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Macron unites world leaders behind Paris

Macron: Calls to "make the world great again"

Pledges of financing to tackle the worst effects of climate change, made at the One Planet Summit, underline the world's commitment to the accord struck in Paris. **Junior Isles**

World leaders, businesses and sustainability supporters marked the second anniversary of the Paris climate agreement by making a series of financial commitments to help tackle climate change.

At the One Planet Summit in December, French President Emmanuel Macron called on the international community to "make the world great again" by getting world leaders together to ensure plans to tackle climate change remain on track.

Mohamed Adow, Christian Aid's International Climate Lead, said the summit "sent a clear message" to the world that countries, states, cities, businesses and civil society are firmly committed to their Paris commitments and are coming good on their promises, with or without the US.

"Where there is political will, money flows and this summit has started to see that crucial green finance uncorked. The global demand for clean technology is a great investment opportunity for private investors but also for development banks and leaders that want to see their countries prosper."

During the summit, Miguel Arias Cañete, European Commissioner for Climate Action and Energy unveiled a series of "climate-smart" investments for Africa and the EU Neighbourhood countries worth €9 billion.

They are part of the EU External Investment Plan, which was adopted in September to boost climate investment in partner countries in Africa and the European Neighbourhood. These are countries located east and south of the EU, including Algeria, Morocco, Egypt, Tunisia, Azerbaijan, and Ukraine.

Three areas are being targeted for investment. The first area is sustainable cities, referring to projects such as waste management, water, sanitation and sustainable urban planning. The second is sustainable energy and connectivity to support new low-carbon energy projects, climate-resilient energy infrastructure and reduce energy poverty. The third is sustainable agriculture and climate-resilient agri-business.

UK Prime Minister Theresa May also announced new climate change policies to help vulnerable nations affected by climate change. The Prime Minister said £30 million will be allocated to the Department for International Development's Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED). Additionally, £87 million will be provided to the Forest Governance, Markets and Climate (FGMC) Programme of the Department for International Development.

May said it was Britain's duty to aid countries that are disproportionally affected by deforestation and vulnerable to natural disasters and extreme weather events associated with climate change.

"There is a clear moral imperative for developed economies like the UK to help those around the world who

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Electricity sector commits to accelerate clean energy transition

Eurelectric, the association representing the European electricity industry, has set out a new long-term vision for the electricity industry in Europe. National associations and Chief Executives from all major power companies in Europe have agreed a Vision Declaration that commits the sector to accelerate the clean energy transition, taking a leading role in Europe's decarbonisation efforts towards the Paris Agreement.

Francesco Starace, Eurelectric President and CEO of the Italian energy group Enel said the industry sees a great opportunity on the path towards a progressively decarbonised and fully sustainable European energy future and that electricity is playing a growing role in making this vision happen.

"We are determined to accelerate the energy transition through a progressive electrification of Europe's energy consumption while making the European power sector carbon-neutral well before mid-century," he said.

With the new vision the sector strengthens its commitment to invest in clean power generation and other transition-enabling solutions and, importantly, to help accelerate CO_2 emission reductions in other sectors through increasingly efficient use of clean electricity.

"Electrification of heating, transport and industry is a win-win. It comes with higher efficiency and lower CO_2 emissions. We should do everything possible to advance electrification with smart regulation," said Magnus Hall, CEO of Vattenfall and Vice-President of Eurelectric.

The rise of digital solutions and decentralised generation technologies have been centre stage in the discussions over the new vision. They are widely believed to have profound impacts on the organisation of the sector and on the relations between companies and customers.

Alistair Philips-Davies, CEO of SSE and Vice-President of Eurelectric noted: "The investment required in clean electricity and transition-enabling technologies is huge. This statement reflects our full commitment to invest in innovation, to build new cross-sector business models, and ensure that electricity keeps creating value in decades to come."

The announcement follows a comprehensive consultation process, which engaged company CEOs and industry representatives from across Europe. The final declaration received unanimous support at its adoption. Eurelectric said it demonstrates the "unwavering commitment" from the power sector to play a key role in the transition to a sustainable, smart and energy efficient society.

The organisation called on policy-makers to do their utmost to ensure a fair and responsible transition, both socially and geographically, and provide the necessary support and funding to address any socio-economic impacts.

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stand to lose most from the consequences of man-made climate change," she said.

The UK Prime Minister also renewed the country's commitment to lead the phase-out of coal in alliance with Canada.

She described coal as "one of the dirtiest and most destructive ways of generating power" and underlined the "enormous commercial opportunity which the shift to cleaner forms of energy represents".

On the eve of the summit, Christian Aid said new finance for poorer countries was essential if the Paris accord was to succeed. "It's great that President Macron is getting the world together to celebrate the two-year anniversary of the Paris Agreement but its success won't lie in how well countries celebrate the day it was struck," noted Adow.

He said the "missing piece of the jigsaw" is the funding to help the world's poorer countries access clean energy so they do not "follow the fossil fuel powered path of the rich world".

"This is the missing piece that the One Planet Summit needs to begin to put into place. Without adequate finance there is no way developing countries can deal with climate change or decarbonise fast enough to deliver the Paris goals.

"What would help this would be for organisations like the World Bank to stop their fossil fuel investments, which is only making the problem worse and use their huge financial resources to kick-start much needed clean, renewable powered, development in poor countries."

May: clean energy represents an "enormous opportunity"

On the sidelines of the summit, Environmental campaign groups accused many of the world's largest banks of actively undermining the Paris agreement on climate change by pouring billions of dollars into coal plant developers.

"The bottom-line is that we need an immediate halt to all coal infrastructure investment," said Jason Disterhoft, senior campaigner at Rainforest Action Network, a Californian environmental organisation. Research groups recently revealed that between January 2014 and September 2017 international banks channelled $630 billion to the top 120 companies planning to build new coal plants around the world.

There is evidence, however, that banks are increasingly shifting policy. In December the World Bank Group said that it will stop investing in upstream oil and gas, and will provide analysis to support efforts towards a transition away from coal. The National Australia Bank (NAB) also said it would stop financing new thermal coal power plants. It will be the first major Australian bank to do so, sending a strong signal to the Australian financial sector about the future of coal in the country.

In November, Commonwealth Bank told its shareholders to expect a decline of financial support for the coal industry, indicating that the bank is unlikely to act as a lender for future large coal projects.

Northern Powergrid plans new energy market

UK distribution network operators are setting out plans to transform their businesses in order to take advantage of the opportunities presented by the energy transition. **Junior Isles**

UK distribution network operator (DNO) Northern Powergrid is planning to put its eight million customers at the heart of the smart grid, creating a new energy market where they can make money from solar panels, electric vehicles and home batteries.

The DNO will draw up recommendations as part of a unique, three-year project – the Customer-Led Distribution System – to identify the best use of technologies in a future smart energy system and the business models and policies necessary to support them.

The company, which distributes electricity to 3.9 million homes in the North East, Yorkshire and northern Lincolnshire, made the announcement as it set out its plans to evolve into a distribution system operator (DSO), actively managing the network and ensuring that customers gain maximum benefits from low-carbon technologies that are transforming the energy network.

Jim Cardwell, Head of Regulation & Strategy, Northern Powergrid, said: "We are changing the way we interact with the customer in the future. We are moving from a relationship where the customer has received two main services from us – initial connection to the grid locally and continuing use of the grid, for which we would charge as part of their electricity bill in order to maintain and upgrade the system.

"The customer is generally either a generator providing electricity, or a demand customer – typically houses and businesses – taking power. Moving forward we are seeing a situation where customers don't fit so neatly into those two categories."

Northern Powergrid believes the changing market presents major opportunities. The £1.9 million Customer-Led Distribution System project is the first to take a holistic view of how to maximise the benefits of a future smart energy system, identifying how to accommodate large volumes of new technologies, such as local generation and electric vehicles, at least cost while at the same time enabling customers to earn income by selling energy or services to balance the network.

Researchers at the University of Bath and Newcastle University will develop models and laboratory demonstrations of distributed energy systems, local energy markets and network operations, tracking flows of energy, payments and information. This virtual system will enable them to explore different approaches, using data from real networks, and will also allow them to develop strategies that may be used to coordinate network and market operations.

Customers and stakeholders will be kept closely involved in the work during the project. A new expert advisory group with a wide range of perspectives will oversee this work and help refine it into practical reports to help the industry adapt to new roles and inform government policy. Early thinking on industry and market structures will be shared in the first quarter of 2018 with regular updates throughout the project.

Northern Powergrid is already taking steps to gain hands-on experience of new technologies. It is exploring how to use home batteries to relieve pressure on the network caused by solar panels, in a trial in 40 homes near Barnsley with smart battery company Moixa.

It is expected to halve residents' energy bills, enable more solar power to be installed without upgrading the local network, and save millions in the cost of running the UK's electricity system. It is also launching a consultation on plans to manage power losses, which cost its customers around £100 million a year.

Northern Powergrid's project marks the start of a growing trend that is seeing network operators adapting their businesses to the changing market. Following the Northern Powergrid news, electricity network companies operating across England, Scotland and Wales announced a joint commitment to "create new markets to enable flexibility services that will compete alongside traditional investment".

The move will help reduce the cost of running the network to customers and provide new opportunities for businesses and communities to offer flexibility services to local network operators. The plan is published in the "Opening Markets for Network Flexibility" report for the Open Networks Project.

The pan-industry Open Networks Project is a key initiative for addressing the changes that need to be made to energy networks to create a more flexible energy system, as recently set out in Ofgem and the Department for Business, Energy & Industrial Strategy's Smart Systems and Flexibility Plan.

Research conducted by Imperial College London and The Carbon Trust for the Smart Systems and Flexibility Plan shows that the UK could deliver £17-40 billion of benefits across the energy system by 2050.

Australia eyes huge renewables export project

Western Australia is looking to take advantage of its significant solar and wind resources through a plan to export renewable energy to Indonesia. Under a proposed project called the Asian Renewable Energy Hub (AREH) an international consortium of energy companies plans to develop a 6 GW solar and wind hybrid project in Western Australia and export clean energy to Indonesia through subsea cables.

Backers of the idea, first floated in 2014, are now seeking financial investors. The first phase of development is expected to cost $10 billion.

The hybrid power project would comprise approximately 1200 wind turbines supplying 4 GW and 10 million solar panels with a generating capacity of 2 GW, spread over 14 000 km^2 of flat desert land in the East Pilbara region on the northwest coast of Australia.

The location, which was decided on after two years of investigation, is considered ideal due to its particular geography and topography. The site allows optimal performance for both wind and solar technology, which perfectly complement one another throughout the day.

Turbines for the project would be supplied by Vestas. Other project partners include renewables developers CWP Energy Asia and InterContinental Energy, plus Italian cable manufacturer Prysmian and Singapore-based offshore contractor Swire Pacific Offshore.

In addition to the financial benefits the project would bring to Western Australia, it would also play an important role in Indonesia's economic development, as the wind and solar generating equipment would be manufactured in Indonesia.

Construction of the project could start as early as 2023 and be completed by 2029.

There is currently a greater focus on solar and onshore wind projects in Australia, as they are currently cheaper than offshore wind but the country is beginning to identify potential projects as costs fall.

Early last month Australia's first offshore wind farm, an $8 billion, 2 GW project, secured financial backing from a major international green energy investment fund.

The offshore wind farm, dubbed the Star of the South, will be built 10 to 25 km off the coast of Gippsland region, in the Bass Strait, and could provide one and a half times the energy of the now closed Hazelwood coal fired power station in Victoria.

GE hit by difficult fossil fuel power market

GE is to cut 18 per cent of its power division's global workforce in response to a sharp fall in demand for fossil fuel power equipment.

The company plans to cut 12 000 jobs, nearly half of which will be in Europe. Trimming the workforce will help GE achieve its goal of eliminating $1 billion of structural costs in 2018 in the power unit. This is part of a larger effort to cut $3.5 billion of expenses across the company through 2017 and 2018.

The move adds to a flurry of cost cuts by Chief Executive Officer John Flannery, has already scaled back the use of corporate jets and delayed work on a new Boston headquarters since taking over in August. GE said in November it would reduce the quarterly dividend and sell some businesses. It is also reassessing spending in areas such as research and development.

"This decision was painful but necessary for GE Power to respond to the disruption in the power market, which is driving significantly lower volumes in products and services," said Russell Stokes, President and CEO, GE Power. "Power will remain a work in progress in 2018. We expect market challenges to continue, but this plan will position us for 2019 and beyond."

Many of the job cuts in Europe are former Alstom employees who joined GE when GE Power acquired the French energy giant in 2015 in a $10 billion deal. Positions in France, however, will not be affected due to stipulations in the deal.

GE Power expanded considerably with the Alstom acquisition, but the deal has weighed heavily on GE. Intended to broaden the product line-up with steam-turbine technology, the tie-up pushed GE Power's workforce to 65 000 at a time when the market was slowing.

"Alstom has clearly performed below our expectations," Flannery said in November, referring to the assets acquired from the French company.

GE Power saw profits in the power division plunge to $611 million in the third quarter of 2017, down 51 per cent from the same period of 2016.

The world's largest maker of gas turbines says it needs to become leaner as customers turn away from fossil fuel-based energy sources to renewables.

■ At the start of December, GE Power announced that its largest and most efficient gas turbine, the HA, is now available at more than 64 per cent efficiency in combined cycle power plants. In addition to offering the highest plant efficiency, the HA is designed to be a flexible complement to intermittent renewable sources, capable of ramping up or down at 65 MW/minute while still meeting emissions requirements to help balance grid instability.

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Chile interconnects SIC and SING

The interconnection of Chile's two transmission grids marks the launch of the country's new National Electric System.

