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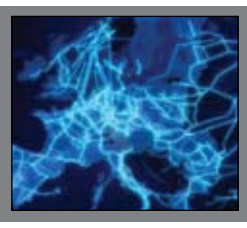

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Renewables transition takes hold in MENA countries

Diversifying the energy mix: Saudi Energy Minister, Khalid al-Falih

Countries in the Middle East and North Africa are accelerating the shift towards renewables after a long period of slow activity. **Junior Isles**

The transition from a fossil based energy economy to one based on renewables is gathering momentum in oil and gas producing countries in the Middle East and North Africa (MENA) region.

A study by EY showed that renewables activity picked up in 2016 across the Middle East and Africa after a long period of slow activity and would continue to do so going forward.

According to the report on 'Power transactions and trends', the focus in 2017 will be very much on the Kingdom of Saudi Arabia's renewable energy programme, now that this has been launched by the Ministry of Energy, Industry and Mineral Resources. Moreover, a tender in 2018 for 300 MW will boost solar capacity in the kingdom, followed by other tenders for 900 MW in 2019 and 750 MW in 2020.

In February Saudi Arabia, the world's biggest oil exporter, took the first step towards a goal of generating 9.5 GW of energy from solar and wind by 2023 when it issued a request for qualification (RFQ) for two projects. One is for 300 MW of solar energy to be built in Al-Jouf province, in the kingdom's north. The second is for a 400 MW wind power development in Tabuk, northwestern Saudi Arabia, the energy ministry said in a statement.

Those that have successfully prequalified to bid will be announced on April 10th. Selected companies will then move on to further elimination rounds, with the final project award expected on October 20th.

Virtually all of the kingdom's power currently comes from crude, refined oil or natural gas but the government's Vision 2030 economic reform programme, plans to wean itself off its dependency on fossil fuels for power production.

The EY report also noted that Egypt, one of the top 40 most attractive destinations for renewable energy, is planning to build solar plants with an an estimated capacity of 250 MW. In December, Jordan, another top 40 destination, announced its third renewable energy tender for 200 MW and 100 MW of wind energy. Meanwhile, Morocco plans to build 800 MW of solar plants in 2017 and Tunisia plans to attract $429 million in foreign investment to build 320 MW of renewable energy by 2020.

The region's particular interest in

Continued on Page 2

Countries join forces to accelerate global energy transition

Ministers and representatives from frontrunner countries in the energy transition met on the sidelines of the Berlin Energy Transition dialogue in Germany to discuss the urgency for the world to move onto a trajectory of sustainable low carbon economic growth, while meeting increasing global energy demand and addressing climate change. They also emphasized that the technologies and business models to do so are available today.

At the meeting, ministers and high-level representatives from China, Denmark, Germany, Indonesia, Mexico, Morocco, and the United Arab Emirates, agreed to work together to establish an Energy Transition Coalition in the course of this year for accelerating the transition to a sustainable energy future. The Coalition will assemble countries leading in developing long term energy transition strategies to foster investments in a low carbon energy sector. Ensuring increased investor certainty for low carbon economic growth by developing energy transition strategies will be at the heart of the Energy Transition Coalition.

"Few people would have imagined the scale and pace of the energy transition which we are witnessing today. Renewable energy deployment has considerably expanded thanks to reduced costs and record new investments in power generation from renewables. Energy efficiency is picking up and we see important synergies emerging with renewable energy," said International Renewable Energy Agency (Irena) Director-General Adnan Z Amin. "Many countries are proving that the ongoing energy transition in fact has multiple positive social, economic and environmental impacts. By working together, we can hasten the transition to a sustainable energy future," he added.

During the meeting Irena and the International Energy Agency (IEA) launched a joint report, which claims that decarbonisation of the global energy system, led by renewables and efficiency could be achieved by 2060, while creating economic gains.

The study – *Perspectives for the Energy Transition: Investment Needs for a Low-Carbon Energy Transition* – states that global energy-related CO_2 emissions can be reduced by 70 per cent by 2050 and completely phased-out by 2060 with a net positive economic outlook.

While overall the energy investment needed for decarbonising the energy sector is substantial – an additional $29 trillion until 2050 – it amounts to a small share (0.4 per cent) of global GDP, it claims.

Furthermore, Irena's macroeconomic analysis suggests that such investment creates a stimulus that, together with other pro-growth policies, will boost global GDP by 0.8 per cent in 2050; generate new jobs in the renewable energy sector that would more than offset job losses in the fossil fuel industry, with further jobs being created by energy efficiency activities; and improve human welfare through important additional environmental and health benefits, thanks to reduced air pollution.

Renewable energy now accounts for 24 per cent of global power generation and 16 per cent of primary energy supply. To achieve decarbonisation, the report states that by 2050 renewables should be 80 per cent of power generation and 65 per cent of total primary energy supply.

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investing in solar power comes as countries see the economic benefits resulting from falling prices. Algeria recently announced that it is preparing to launch a call for tenders for a number of 100 MW-plus solar projects in the country, and also for one or several photovoltaic (PV) component factories.

EY's report also noted that the United Arab Emirates is supporting sustainable development projects for energy and electricity by launching the Dubai Green Fund worth $27 billion.

A separate study by researchers at Lappeenranta University of Technology (LUT) shows that major oil-producing countries in the MENA region could turn their abundant renewable energy resources into lucrative business opportunities in less than two decades.

