it says. "That market player that connects 20 per cent of those devices already has a business case based on the flexibility of those devices," says Müller-Brühl. "We can connect those devices but it needs to be financed. We need someone who can see the long term business case."

"Whoever does that first will become a very relevant player."

**Müller-Brühl: We are like Google – catch all the data and see what you can do with it later.**

Photo courtesy of Greencom







Junior Isles

# Running out of gas?

The latest Intergovernmental Panel on Climate Change (IPCC) report makes dire reading – especially for any company involved in the production of power from fossil fuels.

Climate change concern has already triggered the demise of coal fired generation in most developing countries and the rise of wind and solar. One wonders if the heightened urgency of the climate situation will see gas become the new coal before too long.

Not so long ago, with shale gas recovery hitting the headlines and the potential replacement of coal fired generation with gas, there was talk from the International Energy Agency (IEA) of a potential golden age for gas.

More recently, DNV GL's 'Energy Transition Outlook 2018' report predicted that natural gas will become the single largest source of energy in 2026 and will meet 25 per cent of the world's energy needs by 2050.

It also forecasts substantial reductions in electricity production from 'conventional' thermal generating technologies, including nuclear, with most also showing declines in total

capacity, except for gas.

Further, as renewables continue to gain favour, many industry experts argue that that gas fired generation is the best technology to complement intermittent renewables.

Yet things are not quite panning out as gas turbine proponents had expected. If anything, the gas turbine market appears to be running out of gas. Market reports show that global sales of gas turbines continues to fall – from a total generation capacity of 71.6 GW in 2011, according to McCoy Power Reports, to 34.4 GW last year. And this year it is expected to be smaller again at about 30 GW.

But the future for the gas turbine industry is not all doom and gloom. In his opening remarks at the recent International Gas Turbine Conference (IGTC) organised by the European Turbine Network (ETN), Bernard Quoix, Head of Rotating Machinery at Total E&P and President of ETN Global, acknowledged that these were difficult times but remained upbeat.

He asked whether the current situation is "just a short term dip" and if perhaps the "golden age for gas is still to come". It appears that much of the

problem in the sector is with large gas turbines for power generation. Quoix showed that cumulative megawatts for gas turbines in the oil and gas sector has, for the most part, continued to rise steadily over the last ten years.

This was essentially echoed by Karim Amin, Siemens' CEO of Power and Gas Sales & Customer Operations. Speaking during a recent press visit to the company's Beni Suef megaproject in Egypt in late October, he said: "The industry is going through a difficult time right now because of a major shift that is bringing disruption to technologies and business models."

He said the global sales of gas turbines in terms of megawatts was around 38 GW last year and would close 2018 at around 8-10 per cent down on that figure. "At the start of the year, we were expecting that the market for large gas turbines [above 100 MW] would be around 130-140 units. I think we will see the year closing at a notch above 100... we believe next year will be in the same range, somewhere in the region of 90 large gas turbines."

Amin noted that the market for small and medium sized gas turbines was continuing to grow at around 8-9 per cent per cent per year. "When you look at decentralised [small gas turbines], that is growing. But it is not growing as fast as we expected because the main part of the market is covered by solar photovoltaics."

It is this unexpected growth in solar PV plus battery storage that is turning out to be the spanner in the works for gas turbine original equipment manufacturers (OEMs). If these OEMs are to survive and prosper going forward, they will have to become more creative.

Challenges bring opportunities; and there are still some positives – the anticipated electrification of sectors such as heat and in particular transport will accelerate electricity demand.

Amin believes that there is still a market for the foreseeable future and says Siemens will therefore continue to invest in large gas turbines and gas turbine technology – in spite of the current and potentially increasingly difficult market conditions.

"There is a market for 10-15 years and you have a race for efficiency. If you don't invest in improving efficiency, then you are out of the market," he said. "It's a question of whether you want to invest to stay in the market for the next 10-15 years and maintain technology leadership or not... The maths has told us we should invest. If you look at the gas-to-power market, every project is north of 1.5 GW. With 1 MW worth about \$500, each one of these projects on an EPC is worth \$750 million. For 25 GW, even if you don't get them all, it's still worth it."

Interestingly he said Siemens was also betting on hydrogen for the future. "Storage is not only batteries. Part of it is e-mobility – all these electric cars can provide storage, part of it is hydrogen." In February, Siemens signed a Memorandum of Understanding to kick-off a pilot project for a solar-powered hydrogen electrolysis facility to produce and store hydrogen, and then deploy it for either re-electrification, transportation or other industrial uses.

This seems to be a growing trend. In October grid operators TenneT, Gasunie Deutschland and Thyssen-gas put forward detailed plans to build a power-to-gas pilot plant in Lower Saxony. At a capacity of 100 MW, it will be the largest of its kind in Germany.

'Power-to-x', or power to synthetic fuels (including hydrogen), was a key talking point at the IGTC conference. Presenting the 'Energy Transition Outlook', Liv Hovem, CEO, DNV GL – Oil & Gas said that in 2050 hydrogen would only meet 0.5 per cent of the global energy demand due to infrastructure limitations. She did note, however that, it would vary greatly by region with uptake being much higher in Europe.

Haitze Siemers, Head of Unit, New Energy Technologies, Innovation and Clean Coal, DG Energy, European Commission also believed that hydrogen would not play a big role any time soon but was important nevertheless.

"We know there is significant interest in hydrogen, it is more a question of how we can bring the costs down... one of the things that one could look at in terms of innovation is how we can add hydrogen to the gas mix and having turbines that can use these types of gases."

Dr. Nils A. Røkke, EVP Sustainability SINTEF and Chair of the European Energy Research Alliance (EERA) also said that hydrogen could play a much bigger role in the future.