Siân Crampsie

Plans for a new National Electric System in Chile have reached a significant milestone with the commissioning of a 600 km link between the country's existing northern and southern electric grids.

The new link has been labelled "an unprecedented achievement" and marks a new era in the development of the country's energy system, according to Transmisora Electrica del Norte (TEN), the firm which built the link.

Linking Chile's existing northern SING (Norte Grande Interconnected System) and SIC (Central Interconnected System) paves the way for the creation of a more robust, efficient and competitive electricity market, TEN said in a statement. The 500 kV double circuit transmission line took almost four years to complete and cost $700 million.

"The interconnection project marks the beginning of a new era in energy distribution," said Axel Leveque, President of TEN, which is a joint venture between Engie and Red Electrica Internacional. "In addition to providing Chile with a single electricity system, this is a concrete contribution to the diversification of the energy grid, which will facilitate the entry of renewable projects."

The interconnection, which runs from Mejillones, in the Antofagasta Region, to the area of Cardones in Copiapó, in the Atacama Region, will allow for the first time energy transfers between the two grids. The transfer of solar energy from the north to Chile's southern regions will in particular help to reduce and stabilise energy prices in the country.

It will also help to reduce grid congestion issues, TEN said.

Construction of the project suffered delays due to difficulties installing infrastructure in some areas, according to the government. TEN employed 5000 workers and installed 1335 towers, it said.

The project also included the construction of two thermal substations in the communities of Mejillones and Copiapó; a transformation substation in Mejillones (Changos area) and a compensation substation in Diego de Almagro.

As the line is AC (alternating current), other projects will be able to connect along its length, including solar and wind generators located in the north of the country.

Lawmakers propose Puerto Rico recovery plan

US lawmakers say that adding more renewable energy capacity to Puerto Rico's grid would make the territory more resilient to hurricanes and extreme weather events.

Sen. Bernie Sanders (I-Vt) and Sen. Elizabeth Warren (D-Mass) have put forward plans for Puerto Rico to get substantial debt relief as well as funding for infrastructure, healthcare and education in a bid to help it recover from the devastation caused by Hurricanes Irma and Maria in September 2017.

The proposed legislation – dubbed a "Marshall Plan" for Puerto Rico – underscores the importance of solar and wind energy to grid resilience. It calls for renewables to provide up to 70 per cent of the island's energy needs in the next ten years, and also stresses the importance of energy efficiency.

"More than two months after Hurricane Maria, much of Puerto Rico and the Virgin Islands remain devastated," said Sanders in a statement. "More than half of Puerto Rico is still without power. In both territories, clean drinking water is difficult if not impossible to find in many areas and thousands of people are still living in temporary shelters."

Sanders' $146 billion bill is more generous than other plans that have been proposed, including a $94 billion request by Ricardo Rosselló, Puerto Rico's governor.

The Trump administration has requested $29 billion in emergency natural disaster funding to be shared between Puerto Rico, Florida, and Texas – but only a fraction is designated for Puerto Rico. That package is expected to pass.

In November Richard Branson called for a "Marshall Plan" for the British Virgin Islands and wider Caribbean nations, based around the creation of resilient critical infrastructure using renewable energy, smart grids and battery technologies.

"It is unconscionable that in the wealthiest nation in the world we have allowed our fellow citizens to suffer for so long. The full resources of the United States must be brought to bear on this crisis, for as long as is necessary," said Sanders, who visited Puerto Rico in October. "But we cannot simply rebuild Puerto Rico and the US Virgin Islands the way they were.

"We must go forward to create a strong, sustainable economy and energy system in both territories and address inequities in federal law that have allowed the territories to fall behind in almost every measurable social and economic criteria."

Sanders' added that Puerto Rico must avoid simply rebuilding "an antiquated, centralised and inefficient system dependent on imported fossil fuels". He has proposed $13 billion for rebuilding the electrical grids in Puerto Rico and the Virgin Islands, as well as $428 million in grants for homeowners and cities for solar panels and microturbines and more than $40 million for grants to improve home energy efficiency.

Argentina draws $3 billion renewables investment

■ Verano wins with VeCaSo-1 ■ Phase 2 aims for 600 MW

Argentina is expecting up to $3 billion to be invested in its renewable energy sector following its latest RenovAr auction.

The government has awarded projects totalling 1408 MW of capacity in the latest auction, and said that a second phase of the auction would award a further 600 MW.

The energy ministry said 665.8 MW would come from wind plants, 556.8 MW from solar, 117.2 MW from biomass and 48.1 MW from biogas in the first phase of the RenovAr auction, held in October 2017. It added that winning bids were predominantly from Argentine companies, including YPF Energia Electrica and Central Puerto.

US developer Verano Capital said that it had won 18 per cent of the solar capacity in the auction with its 100 MW VeCaSo-1 solar project.

The project won with a bid of $42.50/MWh, Verano confirmed.

The VeCaSo-1 project is set to be completed in 2019 and will run on a 20-year "take-or-pay" power purchase agreement. Within this PPA framework, the generator takes on the production risk, with its plant expected to deliver power on a must-run basis. Cammesa, Argentina's national utility company, must take all of the plant's output, or remit compensatory energy payments if it fails to do so.

Ramiro Marquesini, Country Manager of Verano Capital in Argentina, said that the auction was "very competitive" with over 99 participating bids and only 12 winning bids.

Argentina has set a target of eight per cent renewables in its electricity mix by the end of 2017 and 20 per cent by the end of 2025. Large power consumers with annual demand of 300 kW or more are required to individually comply with these targets.

The targets are likely to result in the addition of 10 GW of renewable energy capacity in Argentina.

The country has so far held two other renewable power auctions – RenovAr in October 2016 and RenovAr 1.5 in November 2016. Some 2.4 GW of new capacity was awarded through these two auctions.

Tri-Gen plant to prove large-scale hydrogen concept

Toyota Logistics Services in Long Beach, California, is to become the first Toyota business in the USA to be entirely powered by renewables after the firm announced plans to build the world's first megawatt-scale renewable power and hydrogen generation station.

The Japanese technology firm has announced plans to build a carbonate fuel cell-based power generation plant that uses bio-material sourced from agricultural waste to produce water, electricity and hydrogen.

Known as Tri-Gen, the facility will have a power output of approximately 2.35 MWe and produce 1.2 tonnes of hydrogen per day – enough to power the equivalent of around 2350 average-sized US homes and meet the daily driving needs of nearly 1500 vehicles.

The facility will supply Toyota Logistics Services' operations at the port of Long Beach.

The company said that Tri-Gen, which will come on-line in 2020, will be "a major step forward for sustainable mobility" and will serve as a proof-of-concept of 100 per cent renewable, local hydrogen production on a major scale.

Tri-Gen has been developed by FuelCell Energy with the support of the US Department of Energy and a number of California regional agencies, including the University of California at Irvine, where research helped develop the core technology.

South Australia makes headway with storage

South Australia says it is determined to become a global leader in the use of clean energy and storage.

Prompted by the news that Toyota will build the first megawatt-scale hydrogen fuel and renewable generation plant in California, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) recently announced its intention to make Australia a hydrogen fuel world leader.

CSIRO principal research scientist Michael Dolan told *Fairfax Media* that the Tri-Gen plant was a benchmark for the industry. "Once someone goes first it paves the way for others, and hopefully this is something Australia can learn from," Dolan said.

The organisation said it would be investing millions of dollars into research using renewable energy such as solar, instead of bio-waste, to generate hydrogen.

South Australia has also put hydrogen forward as a pillar of its new energy plan. South Australian Energy Minister Tom Koutsantonis said: "Hydrogen offers an opportunity to create a new industry in South Australia where we can export our sun and wind resources to the world."

South Australia is the country's most advanced state in terms of clean energy and such projects will help it optimise its use of wind and solar.

At the start of December, the state began operating the world's largest lithium-ion battery, delivering on a promise by Tesla's Elon Musk to build the storage solution within 100 days or provide it for free.

The battery-storage industry is becoming increasingly important in places like South Australia, which has less access to traditional fossil-fuel sources like coal and gas than the rest of the nation. Instead, the region gets 41 per cent of its electricity from renewable energy, one of the highest penetrations of wind and solar in the world.

Adelaide, South Australia. The region gets 41 per cent of its electricity from renewable energy

S. Korea invests in clean, decentralised generation

Seoul is investing in technologies that will boost generation from household solar, as it reduces reliance on nuclear power.

Syed Ali

South Korea is investing in technologies that will boost the contribution of clean renewable generation from its household sector.

The Seoul city government will inject 1.7 trillion won ($1.5 billion) until 2022 to ensure one out of three households in the city are equipped with solar panels, Seoul Mayor Park Won-soon announced in his "2022 Solarcity Plan".

"This Solarcity plan is a continuation of the city's efforts to reduce reliance on nuclear power plants," Park said. "The plan is to ensure that one million households in Seoul are equipped with solar panels by 2022, which will generate 1 GW of electricity altogether, equalling the capacity of one nuclear power plant."

The Seoul Metropolitan Government said it will install solar panels at 630 000 apartment verandas, 150 000 houses and at 220 000 buildings by 2022. It is looking into mandating the installation of solar panels at newly built public apartments of Seoul Housing and Communities Corporation, a city-run company.

After the installation, the city expects to reduce some 540 000 tons of greenhouse gas emissions annually and generate enough energy to power 310 000 households, 9 per cent of the total in Seoul.

In a separate announcement, South Korea's Ministry of Science, ICT and Future Planning (MSIP) and Korea Electric Power Corporation (Kepco) have developed a blockchain-based system for neighbourhood electricity trading and electric vehicle (EV) charging. The goal of the project is to provide relief to businesses or households that face heavy electricity bills.

The two organisations will test the blockchain system in two apartments in Seoul and nine buildings within Kepco's facilities. The system will allow households that produce power, from their own solar panels for example, to sell their electricity to nearby inhabitants.

Users will post their offer on the platform and be connected to a buyer that can accept it, the Ministry said. They will then gain energy points that can be refunded in cash or be used directly to pay the bills. It can also be used in power stations for electric cars.

MSIPs purpose is to set, manage, and evaluate science and technology policy, support scientific research and development (R&D), develop human resources, conduct R&D leading to the production and consumption of nuclear power, plan national information and information protection strategies, manage radio frequency bands, oversee the information and communications technology (ICT) industry, and operate Korea Post.

Kepco is the largest electric utility in South Korea, responsible for the generation, transmission and distribution of electricity and the development of electric power projects including nuclear power, wind power and coal fired plants. It is responsible for 93 per cent of the country's electricity generation.

Taiwan urged to examine offshore wind rules

Experts have urged the Bureau of Energy to establish clear and legitimate guidelines for its two-stage selection process for offshore wind farm projects, which is to begin next year.

Currently, developers of offshore wind farm projects are required to go through the bureau's selection process after they obtain approvals from the Environmental Protection Administration (EPA).

Under the government's goal to develop a local industry of offshore wind farm technology, the bureau would give first approvals to developers who have closer ties to local suppliers, and who have better techniques and financial backing, the bureau's Energy Technology Division head Chen Chung-hsien said. The bureau would then select projects based on their bidding prices. However, experts attending a recent meeting in Taipei questioned the selection process, saying it is diametrically opposed to its plan to localise foreign techniques of wind farm construction.

As the bureau is to start its first-stage selection process in the first or second quarter of 2018, it is almost impossible for developers to make promises about how they would localize techniques before that time.

Yuni Wang, chairperson of Wpd Taiwan Energy Co Ltd said developers should be allowed to make those promises until the bureau gives them final construction approvals.

Developers of projects that have passed the EPA's initial reviews can be said to have secured "commanding points," said Kao Ming-chih, associate professor at the Institute of Law for Science and Technology at National Tsing Hua University.

The Ministry of Economic Affairs is losing its edge in negotiating with the developers, because it did not expect the EPA would give them initial approvals in such a short time, Kao said.

The ministry should cancel its second selection that is based on bidding price, or it might violate the principle of "legitimate expectation" and infringe on the rights of earlier wind farm developers, he said.

Developers are likely to seek compensation from the nation if the ministry fails to give them construction approvals through convincing procedures, Kao said.

The ministry should clarify the "legal basis" of the selection process and establish a special committee for the process, said Lin Jui-chu, director of the Law and Technology Innovation Center at National Taiwan University of Science and Technology.

Although the government has signed many memorandums of understanding with foreign energy developers, they do not legally bind the signatories, Lin said, adding that the government should sign formal contracts with the developers.

The bureau says it plans to generate 5.5 GW of electricity from offshore wind farms by 2025. As of November, the EPA had given initial approvals to 19 projects, with an aggregate capacity amounting to 10.07 GW.

India moves to cut solar developers' risk

In an attempt to mitigate any risks that prospective solar project developers may face with the sale of generated electricity, India's Ministry of New & Renewable Energy has announced a crucial amendment to the auction guidelines for solar power projects.

Project developers will now have the option to sell electricity to states other than the host state, subject to the issuance of no-objection certificate by the host state. The move may have been prompted by the recent refusal of Andhra Pradesh power distribution companies to procure electricity from a 250 MW solar power project awarded to Solairedirect.

As of October 31st, 2017, India had an installed solar power capacity of 15.6 GW. However, 44 per cent of this capacity was operational in just three states – Andhra Pradesh, Telangana, and Rajasthan. This amendment also ensures that even if the installed capacity is concentrated in a few resource-rich states, other states that are not in a position to meet their renewable purchase obligation can access solar power.

Solar auctions are having their intended effect – prices for developers are tumbling across Asia. But while this is good news for consumers, solar companies are being forced to reconsider the economics of projects already under way.

China-based Trina Solar, the world's biggest solar panel maker, has put on hold its make-in-India plan to set up a 1000 MW manufacturing unit in India because of low prices and absence of supportive policies. However, it said it would invest up to $500 million if it gets the right incentives.