According to the study, a fully renewable electricity system (100 per cent RE) is roughly 50-60 per cent cheaper than other emission-free energy options for the MENA region. For example, new nuclear power costs around €110/MWh. Fossil-CCS options costs around €120/MWh. But the cost of the fully renewable energy electricity is around €60-40/MWh, based on financial and technical assumptions of the year 2030.

Prof. Breyer: the transformation requires a "fundamental change in how we think carbon"

The cost of wind and solar electricity would reduce further to €37-55/MWh if different energy resources were connected with a super grid that allows the transmission of high volumes of electricity across longer distances, said the report.

Notably for Iran, the price could go as low as €40-45/MWh. Such a low cost shows that the transition of the current fossil-based electricity system towards a fully renewable electricity system can cover all electricity needs in the decades to come.

"The low cost renewable electricity system is a driver for growing standards of living, continued economic growth, in particular also for energy intensive products, and finally more peace," emphasized Christian Breyer, Professor of Solar Economy at LUT.

The scientists also prepared a scenario in which a 100 per cent renewables system can still use carbon fuels and chemicals for aviation, materials and medicine. These are the most difficult sectors to decarbonise because batteries are too heavy for powering airplanes and the carbon atom is needed in plastics and various chemicals such as solvents and medicine.

"The picture that emerges from that study is that the fossil fuel industry can transform its business to meet the COP21 target of a net zero emission energy system. This requires fundamental change in how we think carbon, but it could potentially open major new business opportunities," said Breyer.

Coal continues to suffer under global clean energy agenda

Demand for new coal fired plants has fallen dramatically, according to a new report from a group of environmental organisations.

The report published by the Sierra Club, Greenpeace, and CoalSwarm says there has been a 62 per cent drop in new coal plant construction starts globally and a 48 per cent reduction in worldwide pre-construction activity mainly due to shifting policies in Asia.

Now in its third year, the report, entitled: '*Boom and Bust 2017: Tracking The Global Coal Plant Pipeline*', says there has been a dramatic clampdown on new coal plant projects by Chinese central authorities, which saw an 85 per cent decline in new coal plant permits. At the same time it notes that there has been financial retrenchment by coal plant backers in India.

In China and India, which account for 86 per cent of the world's coal fired plants, construction is now frozen at over 100 project sites.

"2016 marked a veritable turning point," said Lauri Myllyvirta, senior global campaigner on Coal and Air Pollution at Greenpeace and co-author of the report. "China all but stopped new coal projects after astonishing clean energy growth has made new coal fired power plants redundant, with all additional power needs covered from non-fossil sources since 2013."

Over 300 GW of projects in various stages of development were put on hold until after China's 13th Five Year Plan (2016–2020), including 55 GW of projects already being built.

In addition to the decline in new plant development, the survey also found that globally there has been a record-breaking 64 GW of coal plant retirements in the past two years, mainly in the European Union and the US.

According to the report, the combination of a slowed new coal plant pipeline and an increase in out-dated coal plant retirements brings the possibility of holding global temperature increase to below 2°C above pre-industrial levels "within feasible reach", provided countries continue to step up action.

Ted Nace, director of CoalSwarm said: "… the abrupt shift from fossil fuels to clean sources in the power sector is a positive one for health, climate security, and jobs. And by all indications, the shift is unstoppable."

Nicole Ghio, senior campaigner for the Sierra Club's International Climate and Energy Campaign added: "The staggering uptick in clean energy and reduction in the new coal plant pipeline is even more proof that coal isn't just bad for public health and the environment – it's bad for the bottom line."

Coal proponents, however, insist that the dramatic reduction may be temporary. Benjamin Sporton, head of the World Coal Association, said it should not come as a huge surprise that some new coal plants had been put on hold.

He told the *Financial Times* there was a "degree of overcapacity at the moment" in India, where demand had fallen short of expectations, but noted that the country was investing "very substantial" sums to make its coal power plants more efficient. China, he argued, was reducing coal station numbers because of broader shifts in its economy rather than a wholesale defection from coal power. He also noted that "very substantial" increases in coal power were planned in countries such as Indonesia and Vietnam.

E.On remains upbeat despite huge losses

German utility E.On is confident of its future despite reporting huge losses, believing that its re-organisation positions it to take advantage of the energy transition.

Junior Isles

E.On remains upbeat despite posting the biggest loss in the company's history, claiming that its re-organisation clears the way for its "healthy core operating businesses" to grow in the future.

The German utility posted a net loss of €16 billion for 2016, more than double the loss for 2015, on the back of write-downs on power generation and higher provisions for Germany's nuclear clean-up.

Last year, in response to Germany's shift away from nuclear power and the rapid adoption of renewables, E.On split into two. Its conventional coal and gas fired power stations, energy trading and gas production units were spun-off into a separate company, called Uniper. Its energy networks, customer solutions, and renewables business segments will continue to be run under the E.On name.

Commenting on the results, E.On CEO Johannes Teyssen said: "2016 was a transitional year. The impact on our balance sheet marks a turning point and clears E.On's way into the new energy world. It enables us to focus all our energy on our three core businesses: energy networks, customer solutions, and renewables."

The renewables division of E.On SE achieved higher earnings in 2016 compared to 2015, thanks to the operation of two offshore wind farms and the proceeds from certain asset sale transactions.

The renewables arm recorded full-year adjusted earnings before interest and tax (EBIT) of €430 million, up by 10 per cent on the year. E.On attributes this improvement mainly to the fact that the 302 MW Amrumbank West and 219 MW Humber Gateway offshore wind farms were, for the first time, operating during the entire year.