Looking at the possibilities for gas turbines in the future, he said: "We need the energy, power and the flexibility that gas turbine cycles can provide in a decarbonised world but we don't need the emissions."

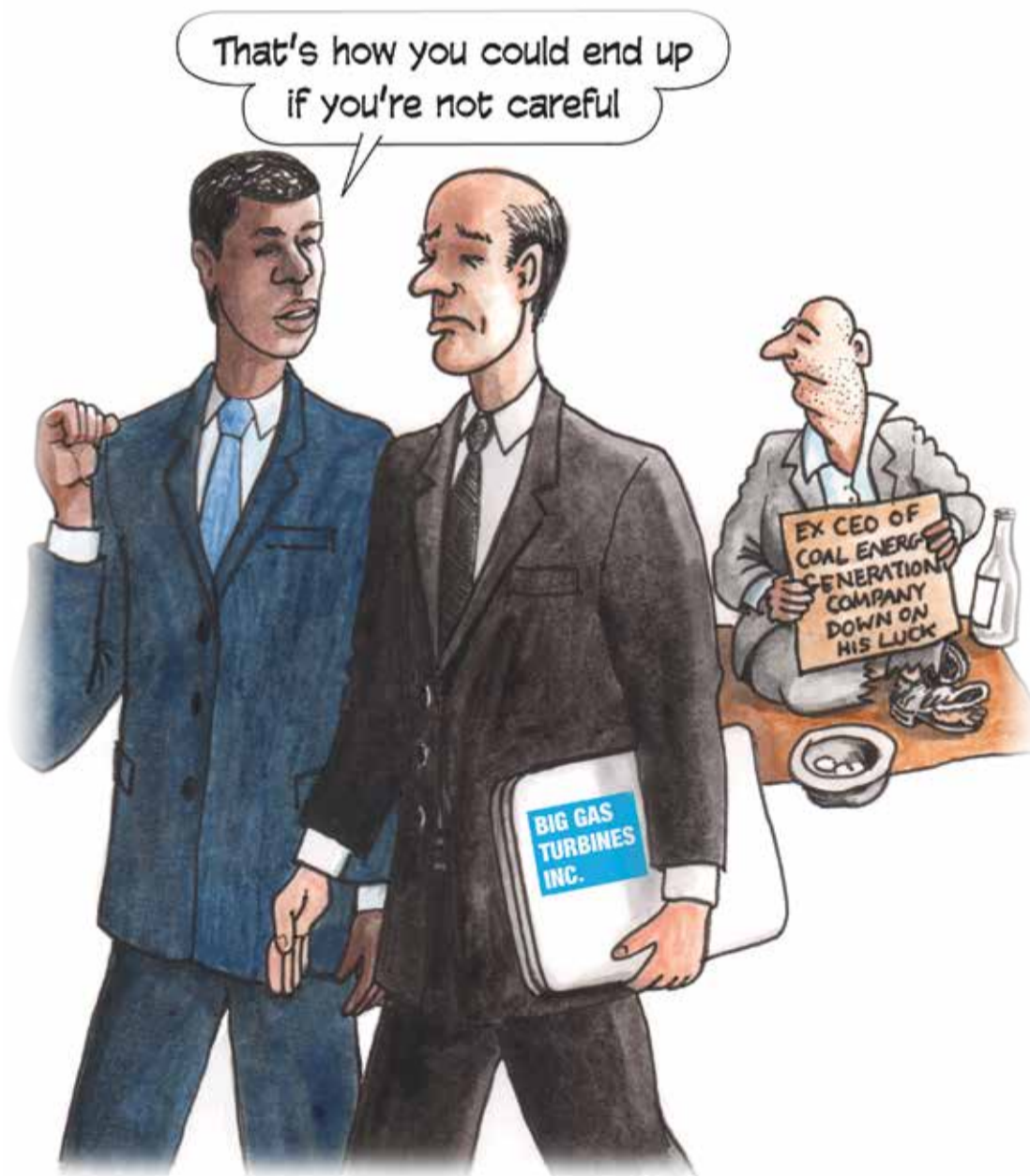
He believes that, currently, the most economic route for utilising hydrogen is to produce it from natural gas or fossil fuel sources, especially when looking at the industrial sector. He cited projects such as Nuon's Magnum power plant in the Netherlands and the H<sub>2</sub>1 Leeds Citygas project in the UK as examples of the way forward for the role of natural gas in a decarbonised world.

But with projects like Magnum being few and far between and the cost of wind and solar continuing to fall, the hydrogen end-game for the power sector could well be via electrolysis. Although expensive at the moment and representing just four per cent of hydrogen production globally, even Dr Røkke agreed that producing hydrogen from electrolysis becomes interesting when renewables are at zero marginal cost.

It certainly seems to be the way the European Commission is thinking. Siemens noted: "I tend to be rather optimistic with regard to hydrogen because we have constantly failed to predict the positive developments in renewables such as wind and solar PV. Considering they produce electricity at zero marginal cost, at some point this is going to make hydrogen production really interesting. Then we are looking at a completely different ball game."

All things considered, Richard Dennis, Technology Manager for Advanced Turbines & CO<sub>2</sub> Power Cycles at the US Department of Energy's National Energy Technology Laboratory, said it could be much longer than three or four decades before our dependence on natural gas perhaps starts to trail off. With regard to the gas turbine market, he said the business is cyclical and sees "plenty of legroom" for their continued use.

Nevertheless, although there is some consensus that gas turbines will be around for a while, whether running on natural gas, hydrogen or some other fuel, the time for change is now. Continuing with a business as usual attitude would be a mistake. The industry would do well to learn from what is happening to coal.



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