"We have put on hold the plans to start production in India, because the prices are too low. This is not the right time to invest in solar as there are overcapacities in the (global) market," Gaurav Mathur, India sales head of Trina Solar.

The cost of electricity from rooftop PV has halved in the last five years due to fierce competition in the market and a drop in equipment prices. Trina Solar's CEO Jifan Gao recently said the price of solar panels could tumble 40 per cent by 2025.

Multi-use offshore assets add up to savings for consumers

A new study suggests that offshore grids connecting wind farms and serving as interconnectors make economic sense.

Siân Crampsie

Offshore grids could play a key role in integrating Europe's grid infrastructure as well as connecting offshore wind farms.

A new study commissioned by TenneT and the Crown Estate has examined the concept of 'WindConnectors' and indicates that such multi-use assets could reduce the cost of energy for consumers as well as make more efficient use of offshore grids.

The study was released in late November as the North Sea Wind Power Hub – a consortium of energy companies aiming to develop a series of offshore islands in the North Sea connecting wind farms and grids – announced that the Port of Rotterdam had joined as a partner.

A so-called WindConnector would combine cross-border connections with electrical infrastructure for offshore wind farms, according to Pöyry, which carried out the study for TenneT and the Crown Estate.

It believes that this multi-use approach could both significantly reduce the overall infrastructure required and also improve the utilisation of the assets when compared with a conventional interconnector and radially connected wind farms.

The study identifies potential capital savings of up to €1.8 billion and increased asset utilisation from 45-50 per cent up to 80 per cent. The modelling undertaken by Pöyry suggests the value of market-to-market flows enabled more than offsets the investment required to install the additional infrastructure required to link the markets.

However it found that current regulatory frameworks present restrictions on the multi-use of offshore transmission assets.

TenneT CEO Mel Kroon said: "The study clearly shows that combining infrastructure for offshore wind energy with an interconnector greatly increases the utilisation rate, and with that reduce the cost of energy for consumers. We can now also examine in concrete terms to what extent a WindConnector system could also be used for future developments of offshore wind energy between the Netherlands and Great Britain."

TenneT is one of the founding partners of the North Sea Wind Power Hub, which is planning to construct one or more artificial island hubs, known as Power Link Islands, at an area such as Dogger Bank in the central North Sea.

The Power Link Islands will connect offshore wind farms in the region as well as enable countries connected to them to trade electricity.

The consortium said that the Port of Rotterdam's recent experience in seaward land reclamation would be an important asset for the consortium.

■ Siemens-Gamesa has launched a new offshore wind turbine, the SG 8.0-167 DD. The new model is expected to be market-ready in 2020 after completing in-house testing, prototype operation, load simulations and grid compliance tests in 2018.

UK boosts nuclear funding

The UK is hoping to gain a competitive edge in the nascent market for small-scale nuclear reactors by supporting research and development in the technology.

Small modular reactors (SMRs) could prove to be a popular option if developed commercially as they provide a source of carbon-free baseload energy and are faster and less complex to build compared with large-scale conventional nuclear reactors.

The UK government has announced funding for the next three years to help support research and development into innovative advanced SMRs as well as assess their feasibility and accelerate the development of promising designs.

The government said it would also enable early access to regulators to build the capability and capacity needed to assess and licence small reactor designs and will establish an expert finance group to advise how small reactor projects could raise private investment in the UK.

The move is part of the UK's so-called Industrial Strategy, which aims to ensure that the country is at the forefront of new and advanced technology development, and is a boost for the UK's nuclear sector.

"New industry figures show that the UK's civil nuclear sector contributed £6.4 billion to the UK economy last year. Today's announcements recognise the importance of industry driving innovation, supported by government, so the sector continues to compete at the very highest level, not just in the UK but globally," said Business Secretary Greg Clark.

A further £86 million was announced by BEIS for fusion research to set up a national fusion technology platform at the Culham Centre for Fusion Energy in Oxfordshire.

The new investment will reinforce the UK's fusion research and development capability, and allow UK firms to compete for up to a further £1 billion of international contracts for fusion technologies, including for the International Thermonuclear Experimental Reactor (ITER).

The sector received more good news last month when NuGen, developer of the proposed Moorside nuclear power plant, confirmed that Toshiba had granted Kepco, South Korea's largest electric utility company, 'preferred bidder status' for the acquisition of NuGen.

NuGen CEO Tom Samson called the move "a significant milestone in the sale process" and said that teams from Kepco will now work with Toshiba and the UK government to consider the proposals and in parallel Kepco will seek approval from the government in Korea to enter the UK and acquire NuGen.

NuGen is planning to build three reactors with a combined capacity of 3.8 GW near Sellafield, with commissioning at the end of 2025. However, the future of the project was thrown into doubt after developer Toshiba's nuclear arm Westinghouse went bankrupt this year.

Toshiba's NuGen joint venture partner Engie subsequently pulled out of the project, leaving the Japanese firm searching for new investors.

Trade unions had called on the government to take a stake in the Moorside project to prevent it from failing in the wake of Toshiba's financial troubles.

Ireland warned on carbon record

Ireland's Climate Change Advisory Council has criticized the government on its lack of action on clean energy and has warned that the country will miss its 2020 targets "by a substantial margin".

The Climate Change Advisory Council believes more effort should be made to phase-out the use of coal and turf for heating and power generation and invest in a low-carbon car and public transport fleet to meet climate change targets. It says that the country is also likely to miss its 2050 target of decarbonising the economy unless changes are made to current policies.

"The council's assessment of progress to date on meeting our climate change commitments clearly shows that Ireland will miss its agreed emissions reduction target for 2020 by a substantial margin," it says.

"Without major new policies and measures, Ireland will also miss both its proposed 2030 EU target and its objective of reducing emissions of carbon dioxide by at least 80 per cent relative to 1990 levels by 2050 by a very large margin. Both the pace and scale of emissions reduction need to be accelerated across all sectors."

Actions outlined in the so-called National Mitigation Plan "do not put Ireland on a pathway to achieve our 2020 targets or our long term decarbonisation objective," council chair Professor John Fitzgerald said.

The Council proposed a number of policy changes to get Ireland on the correct pathway to decarbonisation, including a substantial increase in the carbon tax, and the elimination of subsidies for peat-fired electricity generation.

The Council said incentivising the take-up of electric vehicles over the coming decade will be vital in moving Ireland to a sustainable growth path and it recommended an assessment of the adequacy of the current electric vehicle charging network.

Spain at odds over coal closures

The Spanish government is opposing plans by Iberdrola to shut down coal-fired power plants, according to recent reports.

Iberdrola said in November that it would complete the process of phasing out all of its coal fired power stations around the world in order to meet its commitments to tackling climate change.

These include two plants in Spain – Lada and Velilla – but Spain's energy ministry has drafted a new decree putting new and restrictive conditions on closures of electricity production sites.

The government's restrictions would prevent closure of plants that are profitable or where closure would threaten security of supply.

Environmental group WWF Spain branded the intervention a "desperate move" to block the transition to a "100 per cent renewable and fossil-free future".

Iberdrola has pointed out that the two power plants account for just 0.87 per cent of the country's electricity generation capacity; that it also operates several idle gas power stations that could be fired up if needed; and that none of the 170 employees affected by their proposal will lose their jobs.

Russia ready for Egypt's nuclear build

Construction of Egypt's first nuclear power plant is imminent.

Siân Crampsie

Russia and Egypt have signed a deal paving the way for construction to start on Egypt's first nuclear power plant.

The Notice to Proceed contract was signed in December during a meeting in Cairo between Egyptian President Abdel-Fattah el-Sissi and Russian President Vladimir Putin.

Egypt is planning the construction of at least four 1200 MWe nuclear reactors at El Dabaa on the Mediterranean coast. Russia's Rosatom will build the first four, and plans to commission the first unit in 2026.

The cost of the four units will be in the region of $30 billion, with Russia lending Egypt $25 billion. Rosatom will also supply fuel for the reactors over their operational lifetime.

The Notice to Proceed is a sign of warming relations between the two countries. Russia and Egypt agreed three years ago to begin work on the El Dabaa site but progress was delayed after the 2015 bombing of a Russian airliner over Egypt, which killed 224 holidaymakers.

Rosatom will supply four VVER-1200/V-529 reactors, generating 1190 MWe gross for power generation only. The reactors will use seawater for cooling.

In November 2017, Egypt's parliament approved a draft law that aims to form an Executive Authority Board for the supervision of nuclear power plant build projects.

The draft law amends earlier regulations and gives the authority more power in signing contracts with private sector companies for the construction and financing of nuclear power projects. The authority will be affiliated to Egypt's Ministry of Electricity and Energy.

Egypt is also continuing with plans to expand its renewable energy capacity. Last month the Egyptian Electricity Transmission Company (EETC) issued a tender to establish solar energy plants west of the Nile, with a total capacity of 600 MW.

The projects will be developed in Minya and Aswan regions under a build, own, operate model, with project ownership transferred to the New and Renewable Energy Authority (NREA) after a period of 25 years. The tender documents state that interested bidders should have already completed three projects of at least 100 MW capacity each.

In late November Egyptian firm Elsewedy and Japan's Marubeni announced plans to build two 500 MW wind farms in Egypt.

The projects will also be developed on a build, own, operate basis. The companies are currently negotiating financing and have yet to choose between a site in the Gulf of Suez and another west of the Nile.

PV growth scales new heights

- Innovation and entrepreneurs drive growth
- PV enabling rural electrification

Low-priced equipment and innovative new applications are pushing the pace of solar photovoltaic (PV) market growth in emerging nations to new heights, according to a new report.

Bloomberg New Energy Finance (BNEF) says that a total of 34 GW of new solar power generating capacity came on line in 2016 in 71 emerging market countries, compared with 22 GW in 2015 and 3 GW in 2011. Total cumulative solar capacity grew 54 per cent year-on-year and has more than tripled in three years.

According to BNEF, which studied the trends as part of its Climatescope survey, China added 27 GW in 2016, by far the most of any country. Other nations seeing strong growth include Brazil, Chile, Jordan, Mexico, and Pakistan.

Nine other nations all managed to double their PV capacity in 2016, BNEF said. Overall, solar accounted for 19 per cent of all new generating capacity added in Climatescope countries last year, up from 10.6 per cent in 2015 and 2 per cent in 2011.

The strong growth in emerging nations is in part due to growth in innovative applications for PV technologies, including micro-grids, pay-as-you-go battery/lantern systems, water pumps, and even mobile phone towers. BNEF believes that such applications have been allowed to grow organically, unencumbered by governments and often led by entrepreneurs and venture capitalists.

Most often, start-ups have taken the lead, securing financing from private sources and forging partnerships with large corporations such as telecom providers, BNEF added.

More than 1.5 million households in Africa now use solar home systems that were bought on a mobile-money enabled financing plan, up from just 600 000 at the end of 2015, BNEF said. In Africa's solar financing market, this business model is no longer niche and has closed some of the largest deals this year. The combination of solar power, end-customer financing and smart technology is spreading beyond homes into farms and connectivity hubs. For instance, the number of solar irrigation pumps installed in India has reached 128 000 in May, up from just 12 000 in April 2014.

- The Asian Development Bank (ADB) has approved a $44.76 million grant to develop Afghanistan's first utility-scale grid-connected solar PV plant. The 20 MW facility will be located in Naghlu, Kabul, and will demonstrate the viability of future renewable energy investments through public-private partnerships in Afghanistan, ADB said.

Turkey marks Kirikkale start-up

The start-up of a new, 1 GW power plant in Turkey is a "clear sign of the growth and modernisation" taking place in the country, according to the facility's developer, ACWA Power.

The Saudi Arabia-based company has officially inaugurated the $1 billion Kirikkale power plant in a ceremony hosted by Turkish President Recep Tayyip Erdoğan.

The plant took three years to build and will account for around three per cent of Turkey's total electricity demand.

The combined cycle power plant is located near the city of Kirikkale in Central Anatolia, some 50 km east of Ankara. Its construction was supported by a long-term financing package arranged by the European Bank for Reconstruction and Development (EBRD).

Kirikkale will help Turkey to meet its growing demand for energy, supplying steady and reliable electricity to Turkey's grid. ACWA says that it will be among the most efficient power plants of its kind in the country and will therefore result in savings in gas consumption.

Uzbekistan expands capacity with ADB help

Uzbekistan has signed agreements to expand power generating capacity and improve energy efficiency.

The Asian Development Bank (ADB) has approved a $450 million loan to add up to 950 MW of generating capacity to the Talimarjan thermal power plant.

The project will use combined cycle technology for improved power generation efficiency, the ADB said in a statement.

In November, South Korea's Hyundai Engineering & Construction Co. and Posco Daewoo Corp. announced plans to for a project worth $4.5 billion to build a combined cycle power plant and a power transmission line in the country.

Their plans include a 450 MW power plant in Navoi and a 1230 km-long transmission line.

"Modernising Uzbekistan's energy sector and power generation facilities are central to the economy and development of the country," said Seung Duck Kim, Energy Specialist at ADB's Central and West Asia Department. "ADB's assistance will help Uzbekistan meet its growing energy needs and enhance the sustainability of the energy sector."

Uzbekistan's energy sector currently contributes around 10 per cent of the country's gross domestic product and about 25 per cent of its total exports. However, the country's electricity supply demand gap is widening and is expected to reach around 14 600 GWh by 2020.

The project will help expand the Talimarjan plant's aggregate capacity to approximately 2600 MW and improve its thermal efficiency from 48 per cent to 52 per cent.

In August 2017 Uzbekistan commissioned a 900 MW combined cycle power plant expansion at Talimarjan.