The Offshore Wind/Other segment contributed €338 million to adjusted EBIT, up from €202 million from a year earlier, and Onshore Wind/Solar added €92 million, down from €189 million.

As at December 31, 2016, E.On had 4176 MW of fully-consolidated renewable energy generating capacity, with the attributable generating capacity amounting to 4574 MW. Both were up 5 per cent on the year.

Despite the improved performance of the renewables and other business segments, Moody's downgraded E. On's credit rating to Baa2 from Baa1 on the back of the poor overall figures and current plans to turn the company around.

Commenting on the results, Professor David Elmes, of Warwick Business School, Head of the Global Energy Research Network said: "E.On would desperately like to draw a line under the old company that generated electricity from fossil fuels and now be seen as a new company with a mix of energy services and renewables. Today's results throw many of the problems that change created into a huge loss.

"Researchers talk of energy transitions taking 20-30 years and we're making that change in half that time or less. That means there's a cost and that's part of the bills we pay. It also opens up the debate of whether we should carry on with big power stations and centralised networks, or shift to energy being made, stored and consumed more locally. The new version of E.On looks to move ahead with those ideas."

■ E.On has appointed Anja Dotzenrath as the new Chief Executive Officer of E.On Climate & Renewables and Michael Lewis, the current CEO of the company's renewables division, as the new CEO of E.On UK.

North Sea Wind Power Hub moves forward

Plans for an offshore hub in the North Sea to link thousands of future offshore wind turbines progressed last month, with the signing of a trilateral agreement between the transmission system operators (TSOs) driving the project.

In March TenneT TSO B.V. (Netherlands), Energinet (Denmark) and TenneT TSO GmbH (Germany) signed the agreement aimed at investigating the feasibility of one or more 'Power Link Islands'. Known as the 'North Sea Wind Power Hub', the island has the potential to supply 70 to 100 million Europeans with renewable energy by 2050.

According to TenneT, a North Sea Wind Power Hub project at a location with shallow waters and optimal wind conditions could make the energy transition both feasible and affordable for European consumers.

TenneT CEO Mel Kroon commented: "This cooperation with Energinet is an invitation to TSOs from North Sea countries as well as other infrastructure companies to join the initiative. The ultimate goal is to build a solid coalition of companies that will make the European energy transition feasible and affordable."

"Building one or more artificial islands in the middle of the North Sea sounds like a science fiction project, but it could actually be a very efficient and affordable way for the North Sea countries to meet the future demand for more renewable electricity," commented Torben Glar Nielsen, CTO of Energinet, .

The current idea is to build the North Sea Wind Power Hub at a location like Dogger Bank. TenneT says a total capacity of possibly 70 000 MW to 100 000 MW of wind capacity could be connected to one or more Power Link Islands. Such a Power Link Island would create near-shore transmission connections and reduce costs at offshore locations.

Generated wind energy could then be distributed and transmitted via direct-current connections to all countries bordering the North Sea: the Netherlands, Denmark, Germany, the United Kingdom, Norway and Belgium.

Trump takes aim at climate plans

US President Donald Trump's plan to dismantle the Clean Power Plan could harm the US economy and leave the country behind in the battle against climate change.

Siân Crampsie

US President Donald Trump's latest executive order to roll back Barack Obama's climate change efforts threaten to undermine the country's commitment to the Paris Agreement.

Trump signed the executive order at the end of March in front of an audience of coal miners at the offices of the Environmental Protection Agency (EPA), promising "to lift the restrictions on American energy, to reverse government intrusion, and to cancel job-killing regulations".

The executive order takes a broad swipe at regulations ushered in during Obama's presidential years to reduce the USA's greenhouse gas emissions, most notably the Clean Power Plan (CPP).

It instructs the EPA to begin the process of unwinding the CPP. It also initiates a review of the Department of Justice's defence of the rule in court, and for a working group to "reconsider" the social cost of carbon. In addition, the order brings to an end the moratorium on new and modified coal leasing on public land.

Trump's move is part of his so-called Energy Independence policy. "We are going to continue to expand energy production, and we will also create more jobs in infrastructure, trucking, and manufacturing," said Trump. "This will allow the EPA to focus on its primary mission of protecting our air and protecting our water. Together, we are going to start a new energy revolution – one that celebrates American production on American soil."

His announcement was met with swift and strong criticism from environmental quarters, including the World Resources Institute (WRI). "In taking a sledgehammer to US climate action, the administration will push the country backward, making it harder and more expensive to reduce emissions," said Dr. Andrew Steer, President and CEO of WRI. "Climate science is clear and unwavering: mounting greenhouse gas emissions are warming our planet, putting people and business in harm's way."

Trump's order will force the EPA to contradict its own findings on climate change that it cited on issuing the final CPP rule in August 2016, which incorporated feedback from 4.3 million comments and months of meetings with state regulators, utilities, and officials. It will also have to overturn its 2009 finding that greenhouse gases endanger public health.

The executive order does not indicate whether the USA will withdraw from the Paris Agreement on climate change. However, eliminating the CPP will make it difficult for the country to meet its obligations to cut its carbon emissions to 26 per cent below 2005 levels by 2025. The CPP requires a 32 per cent reduction in power plant CO_2 levels from 2005 levels by 2030.