That project was also backed by ADB finance and was built by Hyundai Engineering & Construction Co. and Posco Daewoo Corp. on an engineering, procurement and construction (EPC) basis for Uzbekenergo.

Posco Daewoo said it has also signed an agreement with the State Committee of the Republic of Uzbekistan on Investments and the National Energy Saving Company for the construction of a 2 GW solar power plant and a solar module manufacturing facility.

Those facilities will be on-line by 2035, Daewoo said.

Engie takes gas green

Engie is to invest heavily in biomethane and hydrogen in order to turn its gas supplies renewable.

The French utility says that all of its French clients will be supplied by 100 per cent renewable gas by 2050 and that its renewable gas investments will grow from tens of millions of euros to "a few hundred" million euros per year.

In a press conference, Engie's CEO Isabelle Kocher said the company is already working on some 40 biogas projects in France – facilities that turn waste, mostly agricultural waste, into methane.

However it also wants to develop hydrogen production units, converting electricity produced by renewable sources into gas to power fuel cell vehicles. "We are going to gradually green our gas supply, so that by 2050 it can be 100 per cent green," Kocher said.

Engie sees renewable gas as a key element of the energy transition because of the flexibility that gas brings to the energy system and its ability to support the integration of intermittent renewable electricity generation. It estimates that green gas could represent ten per cent of French consumption by 2025 and 30 per cent by 2030.

Engie said it is looking to produce hydrogen using solar energy and is therefore looking for large-scale solar power projects that would enable its strategy.

"In places like Chile's Atacama desert we could produce hydrogen on industrial scale and hopefully ship it abroad at a competitive price, transport included," said Kocher. She also said the company was looking to acquire start-ups in hydrogen technology, especially electrolysis.

In May 2017, Engie agreed to sell its oil and gas exploration business for $3.9 billion and in November last year sold its gas liquefaction, shipping and trading business to Total for $1.5 billion.

The sale included a deal to make Engie Total's preferred supplier of biogas and renewable hydrogen.

BP switches on to solar

BP's foray into solar panel manufacturing failed six years ago, but the oil giant now believes success lies in partnership with solar power developer Lightsource.

Siân Crampsie

BP is once again hoping to become a major player in solar energy six years after abandoning its solar panel manufacturing business.

The oil giant is to invest $200 million over three years in Lightsource, the largest solar energy developer in Europe. The two companies have agreed to form a strategic partnership "to drive further growth across the world" in solar energy.

Octopus-backed Lightsource took just seven years to become Europe's largest solar power company, with much of its operations developed during the UK's solar energy boom. It will re-brand as Lightsource BP and BP will have two seats on the board of directors.

BP said that the investment in Lightsource will complement its existing Alternative Energy business, which includes wind energy, biofuels and biopower. BP Wind Energy has interests in onshore wind energy across the US with total gross generating capacity of 2.3 GW.

Lightsource has commissioned 1.3 GW of solar capacity to date and manages approximately 2 GW of capacity under long-term operations and maintenance contracts.

Lightsource BP will target the growing demand for large-scale solar projects worldwide with a focus on grid-connected plants and corporate power purchase agreements (PPAs). The company will continue to develop and deliver Lightsource's 6 GW growth pipeline, which is largely focused in the US, India, Europe and the Middle East.

The companies also see opportunities to create additional value through integrating solar with BP's other businesses and trading capabilities as well as through BP's international scale and relationships.

Dev Sanyal, BP's Chief Executive for Alternative Energy, said: "We see significant opportunity to offer affordable, reliable, low-carbon power solutions by integrating solar alongside our existing Alternative Energy and gas business. We see Lightsource as a strategic partner with a similar vision and, with the benefits of BP's global scale and relationships, we together plan to build the global market leader for solar."

Bob Dudley, BP Group Chief Executive, added: "BP has been committed to advancing lower-carbon energy for over 20 years and we're excited to be coming back to solar, but in a new and very different way. While our history in the solar industry was centred on manufacturing panels, Lightsource BP will instead grow value through developing and managing major solar projects around the world."

Global installed solar generating capacity more than tripled in the past four years and grew by over 30 per cent in 2016 alone, according to BP's *Statistical Review of World Energy*. BP's Energy Outlook analysis sees solar as likely to generate around a third of the world's total renewable power and up to ten per cent of total global power by 2035.

Arjun acquires Enviromena

Arjun Infrastructure Partners (AIP) says it will "become part of the incredible story of clean energy" in the Middle East and North Africa (MENA) region with the acquisition of Enviromena Power Systems.

AIP, an independent infrastructure investment advisory company, said that the purchase of Enviromena would give it access to over 175 MW of clean energy projects under operation and a further 500 MW under construction. UAE-based Enviromena has a project footprint spanning nine countries, it said.

"We are very excited to complete this transaction and become part of the incredible story of clean energy in the MENA," said Surinder Toor, Founding Partner of AIP. "We are firm believers in the solar opportunity presented in the region, and see Enviromena as the ideal platform to facilitate our strategy to deploy capital into renewable assets."

Sami Khoreibi, Chief Executive Officer of Enviromena, says: "This transaction comes at perfect time for Enviromena. The opportunity to deploy solar assets throughout MENA is happening now, and the strategic support and access to capital that AIP brings to the table enables us to enhance our position as the market leader.

GFG pledges green strategies

Industrial conglomerate GFG Alliance has inked new deals in the hydropower and tidal sectors as part of its strategy to become the UK's largest provider of renewable energy.

GFG, which is controlled by the Gupta family, last month struck a deal with global tidal power developers, Atlantis Resources Ltd, to buy a 49.99 per cent stake in the firm.

The deal was made through Simec, part of the GFG Alliance, and includes the purchase of the coal fired Uskmouth power plant in South Wales by Atlantis.

Simec has also signed an unconditional agreement to acquire Green Highland Renewables (GHR) from Ancala Partners, and has pledged to build 1 GW of renewable power generation capacity in the UK within three years.

Atlantis will be renamed Simec Atlantis Energy and will spearhead a project to convert the 363 MW Uskmouth power plant to renewable energy as well as drive forward existing plans for the Meygen tidal stream project in Scotland and the Wyre Estuary tidal barrage project in Lancashire.

The purchase of GHR from Ancala Partners includes 18 hydroelectric power stations in the Scottish Highlands and a team of 17 engineers, operators and designers. In addition, SIMEC said it will develop a further eight hydropower plants on its Lochaber Highland estate lands, with the planning process due to start in 2018.

Centrica keen to sell nuclear stake

Call on government: GMB says nuclear sell-off should be stopped

Energy workers' union, the GMB, has called on the UK government to step in and stop Centrica selling its 20 per cent stake in eight nuclear power stations.

The GMB says that the possible sale – reported by the *Times* newspaper – would lead to the UK "relying on foreign powers" to keep the lights on and amounts to Centrica "selling off the family silver".

Centrica boss Iain Conn told the *Times* that the company is open to bids for its 20 per cent stake in EDF Energy's UK nuclear fleet.

The sell-off appears to have been sparked by Centrica's share price plummeting to its lowest level in 14 years after its retail arm, British Gas, lost 823 000 customers in the three months to the end of September 2017.

"This sale could see 20 per cent – a fifth – of the UK's fleet of nuclear power stations end up in the hands of private equity and foreign investment vehicles," said Stuart Fegan, GMB National Officer for Energy.

"The Government needs to step in, block this sale and stop relying on foreign powers to keep Britain's lights on."

Centrica is in the midst of a strategic transformation aimed at revamping its asset portfolio and becoming a more customer-focused organisation.

Americas

Bruce Power inks contract

Canada's Bruce Power has signed a C$130 million ($103.3 million) contract with an international consortium to replace steam generators at Unit 6 of the Bruce nuclear power plant in Ontario.

AECOM, Aecon and Areva NP have joined forces to implement the project at Unit 6 and have also signed a long-term Preferred Supplier Agreement, with a firm pricing structure, for steam generator replacements at the plant's remaining five units, Bruce Power said.

AECOM, Aecon and Areva NP's responsibilities include the removal of the eight original steam generators at Unit 6 and the installation of replacement steam generators with related plant modifications. They are currently completing the engineering work for the replacements, Bruce Power said.

Work is scheduled to reach substantial completion in the first quarter of 2022.

Canadian Solar secures Mexico PV contracts

Canadian Solar has secured contracts for the construction of three new solar photovoltaic (PV) plants in Mexico's latest renewable energy auction.

The firm will build a total of 367 MW of solar capacity across three sites: Obregon, Hermosillo and Aguascalientes. Canadian Solar secured a 20-year purchase agreements for clean energy certificates at an average price of $21/MWh for the projects, and 15-year power purchase agreements for energy.

Mexico's CFE will purchase the energy from the plants, which are due to start operating by mid-2020.

El Morro signs up Wärtsilä

Technology group Wärtsilä has signed a seven-year operations and maintenance (O&M) contract with Termo Mechero Morro S.A.S. E.S.P. covering the firm's 55 MW El Morro power plant in Colombia.

The O&M agreement expands on an earlier Wärtsilä engineering, procurement and construction (EPC) contract and includes performance guarantees for the El Morro facility.

Wärtsilä will apply its advanced digital solutions in the El Morro plant to ensure optimal operations: the plant equipment will be remotely monitored and its maintenance needs will be optimised.

El Morro will be a baseload power plant equipped with six Wärtsilä 34SG gas engines and was due to start operating at the end of 2017.

MidAmerican orders V110 turbines

Berkshire Hathaway Energy subsidiary MidAmerican Energy Company has placed an order with Vestas for the delivery of V110-2.0 MW turbines for the 2000 MW Wind XI project in Iowa, USA.

The turbines are expected to be delivered in Q2 2018.

Scheduled to be fully operational by 2020, the Wind XI project will enable MidAmerican Energy to produce around 95 per cent of its annual retail load from wind.

The project comprises multiple sites in Iowa that will enter service between 2018 and 2019.

Fluor to refurbish Darlington

Ontario Power Generation (OPG) has awarded a contract to Fluor for the procurement and construction of refurbishment work at the 3500 MW Darlington nuclear generating station in Ontario, Canada.

The contract calls for the replacement of existing emergency power generators for Units 1 and 2 as they are nearing the end of their design life. The work is part of a ten-year, C$12.8 billion ($10.17 billion) refurbishment programme at the plant.

Asia-Pacific

L&T commissions Sikalbaha

India's Larsen & Toubro has completed commissioning of the 225 MW Sikalbaha combined cycle power plant in Bangladesh.

The natural gas-fired facility is located near Chittagong and is owned by the Bangladesh Power Development Board (BPDB). It was built by L&T under a $200 million engineering, procurement and construction (EPC) contract awarded in 2014.

L&T-Sargent & Lundy, a joint venture between L&T and US-based Sargent & Lundy, carried out plant integration and detailed engineering of the Sikalbaha power project. Siemens provided the gas turbines, steam turbine and generators for the plant.

Ormat secures New Zealand contract

An Ormat Technologies subsidiary has signed an engineering, procurement and construction (EPC) contract with Top Energy for the Ngawha extension geothermal project in New Zealand.

Under the $50 million contract, Ormat will provide its air-cooled Ormat Energy Converters for the project, located in Ngawha, New Zealand. The contract is the third signed by the two companies in 20 years.

Ormat anticipates final notice to proceed in the second half of 2018 and aims to complete the project in early 2021.

Vestas secures Quang Tri deal

Vestas has signed a wind turbine supply contract with Tan Hoang Cau (THC) for the 30 MW Huong Linh 1 wind farm in Vietnam's Quang Tri province.

Construction of the €22 million Huong Linh 1 wind farm will take eight months. The Danish firm will work in partnership with THC to determine the best locations for the wind turbine towers.

The two companies have also signed a memorandum of understanding (MoU) on the pre-development of three other wind projects.

BHEL bags Kahalgaon ESP package

Bharat Heavy Electricals Limited (BHEL) has won an order for the renovation and modernisation of electrostatic precipitators (ESPs) at the Kahalgaon Super Thermal Power Station (STPS) in the Indian state of Bihar.

Under the contract, BHEL will renovate and modernise the ESPs at stage 1 of Kahalgaon, comprising four 210 MW units. Renovation of the units will enable them to meet new standards for suspended particulate matter, according to the plant's owner, NTPC.

BHEL's scope of work in the contract includes design, engineering, manufacture, supply, dismantling, erection, testing and commissioning of the ESPs.

Hitachi planning power-to-gas plant

Swiss clean-tech company Hitachi Zosen Inova and its parent company Hitachi Zosen Corporation have announced plans for a power-to-gas plant in Japan.

The proposed plant will produce synthetic natural gas from carbon dioxide and hydrogen and will be the first of its kind in Japan. Hitachi Zosen Inova and Hitachi Zosen Corporation will build the facility on behalf of Japan's New Energy and Industrial Technology Development Organization (NEDO).

The plant will use carbon dioxide captured from the flue gas of an existing coal-fired thermal power station. Its objective will be to prove the feasibility of large-scale power-to-gas plants.

Europe

R-R to deliver gas engines for greenhouse

Rolls-Royce has signed a contract with Tuinbouwbedrijf Marc Pittoors (T.B.M.P) BVBA for the supply of a 7 MWe combined heat and power plant (CHP) for a tomato-growing business in Belgium.

The CHP plant will be designed around two gas-fired gensets based on the new medium-speed Bergen B36:45L6 engine. The contract also includes a service agreement for 10 years.

Marc Pittoors will use the generated electricity to power the greenhouse artificial lighting and the heat extracted from exhaust gases and engine cooling systems to heat up the facility. In addition, cleaned engine exhaust gases will be injected into the greenhouse to increase the level of CO_2 and boost plant growth.

The gensets are scheduled to go into operation early November 2018.

Nordex wins in Italy

The Nordex Group has been awarded contracts for the installation of two wind farms in Apulia, Italy.

The firm will supply a total of 13 N131 turbines with 84 m steel towers for the projects, construction of which is due to start in the third quarter of 2018.

The order was placed by an Italy-based project developer and independent power producer, Nordex said.

National Grid orders Channel link transformers

National Grid has placed orders with Siemens for the delivery of four transformers that will replace the existing transformers in the high voltage direct current (HVDC) cross-Channel link connecting England and France.

The new transformers will each have a capacity of 400 kV and 315 MVA, and will be quieter, more efficient and more reliable than the existing units. The order includes the supply, installation and commissioning of the transformers for the Sellindge converter station in England.

Siemens will complete the work by mid-2019.

International

Ghana to build 650 MW combined cycle plant

Siemens and Rotan Power have signed a memorandum of understanding (MoU) to develop and build a combined cycle power plant at the Aboadze Power Enclave located in the west ern region of Ghana. The proposed power plant will have a capacity of 650 MW and will be built in two phases, Siemens said. It will be based around the firm's F-Class gas turbine technology.

According to the MoU, Siemens will build the plant on a turnkey engineering, procurement and construction (EPC) basis. Siemens will also provide operations and maintenance services for a 20-year period.

The first phase of the plant is due on-line in 2023 and the second in 2025.

Wärtsilä builds Jordan PV plant

Wärtsilä has signed an engineering, procurement and construction (EPC) contract to develop a 52 MWp solar photovoltaic (PV) plant in Jordan.

The project represents Wärtsilä's first contract for a utility-scale PV plant. Jordanian firm NEPCO will be the offtaker of the solar plant's electricity and will be responsible for constructing the interconnection facilities.

The new PV plant will be installed near IPP4, a 250 MW Wärtsilä-built power plant, which has been operational since 2014. The construction of the new plant is expected to start in June 2018 and commercial operation is expected in July 2019.

GE updates GAMA agreement

GE has signed a new multi-year service agreement with GAMA Enerji that will help the Turkish power firm to reduce fuel costs and improve asset reliability at its İçanadolu Doğal Gaz Elektrik Üretim Ve Ticaret A.Ş. (ICAN) power plant.

The two companies say that they have reconfigured an existing service agreement and that the benefits realised from the power plant's improved fuel savings will be shared between the two companies.

It represents the first time that GE has implemented its Outcome as a Service (OaaS) model in Turkey.

Under the agreement, GE will install and deploy its Asset Strategy Optimization solution and will also extend the scope of its implementation of GE's Asset Performance Management (APM) software suite at the ICAN site.

The project, which includes balance-of-plant equipment, will provide added reliability and visibility of asset performance, enabling better, clearer and faster predictive maintenance and condition monitoring on the plant's two GE 9FB gas turbines.

Siemens boosts GECOL capacity

Siemens has signed contracts with the state-owned utility General Electricity Company of Libya (GECOL) to expand its generation capacity by about 1.3 GW to alleviate power shortages.

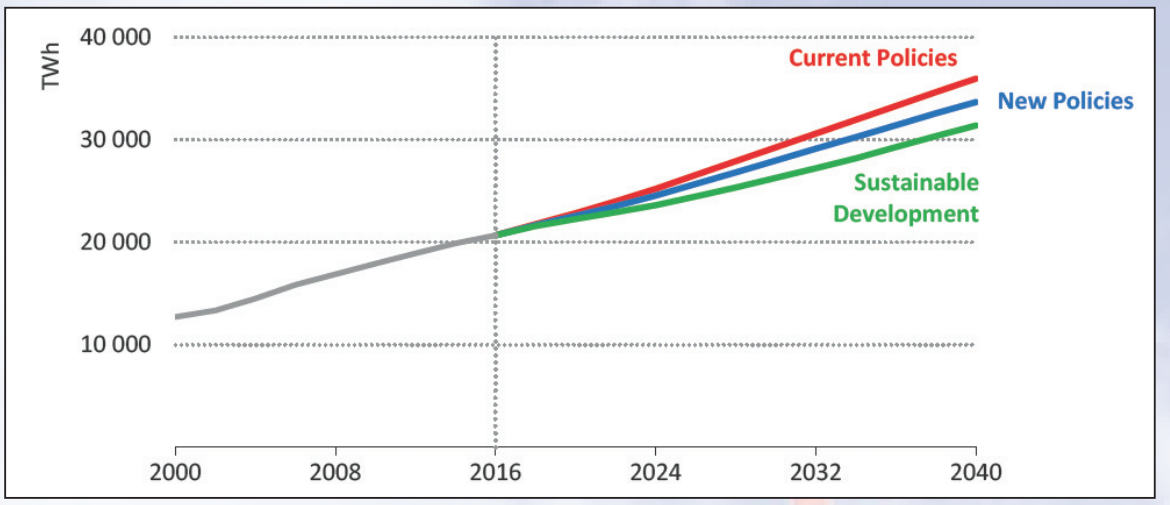
Under the contracts, Siemens will build a 650 MW open cycle power plant in Misrata, equipped with two F-class gas turbines, and a 690 MW open cycle power plant in Tripoli West, equipped with four E-class gas turbines.

Beyhan secures Pöyry services

Kalehan Murat Enerji Üretim A.S. has awarded Pöyry a contract to provide the basic design engineering services assignment for the Beyhan II Dam and Hydroelectric Power Plant (HPP) project in Turkey.

The design contract will place special emphasis on risk analysis for the dam and related structures, which will help determine the investment decision. The 320 MW project will generate 710 GWh annually.

Evolution of electricity demand in the three WEO scenarios



World Energy Outlook 2017, © IEA/OECD, Figure 6.2 , page 233

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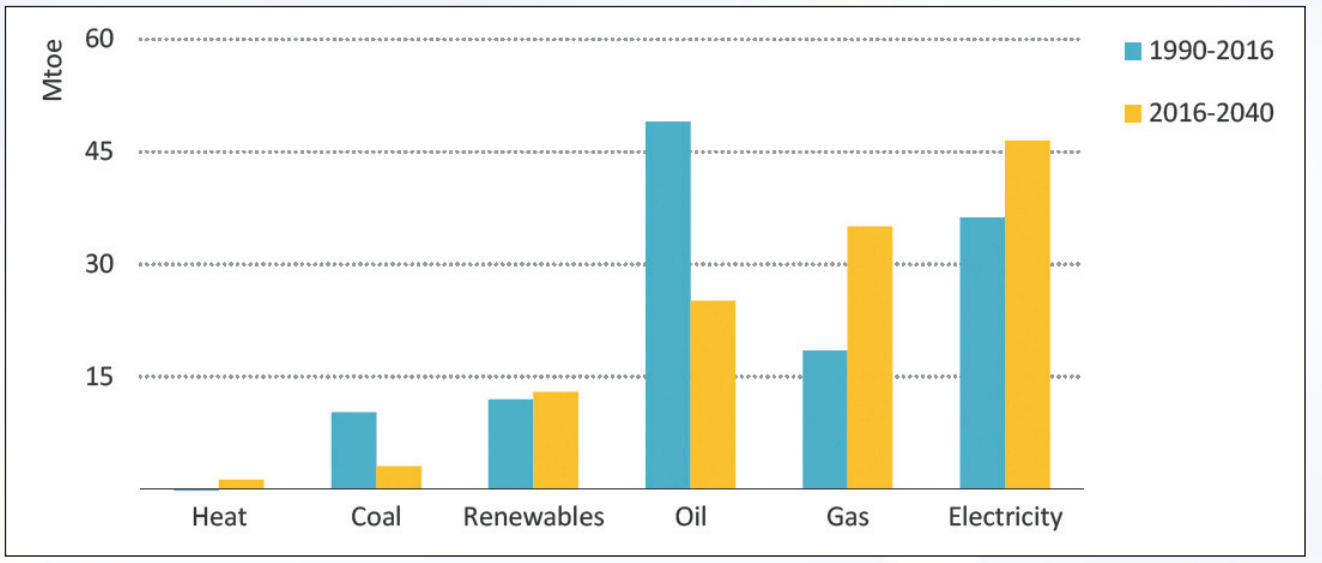
Annual average growth of final energy demand historically and in the New Policies Scenario



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Electricity demand by region and scenario (TWh)

				New Policies						Current Policies		Sustainable Development	
	2000	2016	CAAGR 2000-2016	2020	2025	2030	2035	2040	CAAGR 2016-2040	2040	CAAGR 2016-2040	2040	CAAGR 2016-2040
North America	4 261	4 694	0.6%	4 866	5 017	5 208	5 417	5 651	0.8%	5 980	1.0%	5 505	0.7%
United States	3 590	3 886	0.5%	4 027	4 131	4 266	4 409	4 570	0.7%	4 846	0.9%	4 545	0.7%
C & S America	660	1 063	3.0%	1 164	1 308	1 479	1 664	1 858	2.4%	1 987	2.6%	1 733	2.1%
Brazil	327	512	2.8%	559	617	690	769	852	2.1%	918	2.5%	827	2.0%
Europe	3 114	3 555	0.8%	3 698	3 790	3 902	4 041	4 194	0.7%	4 522	1.0%	4 005	0.5%
European Union	2 605	2 857	0.6%	2 947	2 980	3 026	3 096	3 178	0.4%	3 436	0.8%	3 090	0.3%
Africa	385	655	3.4%	736	885	1 099	1 371	1 707	4.1%	1 608	3.8%	1 753	4.2%
South Africa	190	207	0.5%	221	240	267	299	335	2.0%	359	2.3%	275	1.2%
Middle East	359	910	6.0%	974	1 118	1 337	1 576	1 798	2.9%	1 976	3.3%	1 621	2.4%
Eurasia	809	1 065	1.7%	1 120	1 193	1 273	1 354	1 432	1.2%	1 506	1.5%	1 248	0.7%
Russia	677	865	1.5%	896	934	985	1 030	1 069	0.9%	1 126	1.1%	946	0.4%
Asia Pacific	3 611	9 433	6.2%	10 738	12 551	14 434	16 199	17 827	2.7%	19 258	3.0%	16 155	2.3%
China	1 174	5 320	9.9%	6 087	7 018	7 905	8 645	9 230	2.3%	10 279	2.8%	8 260	1.8%
India	376	1 102	6.9%	1 383	1 880	2 449	3 033	3 606	5.1%	3 732	5.2%	3 350	4.7%
Japan	1 005	969	-0.2%	962	967	978	991	1 005	0.2%	1 043	0.3%	855	-0.5%
Southeast Asia	322	837	6.2%	993	1 214	1 461	1 718	1 997	3.7%	2 105	3.9%	1 828	3.3%
World	13 199	21 375	3.1%	23 295	25 861	28 733	31 622	34 467	2.0%	36 837	2.3%	32 022	1.7%

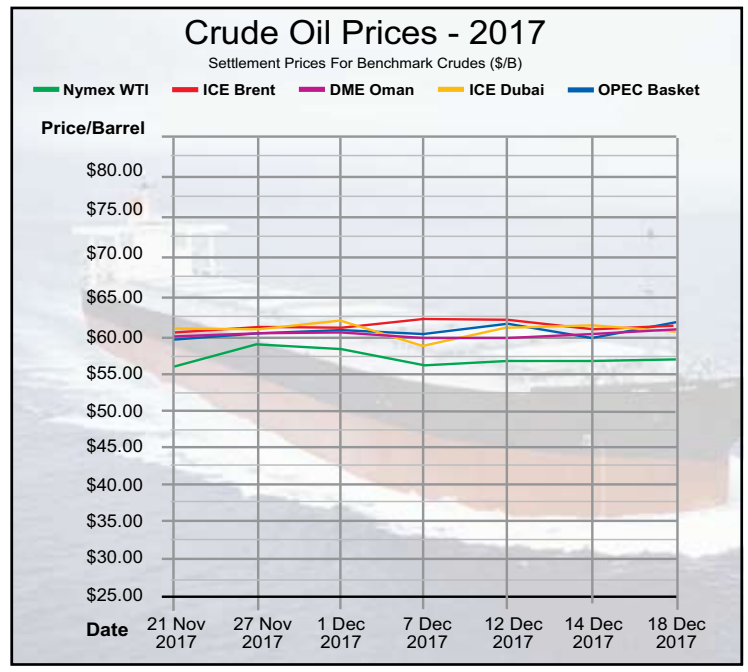
World Energy Outlook 2017, © IEA/OECD, Table 6.1, page 238

Source: World Energy Outlook 2017

Oil

Duelling figures leave market guessing over course of 2018

- Opec and allies extend production cuts to end of 2018
- IEA forecasts global demand growth will decline



David Gregory

Crude oil prices are making gains. Much of the rise in price over the last month could be attributed to the closure in mid-December of the UK's Forties pipeline, which transports some 400 000 b/d of North Sea crude from the UK's offshore oil fields to land. The pipeline will likely be closed well into January of next year, in which case the closure will impact the market for a short time. But in its December *Oil Market Report*, the International Energy Agency (IEA) forecast that the market would soon settle down, suggesting that prices could decline.

The price of Brent crude has been in the lower $60/b range since the end of October, reflecting an increase in demand and a decline in inventories. The price has been at this level long enough to convince Opec and its non-Opec partners that their efforts to restrict oil production are succeeding and that continuing that strategy would bring the oil market back into balance by removing excess stocks, thus boosting oil prices further. At their meeting in Vienna on November 30, Opec and its allies agreed to extend the production cuts to the end of 2018. This process began in January 2017 with a timeline for production cuts of six months.

Getting the price to a level that Opec members and other oil producers outside the group can live with has been the primary market focus for some three years. Opec is now saying that it believes its method is working and that the oil glut should begin to evaporate by mid-2018. The figures in its December market report says non-Opec supply will rise by 990 000 b/d to average 58.81 million b/d during 2018. Of this, US oil supply growth would average 1.05 million b/d after taking into account declines in production from Mexico, Colombia, Russia, China, Azerbaijan and Norway.