"Around the globe, countries have committed to transition to a low-carbon economy that will make the world safer and more prosperous," added Steer. "Make no mistake: This Executive Order will undermine people's health and the US economy. It hands moral authority and global leadership over to others, leaving America behind."

NRC accepts SMR for review

Siân Crampsie

Designs for the first small modular reactor (SMR) have come one step closer to approval and production following the acceptance of NuScale's plans for review by the USA's Nuclear Regulatory Commission (NRC).

NuScale announced last month that its design certification application has been accepted by the NRC, meaning that it met the requirements for a full-scale technical review.

The announcement came just weeks after GE Hitachi Nuclear Energy (GEH) said it had reached a deal with Advanced Reactor Concepts (ARC Nuclear) to collaborate in the development and licensing of an advanced small modular reactor (aSMR) based on mature Generation IV sodium-cooled reactor technology.

NuScale, a subsidiary of Fluor Corp., submitted its 12 000-page application in December 2016 and said that it expected the NRC's review to take at least 40 months.

"There is still much to do and we firmly believe that not only will NuScale be the first SMR certified by the US NRC, but that the size and simplicity of the NuScale design will change the way we think and talk about nuclear going forward," said NuScale COO and CNO Dale Atkinson.

SMR technology has gained traction as a commercially viable option for utilities due to its small-scale, modular nature. It is also carbon-free and simpler in design compared to large-scale nuclear reactor units.

The first commercial NuScale power plant is planned for construction on the site of the Idaho National Laboratory for the Utah Associated Municipal Power Systems (UAMPS) and operated by Energy Northwest.

Conservative estimates predict approximately 55-75 GW of electricity will come from operating SMRs around the world by 2035, NuScale said. "There is a real need to upgrade American infrastructure to provide for clean and reliable electricity to spur growth in the US," Atkinson added.

Earlier in March, GEH signed a memorandum of understanding (MOU) with ARC Nuclear to progress a joint aSMR design for power generation applications. The first unit could be deployed in Canada, GEH said.

The companies will pursue a preliminary regulatory review by the Canadian Nuclear Safety Commission through its Vendor Design Review process, building on earlier technology licensing success in the US. This collaborative commercialisation programme also includes the near-term goals of confirming projected construction and operating costs, as well as the identification of a lead-plant owner/operator for the joint aSMR.

GEH and ARC Nuclear have each developed advanced reactor designs based on the EBR-II, an integral sodium-cooled fast reactor prototype, which was developed by Argonne National Laboratory and operated successfully for more than 30 years at Idaho Falls, Idaho.

US storage market ramps up

- California surges ahead of PJM
- E.On plans 20 MW

Siân Crampsie

German energy giant E.On says that it is aiming to establish itself as a leading energy storage provider in the USA.

The firm has teamed up with Greensmith Energy to build two grid-scale energy storage systems in Texas, totalling 20 MW of storage.

The move follows an announcement by AES that it had completed construction of a 30 MW energy storage facility in California capable of storing up to 120 MWh of energy.

The projects are the latest in a raft of new storage projects in the USA and indicate that the market has reached a turning point.

GTM Research said last month that the energy storage market in the USA doubled in terms of MWh deployed in 2016, largely thanks to a very active fourth quarter.

According to GTM Research and the Energy Storage Association's 'US Energy Storage Monitor 2016 Year in Review' report, 230 MWh came online in the fourth quarter of 2016, more than the sum of the previous 12 quarters combined.

Both California and PJM have been pivotal markets in the growth of energy storage in the USA, with the former surging ahead of PJM in 2016 as the largest market for utility-scale energy storage.

GTM expects the US energy storage market to grow from 221 MW in 2016 to roughly 2.6 GW in 2022. Other key regions to emerge in the storage market will include Hawaii, Massachusetts, New York and Texas, it added.

In Texas, E.On North America will deliver two 9.9 MW short duration energy storage plants based on lithium ion technology, it said.

The projects are designed to provide ancillary services to the Electric Reliability Council of Texas (ERCOT) market and will be capable of responding to shifts in power demand quickly, increasing system reliability and efficiency.

"The battery energy storage systems will be an integral part of the wind farm facilities near Roscoe, Texas, and will be charged from the wind farm," Mark Frigo, VP of Energy Storage North America at E.On, commented. "These projects will benefit from the lessons learned and experience accumulated on our Iron Horse project, which is currently under construction."

In California, AES Energy Storage installed a lithium-ion storage facility for San Diego Gas & Electric under a programme implemented by the California Public Utility Commission to fast-track energy storage capacity.

IEA applauds Mexico's transformations

Mexico has won praise from the International Energy Agency (IEA) for its pursuit of energy market reforms.

The Paris-based agency's latest review of Mexico's energy sector says that the country's efforts to restructure its oil and gas and power sectors has attracted investment and led to improved transparency and energy security, and has strengthened environmental sustainability.

Mexico initiated its energy reform process in 2013, ending decades-long monopolies. "In terms of scope, depth and pace of implementation, Mexico's energy reform ranks as the most ambitious energy system transformation worldwide in a long time," said Paul Simons, the IEA Deputy Executive Director.

The IEA has called for reforms to continue, however, particularly with respect to the break-up of national electric utility CFE, and strengthening energy security.

The IEA also said that Mexico is set to increase its share of renewable energy production, increase energy efficiency and slow the growth in carbon dioxide emissions.