The IEA, on the other hand, is seeing things differently. It has forecast that global demand growth will decline by 200 000 b/d to average growth of 1.3 million b/d in 2018, compared to 1.5 million b/d in 2017. Furthermore, it forecast non-Opec supply growth rising by 1.6 million b/d next year.

The Paris-based agency says that its expected average price for Brent crude will be $54/b for 2017, up by 20 per cent and reason enough to make Opec happy, but it asked if this optimism will carry on into the new year considering its calculations that forecast the oil market might not tighten as much as Opec expects.

Taking US oil production, particularly US shale oil production, into consideration, the IEA said that total supply growth could exceed demand growth. Much could change in a short time, the IEA said, but added that "the producers' hopes for a happy New Year with de-stocking continuing into 2018 at the same 500 000 b/d pace we have seen in 2017 may not be fulfilled".

For its part, the US Energy Information Administration (EIA) forecast in its December report that non-Opec production during 2018 would rise by 1.7 million b/d over the 2017 average to reach 60.3 million b/d in 2018.

The administration also said that the price increases of late 2017 will contribute to US crude oil production growing to more than 10 million b/d by mid-2018, up by 800 000 b/d over 2017. Besides US crude production, Canada, Brazil, Norway, the UK, and Kazakhstan would add a combined 700 000 b/d of liquids to overall 2018 non-Opec production, the EIA said.

Despite higher prices, the administration expects to see global liquid fuel demand rise by more than 1.6 million b/d next year, up from average growth during 2017 of 1.4 million b/d. Demand growth is not forecast to keep pace with supply growth, however, resulting in global liquids inventories increasing modestly in 2018, the EIA said, adding that the rise in global inventories will lead to a decline in the price of Brent from levels of late 2017 to an average of $57/b in 2018.

Higher prices will be attractive for US oil producers, as they will be to Opec. But it is not yet clear if shale oil producers will ratchet up output for the sake of reaping higher prices or whether they will level off and attempt to consolidate the ground they have gained in their production tussle with Opec. Oil producers are not known for holding back except for when they have to.

Gas

Yamal LNG puts Russia on path to larger role in global market

The launch of a first cargo from Russia's Yamal LNG facility in northwestern Siberia marks the start of a new great game to be played out for future global gas markets among new major producers.

Mark Goetz

In the coming years, the liquefied natural gas (LNG) industry will see competition expand as the US, Australia, East Africa and possibly the East Mediterranean provide new sources of natural gas that will challenge Russia's market share in Europe and pose a challenge to the world's established gas exporters. As the world moves away from coal and crude, gas will move into developing markets, particularly China and India.

Russia has up to now had only Gazprom's Sakhalin II LNG facility in the Far East, where output is 10 million tons/year, through which to sell its gas in the growing LNG market, but with the launch of a first cargo from Yamal LNG in northwestern Siberia, the capacity of which will reach 16.5 million tons/year when all three trains are completed by end 2019, Russia can now deal itself in for a better stake.

Until now, Russia has relied on pipelines to export its vast gas reserves, primarily to Europe, which have limited its ability to reach markets, but that will change as Russia develops its LNG sector. Realising the state-owned gas company Gazprom could not cope with the size of gas resources that could be developed for LNG, Russian President Vladimir Putin endorsed Novatek's proposal to develop the Yamal resources when some of his advisors advised against it. Yamal LNG was a risk, but one that he said he was glad the consortium partners made.

The huge facility at Sabette was created where there was nothing but frozen wasteland. Work was carried out in the harshest of conditions to build an airport, seaport, the massive LNG facility and accommodation for workers. If that can be accomplished in one part of Siberia, it can be done in other remote and frozen locales.

A loading ceremony to mark the start of Russia's newest energy endeavour was held at Sabetta on December 7 and was attended by a number of dignitaries including President Putin, the current CEO of Total Patrick Pouyanne and Saudi Arabia's Minister of Petroleum Khalid Al-Falih.

The Yamal LNG consortium has ordered the construction of 15 ice-class (ARC7) LNG tankers capable to sailing east from Yamal through the Arctic Ocean to markets in the Far East. Each has a capacity of 170 000 m^3. The northern shipping route to the Far East and China will cut two weeks off sailing time compared to the westward route around Europe and South Asia.

Yamal LNG partners consist of Russia's privately-owned Novatek (51 per cent), France's Total (20 per cent), China National Petroleum Corporation (20 per cent) and China's Silk Road Fund (9.9 per cent) in a venture that will cost $27 billion.

There had been concerns that the project would be impeded by US sanctions that had been imposed by Washington over Russia's involvement in the Ukraine crisis, but Total was able to supply the technology the facility required. The project was also helped financially when Chinese lenders agreed to provide $12 billion in funding after CNPC bought 20 per cent of the venture and the Silk Road Fund acquired its stake.

Total announced on December 11 that the first cargo of 170 000 m^3 had sailed. The first shipment was sold to a UK-based LNG trading company that is a subsidiary of Malaysia's Petronas. Most of Yamal LNG's exports have been contracted on a long-term basis, with 54 per cent of them marked for Asia and 46 per cent going to Europe, but these will not come into effect until April 2018. Until then, Yamal LNG will be sold on the spot market, although Total will be lifting 4 million tons/year to add to its group portfolio, which when its acquisition of Engie's upstream LNG business is completed in mid-2018, will boost Total's LNG volume to 40 million tons/year by 2020. This will make Total the world's second largest LNG supplier with 10 per cent of the global market.

The first shipment of a Yamal LNG cargo prompted Novatek CEO Leonid Mikhelson to remark that his company was now officially in the LNG game and planned to become a major player in its own right. "This event begins the process of developing and liquefying our massive natural gas resources on the Yamal and Gydan peninsulas into more than 70 million tons/year," he said.

Yamal LNG has access to gas resources amounting to more than 4.6 billion barrels of oil equivalent, plenty to make it a global player and but a fraction of Russia's gas resource total.

The digital transformation

Digitalisation not only presents big opportunities for utilities and solution providers but is also crucial to the transition of the energy sector, according to recent reports from BNEF and the IEA. **Junior Isles** reports.

Global energy systems are facing a number of challenges as the sector adjusts to a world where intermittent renewables are more widespread and generating sources become more distributed. At the same time, competition for customers in liberalised markets is driving costs down, forcing utilities to adopt new strategies.

Under the new energy scenario, digitalisation is increasingly being seen as a key tool in addressing many of the challenges currently on the table. In today's terminology, digitalisation is defined as the process of connecting devices through digital communications, collecting and sharing data, and analysing that data to improve machine or system operations.

According to the recent study 'Digitalization of Energy Systems' by Bloomberg New Energy Finance (BNEF), it is a technology sector that will generate $64 billion in revenue for the associated value chain in 2025. The research reveals some interesting findings. Currently, the biggest use of digital technologies like sensors, data collection and analytics in the energy sector is to improve the bottom line of fossil fuel generators. Revenue for digital services for fossil fuel operation and maintenance, or O&M, are estimated to be $24 billion in 2017 – some 44 per cent of the total market size for digitalisation measured by BNEF.

Going forward, however, the report predicts significant shifts in the intelligence of digital technologies used in energy from today to 2025, and a big change in the sectors of the energy system that benefit most from these technologies.

As natural gas and coal plants come offline, and those that remain become digitalised, the opportunities for new revenues from the fossil fuel sector will shrink. By 2025, digital technologies will be more intelligent and more capable, helping homeowners that own rooftop solar, batteries or EVs for their own consumption as well as production ('prosumers'), to become more autonomous and derive greater value from these assets. This could be through trading energy with neighbours or better management of peak power prices.

According to BNEF within the $64 billion total, the largest driver for digital technology revenues in 2025 will be smart meters, growing 44 per cent between now and 2025, to $26 billion. This revenue increase matches the fall in digital revenues from fossil fuel O&M – 46 per cent over that time period. At the same time, grid automation is forecast to be a $10 billion market by 2025, while home energy management technologies will grow from $1 billion in 2017, to $11 billion in 2025.

In its first comprehensive report on the interplay between digitalisation and energy, the International Energy Agency (IEA) also analysed how digitalisation is transforming energy systems.

It noted that digitalisation is cutting across many sectors such as oil and gas production, buildings and transport and said that massive amounts of data, ubiquitous connectivity, and rapid progress in Artificial Intelligence and Machine Learning are enabling new applications and business models across the energy system – from autonomous cars and shared mobility to 3D printing and connected appliances.

The agency stressed, however, that electricity was at the heart of the digital transformation.

"Energy and digitalisation intersect in many ways. Many of the energy companies we speak to are increasing their investment in digital technologies. Our numbers show that the investment in digital electricity infrastructure has increased by 20 per cent each year over the past couple of years," said IEA Executive Director Dr Fatih Birol.

According to the IEA, more than 1 billion households and 11 billion smart appliances could participate in interconnected electricity systems by 2040, thanks to smart meters and connected devices. This would allow homes to alter when and how much electricity they draw from the grid. Demand-side response – in buildings, industry and transport – could provide 185 GW of flexibility, and avoid $270 billion of investment in new electricity infrastructure.

The IEA report finds that with the help of smart thermostats, smart lighting and other digital tools, buildings could reduce energy consumption (mainly in space heating) by 10 per cent by using real-time data to improve operational efficiency.

The same transformation, it says, is taking place in how energy is produced – from smart oil fields to interconnected grids and, increasingly, renewable power sources. Digital technologies could help integrate higher shares of variable renewable energy into the grid by better matching energy demand to solar and wind supplies.

"Digitalisation is blurring the lines between supply and demand," said Birol. "The electricity sector and smart grids are at the centre of this transformation, but ultimately all sectors across both energy supply and demand – households, transport and industry – will be affected."

During the launch of the report Laura Cozzi, Head of the Energy Demand Outlook Division, noted that a major part of the analysis looks at how digitalisation is affecting energy demand trends as well as energy supply trends.

"We often talk about the astonishing cost reduction in solar technology which has dropped by 80 per cent since 2008 but we seldom talk about what has happened to sensors, the costs of which dropped by over 90 per cent. This declining cost in sensors is one of the key trends in digitalisation that is allowing the spread of such technologies throughout our lives," she said.

The oil and gas industry was among the first to use sensors to monitor wells but the IEA still sees potential for the further spreading of digital technology. "This could increase oil recovery by around 5 per cent and decrease production costs by around 10-20 per cent, with unconventional gas and oil benefiting the most from this," said Cozzi.

Looking at the electricity sector, digitalisation is having a significant impact in areas such as predictive maintenance to reduce operation and maintenance costs or extend power plant lifetime. The use of drones to manage transmission and distribution lines is another area that is seeing increasing deployment.

The IEA calculates that digitalisation could save the power sector around $80 billion per year. Cozzi commented that although this does not seem to be very large, digitalisation could be "a bit of a lifeline" to utilities struggling to remain competitive in markets where electricity demand has slowed dramatically.

But digitalisation goes far beyond its ability to increase efficiencies in existing systems; it is a trend that is enabling the transformation of the entire electricity system.

"Like your spare room for an Air BnB, digitalisation is uncovering value for customers that is beyond [just] the electricity *per se*," said Cozzi. "We are seeing value being created in the data from the energy use, in the spare capacity we have at home and in our ability to actually move demand around. We didn't know that we had this value proposition in our houses; digitalisation is actually bringing this forward. "

She added that the transport sector could also uncover value as part of these demand side response, system-balancing programmes. "We are seeing very large potential in the transport sector, with electric vehicles being key in this transformation. A mass-charging infrastructure could allow charging when it's best for the system." The IEA says that smart charging of EVs would provide further flexibility to the grid, saving between $100-280 billion investment in new electricity infrastructure.

Digitalisation is also helping to integrate variable renewables by enabling grids to better match energy demand to times when the sun is shining and the wind is blowing. Further it could facilitate the deployment of distributed energy sources such as residential solar PV and storage, making it easier to store and sell surplus electricity to the grid or locally through peer-to-peer electricity using technologies such as Blockchain.

Although the benefits of digitalisation are clear, embedding devices throughout the energy system increases vulnerability, providing opportunities for cyber attacks.

Dave Turk, Director (Acting) of Sustainability, Technology and Outlooks and Head of the Energy Environment Division, who also led the report pointed out that to-date cyber disruptions to the energy system have been "relatively small". He cautioned, however, that cyber attacks are becoming "easier and cheaper".

This has certainly become more evident in recent years with some experts noting that cyber security is a serious issue for the sector, costing the power industry hundreds, if not billions of dollars each year.