Last month Mexico's Energy Minister Pedro Joaquín Coldwell noted that some 52 new renewable energy projects were planned for construction by 2019, representing investments of $6.6 billion. He added that the country would install a further 12 000 MW of wind power capacity in the next 15 years, with half of that already under construction or in the planning phase.

Acciona said recently that it had started construction of the 168 MW El Cortijo wind farm in Tamaulipas state. It is due to start operating in 2018.

Acciona is also planning to begin construction this year of the 339 MWp Puerto Libertad photovoltaic (PV) complex in Sonora.

China keeps the lid on emissions growth

■ CO_2 emissions and coal consumption fall ■ Focus on efficient nuclear sector

Syed Ali

China's fossil fuel emissions have stalled for a third year running, according to analysis by Greenpeace. The country is forecasting a significant drop in CO_2 emissions of approximately 1 per cent, according to Greenpeace East Asia's analysis of China's National Energy Administration forecasts for 2017. This would be the fourth year in a row of either zero growth or a decline in CO_2 emissions.

Statistics recently released by the Statistical Communique on Economic and Social Development show that coal consumption in 2016 fell for the third year in a row, by approximately 1.3 per cent.

The new data reflects China's efforts to move to a cleaner energy economy. Notably, in late March Beijing closed its last coal fired plant. The Huangneng Beijing thermal power plant is the fourth to be closed and replaced by gas fired generation. Its closure follows China's annual legislative sessions, where Premier Li Keqiang promised to "make our skies blue again" in his state-of-the-nation speech.

According to *Xinhua*, Beijing has become the country's first city to have all its power plants fuelled by natural gas, an objective laid out in 2013 in the capital's five-year clean air action plan.

Following the shutdown of the four coal fired power plants, annual coal use has been reduced by about 8.56 million tonnes, which accounts for nearly 70 per cent of the reduction target.

China is investing heavily in renewables and nuclear in an effort to cut coal use and meet its CO_2 emission targets.

In the Government Work Report delivered during the fifth session of the 12th National People's Congress on March 5, Premier Li Keqiang said China will develop nuclear power in a safe and highly efficient way.

Installed nuclear capacity more than doubled to 27.17 GW in the 12th Five-Year Plan (2011-15) and is expected to double again by 2020 to 58 GW.

Meanwhile, last month the country moved closer to merging two of its nuclear power developers. China National Nuclear Corp, a holding company for reactor design and technology, and China Nuclear Engineering Corporation Group, a company that focuses on construction, said in regulatory filings in late March that a strategic reorganisation of the two nuclear giants is under way.

Joseph Jacobelli, a senior analyst of Asian utilities and infrastructure at Bloomberg Intelligence said that the plan is to boost internal efficiencies in the country's nuclear sector and improve competitiveness overseas.

Australian regulator warns of potential shortages

The Australian Energy Market Operator has warned there could be widespread power shortages in New South Wales and South Australia from next year, followed by Victoria in 2021 and Queensland from 2030.

The regulator's Chief Operating Officer Mike Cleary recently told *ABC*: "If we do nothing, we're going to see shortfalls in gas; we're going to see shortfalls in electricity. If we use the gas for electricity, the potential for shortfalls are in the domestic and the industrial (supplies). If we use it in industrial and domestic, the shortfalls will be in electricity."

Modelling showed supply shortfalls of between 80 GWh and 363 GWh could be expected from summer 2018/19 until 2020/21, if there was no new development to support more gas fired electricity generation.

Cleary stressed that gas and electricity markets could no longer be viewed in isolation, and there was a need for a single energy view from a national perspective.

Energy supply shortfalls could be mitigated in the short term by increased gas production and the possibility of LNG exporters redirecting a small portion of their production to the domestic market. At the same time he said the country would have to increase coal fired generation and renewable energy output.

In March the government of South Australia unveiled a $550 million plan to take charge of the state's energy future and deliver reliable, affordable and clean power.

The South Australian government is building Australia's largest battery to store energy from the wind and sun, part of a new Renewable Technology Fund that supports clean, dispatchable and affordable power. It is also building a government-owned 250 MW gas-fired power plant to provide emergency back-up power and system stability services. In the meantime, it will procure temporary back-up generation if necessary.

■ Australian company Edify Energy and German investor Wirsol have secured A$230 million ($174 million) for three new large-scale solar farms: the Whitsunday and Hamilton solar farms in Collinsville in north Queensland and the Gannawarra solar farm, the first large-scale solar farm in the southern state of Victoria. The funding for the plants, which have a combined capacity of 165 MW, is claimed to be the country's largest single solar project financing deal so far.

Indonesia closes in on electrification target

Indonesia's plan to increase national electrification to 99 per cent by 2019 received a significant boost last month when state-owned power utility PT Perusahaan Listrik Negara (PLN) signed contracts to build 16 projects with a total generating capacity of 1825.5 MW.

The projects are part of the government programme to add 35 000 MW of new generating capacity by 2019. At the signing ceremony, PLN chief executive Sofyan Basir said the projects would include development of 500 kV transmission systems along the northern part of Java.

It is estimated that some of the projects would be completed in 2018 so that the government's electrification target could be reached in 2019, he said. In addition to improving power supply in certain areas of the country, the projects are also designed to replace old and inefficient oil fired power plants.

In a separate development, a consortium of Asian banks has agreed to finance the expansion of the Tanjung Jati B coal fired power plant in Indonesia's Central Java province. The Japan Bank for International Cooperation (JBIC) announced that it has signed a loan agreement with PT Bhumi Jati Power (BJP) for $1678 million supporting the project.