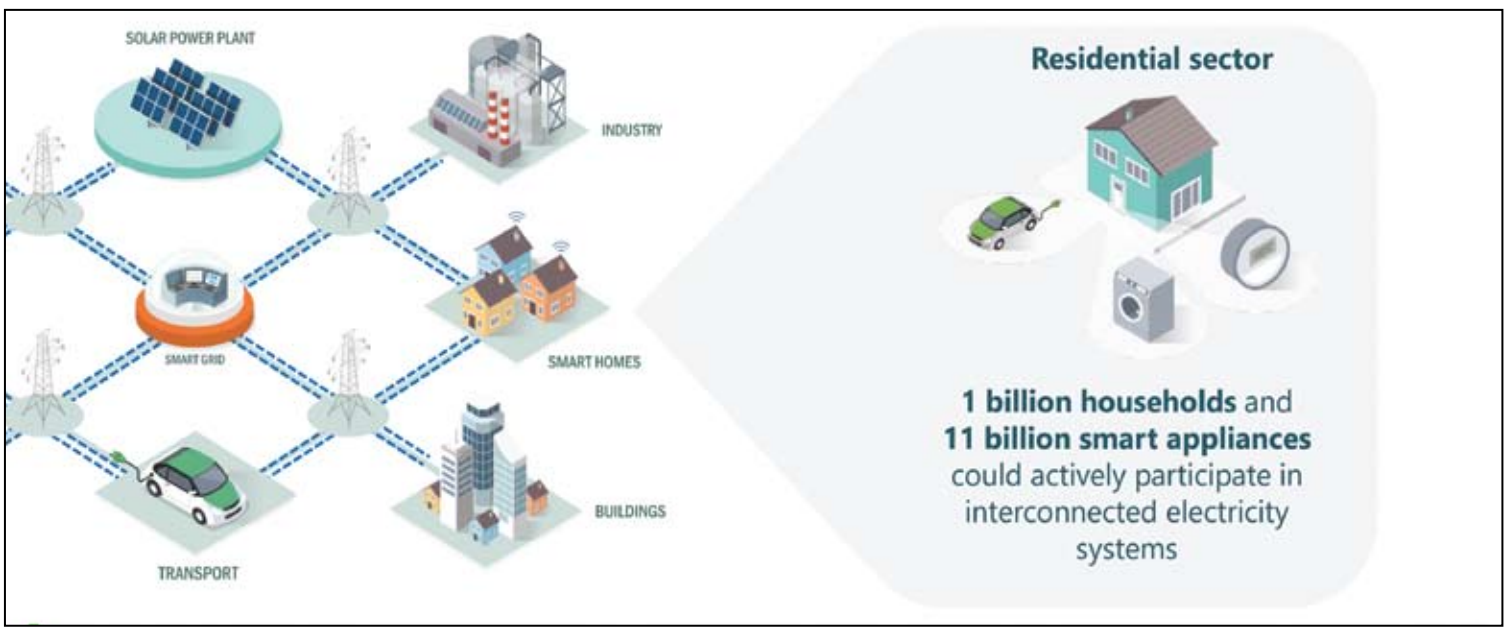
Nils Ahlrich, head of strategy and portfolio management for security at Nokia Networks, said: "Although it has been ongoing for more than 10 years, the number of incidents and impact is clearly rising. One of the biggest ones was in 2015 when the Ukraine electricity grid was attacked, leading to a major blackout.

"Regarding costs to the industry, there are lots of numbers floating around. We don't know how much these numbers can be trusted and figures are not often openly shared… but Chief Security Officers for power utilities have said that in the last two years, 75 per cent of power utilities have been successfully attacked and impacted."

Although not every cyber attack can be thwarted, both Ahlrich and Turk note that the impacts can be limited through raised awareness, better cyber hygiene, staff training and designing digital resilience into technologies and systems from the outset.

Managing concerns such as digital resilience and privacy are crucial going forward, and the impacts of digitalisation are difficult to predict. The energy system may well be "on the cusp of a new digital era", as the IEA puts it, but there is still much work to be done.

Demand response programmes – in buildings, industry and transport – could provide 185 GW of flexibility, and avoid $270 billion of investment in new electricity infrastructure



A bright spot for digitalisation

Acciona's 246 MWp El Romero solar plant in the Atacama desert, Chile, uses ABB solar inverters

With reports showing an increase in consumption of solar energy to satisfy power demand and a growing need in developed economies to increase power generation from renewables, **Leonardo Botti** reviews how solar has matured and how digitalisation of the sector can strengthen and support demand energy response to create a truly sustainable power system of tomorrow.

In 2017, a report from the International Energy Agency outlined how renewables accounted for two-thirds of new power added to the world's grids in 2016, with solar power outstripping all other sources as the fastest growing power source for new energy, worldwide.

Power generation is changing. Mature markets are seeing a very high penetration of renewable energy assets on their grids, while new markets are developing rapidly. As such, utilities and conglomerates in developed countries are transitioning towards solar as a key renewable power source, whilst emerging countries are looking for increased capacity to close the gap on energy demand.

This demand has been strengthened largely by improved levelised cost of electricity (LCOE), which makes solar more competitive when compared with conventional energy sources. This important key performance indicator (KPI) represents the per kWh cost of the installation and operation of a generating plant over an assumed financial life and duty cycle.

The key inputs to calculate LCOE include capital expenditure, fuel costs, along with fixed and variable operations and maintenance (O&M) costs, against an assumed utilisation rate for each plant type.

The importance of these factors will of course vary among the technologies and power source. For renewables, such as solar and wind generation, where there are no fuel costs and often relatively small but variable O&M costs, LCOE fluctuates in proportion to the estimated capital cost of generation capacity.

Botti: The solar industry is poised to lead the charge on digitalisation

At the start of this decade, this crucial KPI for solar would have been five to six times higher than conventional sources, due to the up-front investment cost when adopting such an innovative technology source per kilowatt peak installed.

Today, in countries that have high solar radiation, typically all those located in the 'sun belt', this number is already reducing as utilities review the total life cost of the yields and cost of operation. In some scenarios, the full life cycle costs of building and operating renewables-based projects, such as utility-scale solar photovoltaic (PV) are down approximately 6 per cent from last year, when compared to conventional generation technologies.

Reduced LCOE in solar PV has been driven by evolution in product technology. Over the last ten years, major improvements have been implemented on the silicon for PV modules, as well as inverters and other devices across the system.

With high adoption and penetration of renewable energy generators on the grid, grid operators and utility providers are requiring more and more advanced controls of inverters to maintain reliability, particularly during abnormal grid events.

A further advance, which is being deployed in large-scale PV projects, is the demand for 1500 Vdc technology. These higher voltage levels enhance the optimisation of power generation technology thanks to longer strings of PV panels, which allow for less wiring and trenching, and therefore less labour. This also reduces installation time and costs, such as engineering and civil works.

Operators are therefore realising the benefits that product technology can bring to reduce the total life cost on the balance-of-system (BoS), which offers reduced maintenance costs, and of course improved overall performance efficiency.

The industry may consider that ideal efficiency measures are already being achieved and managed by multi-level inverters in medium-voltage and high-power applications. With it reaching above 98 per cent in inverter efficiency, the most relevant component in the value chain of photovoltaic plants has already been optimised near to the max.

So, what's next? The key determining factor for future solar plants will be the overall system efficiency and all the interactions within it.

Inverter technology can help to improve this by allowing more efficient plant design and utilising digital communication and control.

Digitalisation and integrated technology platforms can provide actionable insights, reliable and accurate figures along with intelligent data on the interactions between one component, one device and all the other systems, to adjust the power feeding the grid.

Greater digitalisation can be achieved in PV plants through advanced communication technologies, like internet protocols, cloud computing and wireless communication, which improve the availability of big data with real-time analytics and remote monitoring. Thanks to these technological advances and data availability, power plants can now be better operated and controlled.

Digitalisation can also deliver better and informed integration and interaction of renewable sources into grid processes and operations, enhancing and delivering a proactive multi-dimensional, balanced power generation system through Demand Energy Response.

Due to the modularity and distributed nature of many modern renewable assets (wind and solar included), operators are now looking to more advanced control and monitoring systems for visibility across the grid and to create a value-added extension to team resources.

This increased visibility is critical to maintain reliability, manage O&M costings and protect operational efficiency. Utility operators can now perform remote monitoring, parameter setting, troubleshooting and condition-based maintenance within their local and global renewable energy assets.

Modern monitoring and management of digital platforms are based on advanced machine learning algorithms, which provide clear visibility to accurately pin-point the root cause of potential problems or under-performance across the grid.

Through the deployment of software applications or apps, operators can convert received measurements into advanced analytics, which deliver deeper and richer performance insights from existing automation systems with diagnostic information and condition-based monitoring.

Photovoltaic plants with digitalisation embedded into their systems can adjust and stabilise power even at marginal levels, across multiple sites, and flex according to demand. These capabilities provide a real and effective virtual power plant (VPP).

A VPP collects units under one central control system. Almost all power generation and storage technologies can be part of a VPP including biogas, biomass, combined heat and power (CHP), wind, solar, hydro, diesel and fossil fired plants.

In these installations, the use of smart inverters with digital capabilities and cloud-based services has delivered full interaction with local utility monitoring and control systems, together with advanced remote tools to enable cost effective energy management.

This results in a more efficient energy flow in the network, according to local consumption and utility's energy strategy (peak-shaving), a better fine tuning of the power quality in the whole local infrastructure and real-time predictive maintenance with troubleshooting and root causes detection.

Solutions such as ABB Ability cloud-based services, can control and optimise virtual power plants and correlate optimised day-ahead load schedules with updated actual load schedules of units, forecast deviations, intra-day trading of free capacity, and disturbances/down-times for each balance group in the district. The system architecture is scalable, from a few up to many thousands of units and customers can implement their own business model.

It provides real-time optimisation of set-points and provision of balancing power while considering current system constraints and ramp speeds. The solution handles real-time processing of large signal and data sets. It manages optimal unit commitment and control of assets in one step.

Thanks to digitalisation, it is possible to improve performance, uptime and yield with reduced CAPEX and OPEX costs related to the installation, commissioning as well as any soft costs associated with renewable energy projects.

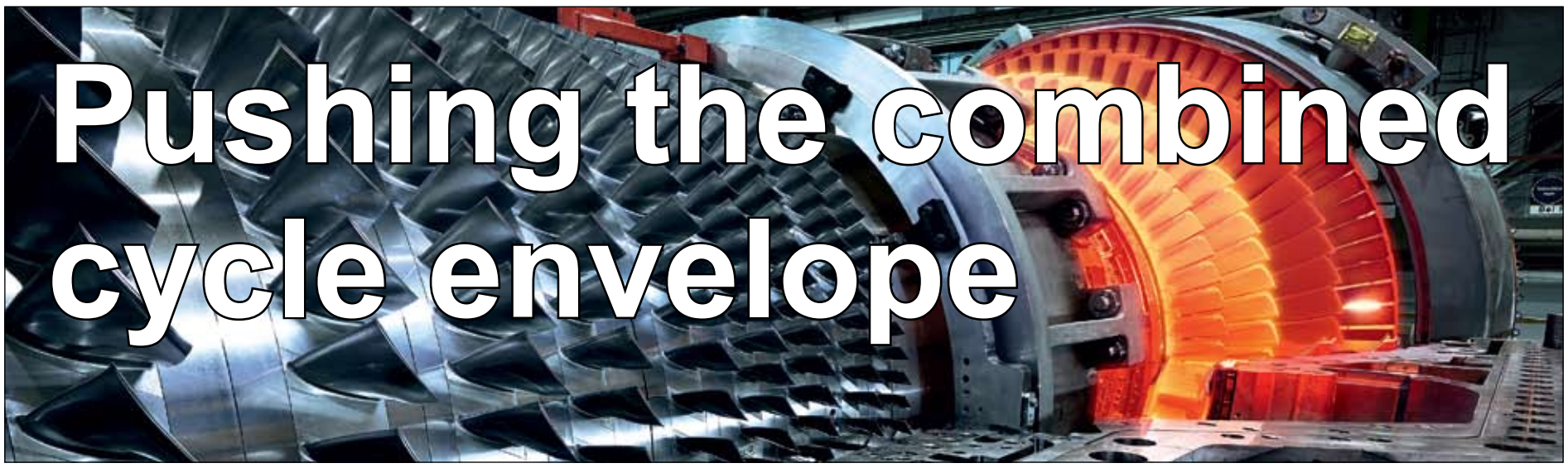
Having a clearer picture of asset performance and health, and being armed with the capabilities to undertake remote asset monitoring and condition-based maintenance, is a great step forward in simplifying workloads, structures and reducing costs in line with modern utility needs and operator grid code requirements.

Access to these intelligent insights and the interpretation of data provides a holistic overview and understanding to control and drive down transmission and distribution costs as demand peaks and troughs between the grid and operators.

As utilities and operators review interaction between renewables and consumption following the emergence of prosumers and the rising costs of energy supply, DER and VPPs are likely to determine the increased uptake of digitalisation and deliver greater need for solar power and storage.

Today, the solar industry should not only focus on producing clean energy but also on how it can produce clean energy that can be controlled, integrated and balanced through IoT. The solar industry is poised to lead the charge on digitalisation to create a more sustainable, consistent energy flow for today and tomorrow.

Leonardo Botti is Global Head of Product Management – PG Solar at ABB



Pushing the combined cycle envelope

In a move that signals the next step in the evolution of combined cycle plant efficiency, Siemens has launched its HL-class gas turbines with the promise of delivering efficiency levels beyond 63 per cent. **Junior Isles** visited the company's Berlin facility to hear the thinking behind the launch and how this level of performance will be achieved.

Gas fired generation has suffered in recent years. Squeezed between cheap coal and renewables as well as weak electricity demand, the market for gas turbines has shrunk dramatically.

According to Siemens, the size of the market has fallen by one third, down from more than 75 GW/annum (around 850 units per year) in 2011 to around 50 GW/annum (about 500 units) in 2016. The company notes, however, that there has been a shift in the market, with a move to "jumbo frames"

Karim Amin, Head of Sales and Customer Operations, Siemens Power and Gas, explained: "Renewable tariffs have been falling, today reaching below three [US] cents per kilowatt-hour in some parts of the world. At the same time, their installed capacity additions has gone from around 70 GW/annum in 2011 (less than 30 per cent of the market) to over 40 GW/a (about 40 per cent of the market) and we believe renewables will take an increasing share going into the future."

"What's happening in the gas turbine market resonates with what's happening here [in renewables]. However, there has also been a change in the Frames that make up the 50 GW/a. The E-class and F-class used to have the lion's share but what we are seeing now is more large, or 'jumbo frames' (H and J class) as well as small GTs for decentralised solutions."