The finance is part of a co-financing deal agreed with a number of other Asian financial institutions, including Mizuho Bank, Sumitomo Mitsui Banking Corporation and the Bank of Tokyo-Mitsubishi, amounting to $3.355 billion.

The project involves the construction and operation of an ultra-supercritical plant with an installed capacity of 2000 MW in Jepara district.

Reports predict significant smart grid investments

Two separate industry reports are forecasting huge investments in the Indian smart grid sector.

A new study recently published by Northeast Group LLC is projecting that smart grid infrastructure investment will total $44.9 billion over the period of 2017-2027.

Ben Gardner, President of Northeast Group, said India has always been seen as the largest potential smart grid market for international vendors but noted that, in spite of extensive government plans and pressing concerns over the $23.2 billion lost each year due to power theft, this potential has been slow to materialise.

Some utilities, however, are now progressing out of the pilot stages with multi-million end-point smart meter projects. India's recently established National Smart Grid Mission has plotted out a deployment schedule for the next ten years but several utilities are already moving forward with smart grid deployments independent of government plans.

A separate report by Navigant Research also predicts that India will be a lucrative market for smart grid companies. According to the report, annual smart grid revenue in India is expected to grow from $12.6 billion in 2017 to over $32.3 billion in 2026.

"Driven by the need to improve grid reliability and reduce system losses, India's Ministry of Power has made an aggressive effort to jump-start this nascent smart grid market," said Michael Kelly research analyst with Navigant Research. "Yesterday's government-sponsored initiatives have evolved from simple electrification schemes and basic IT infrastructure establishment to include smart metering, distribution automation (DA), substation automation (SA), distributed energy resources development, advanced enterprise system implementation, and more."

Minister Goyal is jumpstarting the nascent smart grid market

Smart grid infrastructure is seen as fundamental to the government's effort to incorporate large-scale renewable resources and meet the surging requirement for power across the country.

The Asian Development Bank (ADB) last month said it is lending $500 million for new power transmission capacity in India to better connect the northern and southern regions and facilitate the integration of renewables.

■ All National Thermal Power Company coal fired power plants over 25 years old will be phased out and converted into supercritical plants to augment generation capacity and reduce pollution, Power Minister Piyush Goyal informed the Lok Sabha in March. Separately, BHEL announced the commissioning of a 660 MW supercritical thermal unit in Maharashtra.

Committee slams UK energy policy

■ Plan B needed for Hinkley ■ Interventions "poorly designed"

Siân Crampsie

UK energy policy has prioritised renewables ahead of energy prices and security, according to a new report from a government committee.

The House of Lords Select Committee on economic affairs says the rapid growth of renewable energy in the UK has come at a price for consumers, and that energy security should be put at the forefront of policy because of the country's narrow capacity margin.

The Committee's report – 'The Price of Power: Reforming the Electricity Market' – is an analysis of the UK's energy policy and its impact on the current state of the sector. It is also heavily critical of numerous government interventions in the electricity market, and of the Hinkley nuclear power project.

Chairman of the Committee, Lord Hollick, said: "Poorly-designed government interventions, in pursuit of the decarbonisation, have put unnecessary pressure on the electricity supply and left consumers and industry paying too high a price.

"Domestic electricity bills in Britain have gone from being second cheapest in Europe in the mid-2000s to the seventh cheapest today. Britain's high industrial electricity prices have led some energy-intensive industries to relocate abroad. Low-carbon policies are a factor in these high prices."

The conclusions of the report have been questioned by market experts, who have criticised it for being short-sighted. Michael Grubb, Professor of International Energy and Climate Change Policy at UCL, who gave evidence to the inquiry, said: "Contrary to [the report's] claim, industrial electricity prices in Britain today are not the highest in Europe, and industry also receives significant direct compensation for policy costs.

"It cites the big rise in electricity bills without acknowledging the impact of gas prices as a key historic driver of this over the past decade. It is comparing apples with oranges in a generalised claim that generation from fossil fuels is cheaper than renewables."

Dr Jonathan Marshall, energy analyst at the Energy and Climate Intelligence Unit (ECIU) said that the report's recommendations favoured fossil-fuel power. "The report makes a number of recommendations that would ultimately favour new fossil-fuelled generation capacity, weakening or missing targets set under the Climate Change Act," said Marshall. He added: "Swinging changes in policy are simply not what the energy sector needs."

The report cites the new Hinkley Point C reactor project as "a good example of the way policy has become unbalanced". It does not provide good value for money for consumers and there are substantial risks associated with the project, the report concludes, and suggests that the government formulate a "Plan B" for nuclear.

The government is banking on the 3.2 GW nuclear power plant to provide up to seven per cent of the UK's energy by the middle of next decade and, together with new projects at Moorside and Sizewell, are expected to help cut carbon emissions by 57 per cent from 1990 levels by 2030.

"The government must make sure that the security of the UK's energy supply is the priority of its energy policy," said Lord Hollick. "Affordability must not be neglected and decarbonisation targets should be managed flexibly.

"We would like to see the government step back from the market and allow all generating technologies to compete against each other. It should establish an Energy Commission to ensure competitive auctions have independent oversight and are scrutinised carefully."

■ The UN Economic Commission for Europe (UNECE) has asked the UK to suspend construction of the Hinkley Point C nuclear power plant pending assessment of the environmental impact. Germany, Norway and the Netherlands claim that the UK has failed to properly consult neighbouring countries over the potential environmental risks of building the new nuclear reactors in Somerset, and have formally requested that a trans-boundary environmental impact assessment is carried out.