According to Siemens, this shift has seen the share of jumbo frames in the market go from less than 10 per cent in 2011 to more than 35 per cent in 2016. "This shows us that we need to be at the cutting edge of innovation in this area of the market," noted Amin.

With falling renewable prices, gas turbine plant suppliers, faced with falling sales, have to find ways of making gas fired power plants more competitive.

Arguably, Siemens was the first company to successfully introduce an H-class gas turbine to the market with the startup of the unit at the Irsching 4 (renamed Kraftwerk Ulrich Hartmann) combined power plant in Germany in 2010. At the time, the plant set a new world record of 60.75 per cent for plant efficiency, a figure that has been subsequently improved on at other plants.

Having sold around 90 of these machines worldwide, the company is now taking the next step to improve the power density of the machine and push combined cycle efficiency to beyond 63 per cent, while increasing the operational flexibility needed for operating alongside variable renewables on the grid.

"It has been designed to be a very good complement for fluctuating renewables, as well as a highly efficient baseload system," said Amin.

The new HL-class will be available in three versions: the SGT5-9000HL and SGT6-9000HL for the 50 Hz and 60 Hz markets, respectively, and the SGT5-8000HL for the 50-cycle market.

According to Siemens, the SGT5-9000HL and SGT6-9000HL are designed to have simple cycle power outputs of 567 MW and 388 MW, respectively and 841 MW and 577 MW in combined cycle. Simple cycle efficiency is 42.6 per cent and 42.3 per cent for the 50 Hz and 60 Hz versions, respectively. Siemens says the SGT5-8000HL has a simple cycle output of 481 MW and 708 MW in combined cycle. Simple cycle efficiency is 42.6 per cent. All turbines will achieve more than 63 per cent electrical efficiency in combined cycle, claims the company.

Despite the significantly improved performance, Siemens notes that the new HL draws heavily from the proven H-class design. Like the H-class machine, the HL design is air-cooled and uses the same single tie-bolt rotor 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

"The HL is an evolutionary step from our H-class, not a revolution," said Guido Schuld, Head of Market Introduction New Gas Turbine Technologies. 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 similarities between the H and HL machines mean they have almost the same footprint. In fact the HL is slightly shorter in length due to one less compressor stage – 12 instead of 13. Siemens engineers have nevertheless managed to increase the compression ratio (from 21:1 in the H-class machine, to 24:1) through the use of what it calls its third generation enhanced 3D blades, which improve aerodynamic efficiency.

A similar can-annular combustion system is also retained but is modified to improve fuel/oxygen mixing through the utilisation of a higher number of pre-mix burners – increased from eight to 25. This allows the firing temperature to be increased by around 100 K, while maintaining low NO_x levels. 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. The SGT5-8000HL is able to ramp at 85 MW/min, compared with 55 MW/min for the SGT5-8000H and can achieve NO_x levels of 45 ppm (2 ppm with selective catalytic reduction) at 30 per cent load.

The HL retains a 4-stage turbine design but the higher firing temperature calls for improved blade coating. The turbine vanes and blades, with the exception of the last stage blade, feature a multi-layered thermal barrier coating to withstand higher firing temperatures for longer periods. Blade cooling is also improved. "We have been able to manufacture sophisticated cooling channels inside the blades to enable improved cooling without consuming more air," said Schuld.

The last stage turbine blade is uncoated but is also internally cooled, unlike the 8000H. In addition to accommodating the higher firing temperature, this also allows exhaust gas temperature to be 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.

Siemens is confident of achieving the predicted operation and performance figures. The company is taking a step-wise approach to testing and validation, as it did with the 8000H, which after testing was validated under grid conditions at Irsching before being introduced to the market.

"Our three-step approach involves component testing at the Siemens Clean Energy Centre so we can test combustion parts under real engine conditions. The second step is at the Berlin Test Facility, where we can test a complete engine. But size limitations mean we cannot test the HL-class here. So we came up with a better solution; we found a customer in the US that will allow us to perform tests and validate the engine."

The customer, Duke Energy, will operate the engine in open cycle at its Lincoln County site in North Carolina, according to the demands of the grid. The site currently has 16 gas turbines operating in simple cycle and capable of generating 1200 MW during short periods at times of peak demand.

Construction of the new unit could begin as early as 2018, with testing and validation beginning in 2020. After four years, ownership of the unit will be handed over to Duke Energy for full commercial operation.

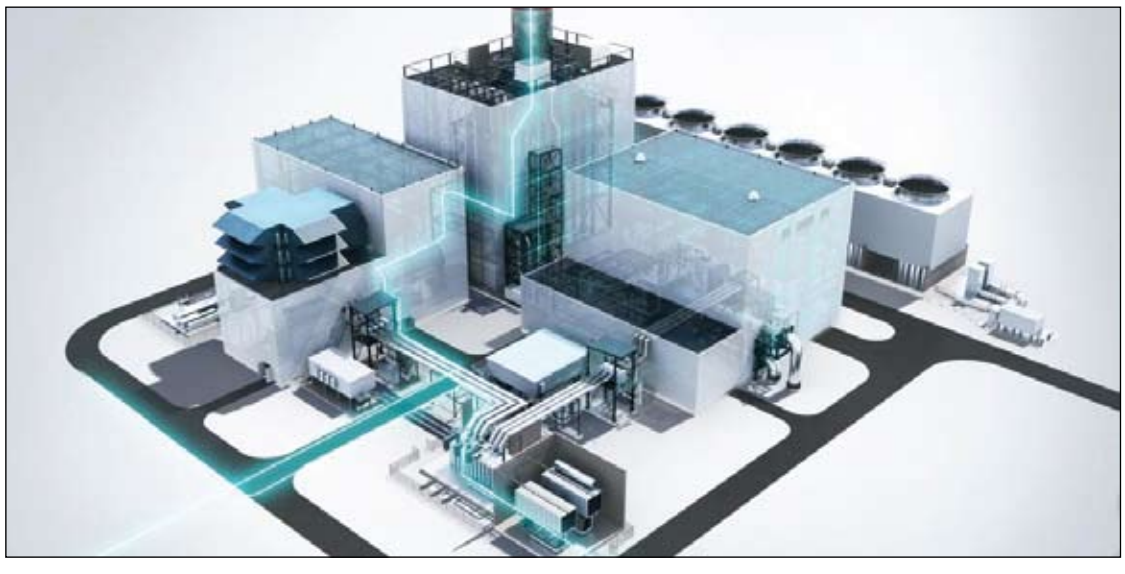
Commenting on the new unit, David Fountain, Duke Energy's North Carolina President said: "This unique arrangement with Siemens offers a significant cost saving to our customers while providing one of the most advanced, efficient gas turbine units in the US. This new technology will provide us with flexible peaking power needed to complement intermittent solar energy resource for our customers and lower emissions across our fleet."

Despite the challenging market for gas turbines, Siemens remains confident in the prospects for the new turbine. With gas prices at high levels in key markets such as Asia and the Middle East, plant efficiency is key. It stresses that increasing efficiency by two percentage points compared to the SGT-8000H has a significant impact on savings. When assuming a gas price of $8.00/million Btu, Siemens' calculations show that the LCOE can be reduced by about 5 per cent compared to the SGT-8000H. This results in savings of $15-20 million per year

Savings will be even greater as efficiency is increased to 65 per cent, which Siemens says is the mid-term goal that will be achieved through higher firing temperature and improvements in the water steam cycle.

According to the International Energy Agency's latest *World Energy Outlook*, the power sector will resume its role as the main engine for gas demand growth after 2025. If forecasts are correct, the introduction of the HL and combined cycle plants operating at 63 per cent and beyond will be well placed to play an important role in the evolving energy landscape.

Improving efficiency: Artist's impression of a HL combined cycle power plant



The world if… only marriage was simple

Junior Isles

Predicting the future is always interesting – even if those predictions seldom turn out as expected.

The Economist hosted a panel at its recent *Energy Summit* based on a publication it issues once a year entitled: 'The World if?' During the session, panellists discussed three imagined but plausible scenarios for the global energy mix: What would happen if renewables made up half of the electricity mix? Or if batteries came down to $100/kWh? What if oil demand started to plummet?

Although rising rapidly, at the moment wind and solar only account for about five per cent of the global energy mix. Meanwhile, battery prices are currently around the $300/kWh mark. So clearly there is a long way to go.

Mark Jacobson, Professor of environmental engineering at Stanford University, USA, set the tone for the debate by focusing on the first question. He fired the opening salvo of the session by stressing that 50 per cent renewables should not be the endgame. He believes the target has to be much higher.

"Electricity is only 20 per cent of all energy; so 50 per cent of electricity means we are only decarbonising 10 per cent of the energy. So we look at situations where we decarbonise 100 per cent of all energy sectors – electricity, transportation, heating and cooling, industry, agriculture, forestry, fishing, everything. The reason we look at this is because to avoid 1.5°C warming, and to eliminate the 4-7 million deaths that occur each year by burning fossil and biofuels, we need to transition to 80 per cent of all energy to clean renewable energy by 2030 and 100 per cent by 2050. This would get us down to 350 ppm by 2100."

He stressed that there was much to be gained by electrifying all energy sectors, noting that 42 per cent of all energy use could be eliminated by transitioning to clean renewable energy and implementing additional energy efficiency improvements, with another 15 per cent saved through the use of heat pumps for low temperature heating and cooling.

It is certainly possible to get to 50 per cent renewables in electricity. Places like California, with 32 per cent (excluding large scale hydro), are already well on the way. The US state expects to reach 50 per cent by 2020 – well ahead of a proposed law to reach 50 per cent by 2027 and 100 per cent by 2045.

A crucial unknown, however, is what the other 50 per cent of global electricity generation will look like. Laura Cozzi, Co-head of the *World Energy Outlook* at the International Energy Agency, observed that much depends on India and China, which are both adding huge amounts of wind and solar in particular. "By 2025, solar PV will be the least-cost solution to produce electricity in India. It will also be the least-cost solution in China. However, the key question is: who wants to be the other half? Who wants to engage in this marriage where you are married to a very volatile person that doesn't always behave as you would like them to?"

But volatility is not the only challenge. In a marriage where renewables are also driving down the wholesale cost of electricity, it is also a question of 'who' will become the other half in what will be an economically challenging arrangement?

Much will depend on how carbon markets and carbon prices develop, as well as a country or region's particular circumstances, as to which form of conventional generation it might be. But it will also hinge on the nature of renewables availability.

Christoph Frei, Secretary General and Chief Executive Officer, World Energy Council explained: "In California, there is almost homogenous wind and sun… but in many places it is very inhomogeneous in the way that it comes in. In India, for example, two thirds of the wind energy is available in three months. That poses the question of seasonal storage. So it's not only about 'who' is the other half, it's also a question of how you manage the massive difference in incoming renewables."

Essentially we are going from living in a world where we have had an unstable demand taken care of by a stable supply, to one where it is the supply that it is unpredictable. This means that the marriage of renewables with other generation will require widespread deployment of digitalisation, a trend that is already well under way.

Louis Shaffer, Distributed Energy Segment Manager, Europe, Middle East and Africa Region, Eaton, echoed Frei. "In every different country and every different region, how the wind and sun come about are different, depending on the time of year. With BNEF [Bloomberg New Energy Finance] we did quite an in-depth study looking at specific countries and what happens on the days (hours, weeks, months, etc.) when you have lots of sun and lots of wind, as well as on days when there is very little sun and very little wind."

He agreed that technologies such as hydrogen and digitalisation to help match demand and supply were key but added that markets and policies are going to be important. For example, many argue that because storage is often classed as a generating asset, it diminishes its economic case.

"We need transparency and markets that allow people to get the value out of something. The storage market is clearly something that will grow very fast as we remove these market barriers," said Shaffer. He added: "In the past, generation was a generating plant; now generation can be on the roof… today there are technologies that allow us to balance supply and demand cost-effectively – more cost-effectively than the way we run the grid today.

Yet just having the technology to facilitate the integration of large amounts of wind and solar will not be the main driver. The reason a growing number of experts believe the power industry will get to 50 per cent renewables is due to falling costs.

Shaffer said: "With regards to whether we will get to 50 per cent renewables, the answer is yes. Clearly the costs of solar and wind are coming down. People are realising that not only are they lower cost compared to building a new plant, but soon we will see the case where it's actually lower cost to install wind and solar than running your existing [fossil] plant."

If volatility and economics of the marriage are key, then in essence the big question is: what will be the lowest cost option while keeping the grid stable? Professor Jacobs believes cheap renewables married to a host of non-fossil burning options is perfectly feasible and cost-effective. He pointed to a recent study by Lazard looking at the levelised cost of energy in the US.

"For the first time they looked at combining solar and batteries; it was 8.2¢/kWh. Onshore wind was the cheapest form of electricity by far in the US, followed by utility-scale solar at about 5¢/kWh, with [baseload] gas at around 6 ¢/kWh. Nuclear was about 15¢/kWh. Solar plus batteries is already cheaper than nuclear and cheaper than new coal.

"We did a study for the entire world. We developed renewable energy plans for 139 countries broken down into 20 world regions and came up with stable grids in all 20 regions. Each one had a different mix of wind and solar but we found we could have a stable grid everywhere, so we do believe it is possible."

No doubt it is technically feasible but some believe storage will not be the single affordable partner for renewables any time soon. The Lazard report stated: "Although alternative energy is increasingly cost-competitive and storage technology holds great promise, alternative energy systems alone will not be capable of meeting the baseload generation needs of a developed economy for the foreseeable future."

Going forward, digitalisation will provide flexibility in the system, and at the same time the cost of storage will come down. But in most countries – even by the time renewables reaches 50 per cent in the electricity system – it is unlikely that renewables will have a monogamous relationship with any single technology.