Paks expansion clears state aid hurdle

The expansion of Hungary's only nuclear power plant is set to go ahead after the project cleared a final regulatory hurdle. The European Commission has said that financial support being provided by Russia for the project meets state aid rules.

It said in a statement that its decision was made "on the basis of commitments made by Hungary to limit distortions of competition".

The approval removes the last roadblock to the €12.5 billion ($13.2 billion) expansion of Hungary's only nuclear facility. Austria has criticised the decision and is threatening to take the case to the European Court of Justice in Strasbourg. Environmental groups have also labelled the decision as irresponsible.

"It's allowing massive subsidies for a project backed by a government that openly challenges the importance of independent oversight for nuclear safety," Greenpeace said.

The 1200 MW Paks II plant will comprise two VVER-1200 reactors built by Rosatom and will be 80 per cent financed by Russia.

The existing Paks plant consists of four VVER-440 pressurised water reactors, which started up between 1982 and 1987. It produces close to 40 per cent of all electricity produced in Hungary.

Ideol partners with Gaelectric

■ Hendry report boosts confidence
■ Mott MacDonald to advise Northern Gateways

Gaelectric is hoping to open up waters around the Irish coast to offshore wind development after sealing a deal with French floating foundation specialist Ideol.

The two companies have signed a memorandum of understanding to develop floating offshore wind energy projects in Irish waters using Ideol's patented 'Damping Pool' technology.

They are aiming to investigate several sites in Irish waters for both short term pre-commercial and long term commercial-scale projects, with an initial objective to develop a 30 MW+ turbine array project, followed by a multi-gigawatt commercial scale extension on both Irish coasts.

Floating offshore wind energy technology is gaining traction in the global offshore wind market due to its ability to open up areas to development that are not suited to fixed foundation turbines.

A number of demonstration projects have been developed in Europe and Japan, including Ideol's Floatgen project currently under construction off the Atlantic coast of France near Saint-Nazaire.

Last month the Scottish government gave the go-ahead for the installation of two floating wind farms off the coast of Scotland. Dounreay Tri is planning to install a 10 MW, twin turbine project off the north coast of Scotland, while Atkins Ltd. and Pilot Offshore Renewables want to install eight Senvion units on floating foundations off the coast of Aberdeen.

The Irish government's Offshore Renewable Energy Development Plan has identified a potential for the generation of as much as 27 000 MW from floating offshore wind installations in Irish coastal waters. "In Ireland, we are blessed with significant reserves of wind energy which are having very tangible impacts in driving energy prices down and improving the sustainability of electricity generation," said Gaelectric Founding Shareholder, Brendan McGrath. "Offshore wind speeds are faster and more consistent. We should also be able to deploy larger turbines with the prospect of moving up to 10 MW turbines."

In January Ideol announced a new partnership with Atlantis Resources to establish a 1.5 GW pipeline of floating offshore wind projects in the UK. The French firm said that the move was a key element of its strategic goal of developing large commercial-scale wind farm projects.

ElecLink takes shape

France and the UK will boost their electricity interconnection capacity by 50 per cent on completion of a new link.

The foundation stone for the £490 million ElecLink interconnector was laid at the end of February and it is hoped that the new cable will not only improve energy security but also support the development of clean energy across Europe.

The 1000 MW high voltage direct current (HVDC) interconnector is the first to be developed between Britain and France since 1986, and will operate as a private electrical interconnector. It has also been designated as a European project of common interest (PCI).

ElecLink will reduce carbon dioxide emissions by approximately 6 million tonnes over the period 2020-2030 by enabling electricity demand in Britain and France to be met by the most efficient generating plants, says ElecLink, a subsidiary of Groupe Eurotunnel.

ElecLink will use the infrastructure of the Channel Tunnel, avoiding the need for submarine cables to be laid. Siemens will build the converter stations in the UK and France, while Balfour Beatty and Prysmian will undertake the installation of the DC cables inside the Channel Tunnel and the underground AC cables on the UK side.

French network firm RTE will install the underground AC cables in France.

Siemens said that its contract is valued at €315 million. Its scope includes converter stations at Peuplingues in France and Folkestone in the UK. Prysmian will provide the 51 km-long, ± 320 kV extruded HVDC underground cable that will run through the rail tunnel.

Notably the link, which is scheduled to start operating in early 2020, is the only interconnector to be privately financed.

Speaking at the ceremony marking the launch of the project, UK Energy Minister Jesse Norman said: "We've created the right environment for co-operative projects like ElecLink to attract investment and compete in the market without needing financial support from our tax and bill payers."

Steven Moore, CEO, ElecLink said the link would improve security of supply and "reduce the risk of blackouts" in the UK. He said it would also allow the country to avoid the "significant cost" of building new generating capacity.

■ Last month Irish energy company ESB officially opened its new 884 MW gas fired power station at Carrington near Manchester, UK. It is the first new large scale, high efficiency, gas fired plant to come on to the British electricity grid since 2013. Speaking at the opening of the station, Ellvena Graham, Chairman of ESB, said: "…this new power station comes into operation at a time when efficient, reliable and flexible power plants such as Carrington are increasingly needed to ensure security of electricity supplies into the future."

Sweihan on track as world's largest PV park

■ Solar price hits new low ■ Mohammed bin Rashid Al Maktoum Phase II on line

Siân Crampsie

The developers of the world's largest solar power plant are aiming to reach financial close on the project this month after signing a 25-year power purchase agreement.

Marubeni Corp and JinkoSolar Holding have inked a contract to sell the output from the 1177 MW Sweihan solar farm in Abu Dhabi to the Abu Dhabi Water and Electricity Co (ADWEC), part of the Abu Dhabi Water and Electricity Authority (ADWEA).

The two companies won a competitive tender for Sweihan, achieving a record-low price for energy from a solar photovoltaic (PV) farm. The project will be built, owned and operated by a special-purpose company, with Marubeni and Jinko each taking a 20 per cent stake and Adwea holding the remaining 60 per cent.

The $872 million Sweihan project will be built 100 km southeast of Abu Dhabi. Marubeni and Jinko submitted a bid of 2.42 US cents/kWh for the project, according to local media reports.

A Jinko Solar spokesman said that it believed that the 2.42 cent price level was the new normal for the solar industry. Prices of solar panels have fallen by 80 per cent since 2009, according to the Abu Dhabi-based International Renewable Energy Agency (Irena).

The price achieved for the Sweihan plant is nearly 17 per cent lower than the previous record set in Chile of 2.91 cents/kWh and 19 per cent cheaper than Dubai's 800 MW third phase of the Mohammed bin Rashid Al Maktoum solar complex.

The solar project is a key element of the United Arab Emirates' clean energy strategy and could start operating in 2019.

The clean energy strategy includes plans to invest up to $163.3 billion to meet demand and aims to enable $190 billion in efficiency savings. Other key projects include the Mohammed bin Rashid Al Maktoum solar park in Dubai, the capacity of which is set to reach 5 GW by 2030, including a concentrated solar power portion. Dubai aims to have a clean energy share in power of 25 per cent by 2030.

The 200 MW Phase II of the Mohammed bin Rashid Al Maktoum solar park has started operating, the Dubai Electricity and Water Authority (DEWA) said in March.

Last month the UAE's Ministry of Energy signed a contract with professional service firm Pricewaterhouse Coopers (PwC) to conduct a technical and economic study of the country's electricity sector.

PwC will analyse and forecast current and future demand for power and the sectors plans and policies for production, distribution and operation to 2030, according to state news agency *WAM*. It will cover the Emirates National Grid, a risk assessment, development of solutions, identification of future opportunities and recommendations to meet demand.

AFD supports Eskom grid goals

■ Financial backing for transmission development plan
■ Kusile unit 1 reaches full load

A loan facility from French development agency Agence Française de Développement (AFD) will help Eskom to continue its efforts to strengthen its transmission grid.

The South African utility has agreed a R6 billion ($462.4 million) multitranche loan with AFD. The funds will support Eskom's programme to extend and reinforce its power grid, a crucial element of the company's development strategy.

Eskom has connected some 62 IPP projects to the national grid with a cumulative capacity of 4200 MW. These projects are part of the Department of Energy's Renewable Energy Independent Power Producer (REIPP) and Peaker programmes.

A further 620 MW is expected to be added to the grid in the 2017/2018 financial year as more projects from the REIPP programme are integrated into the national grid, Eskom says.

In addition, the utility is continuing to drive its universal access programme, which aims to connect all households to the national grid by 2020.

In March Eskom said that it had connected 35 000 customers to the grid in Eastern Cape province in the 11 months ending in February 2017.

Eskom said in a statement that AFD's funding will focus on transmission lines and substations that support grid strengthening in areas where the development of future renewable energy sources are envisaged as well as to support the facilitation of cross border transmission projects.

■ Unit 1 of Eskom's 4800 MW Kusile power project in Mpumalanga reached full load for the first time in March. The milestone follows first synchronisation of the unit in December 2016 and brings it a step closer to full commercial operation.

EEHC examines coal bids

Efforts to boost generating capacity in Egypt are paying off.

The Egyptian Electricity Holding Company (EEHC) has announced it will sign an agreement with Tractebel Engineering Consultancy Company to evaluate the offers made to establish a coal fired electricity plant with a capacity of 6000 MW.

Seven global firms have submitted offers to build the new plant in the Hamrawein area on the Red Sea coast, and Tractebel will assist EEHC in the evaluation of the technical and financial aspects of the bids.

Bids were received from Shanghai Electric, Dongfang Electric, and the consortiums of Harbin-General Electric; Elsewedy-Marubeni; Mitsubishi-Hitachi, Sumitomo Electric; and APEC-Orascom, EEHC said.

In March Siemens announced the official inauguration of the first phase of a 'mega' power project it is building in Egypt.

The German firm says that it has connected 4.8 GW to the Egyptian grid just 18 months after signing a contract for the delivery of three turnkey combined cycle plants. The three plants will add 14.4 GW to Egypt's grid and are scheduled to be fully operational in May 2018.

Egypt's government is aiming to boost installed generating capacity by over 50 GW by 2030 in order to support ambitious economic growth plans. It has encouraged investment in coal, gas and renewable energy plants, according to EEHC.

Last month the Egyptian Electricity Transmission Company (EETC) approved a planned 64 MW solar power plant at Benban, Aswan.

The move has enabled project partners Infinity Solar, ib vogt and Solizer to reach financial closure on the project, which is being developed under Egypt's feed-in tariff (FiT) subsidy programme.

The project is part of the Benban solar development complex, which will have a total capacity of up to 1.86 GWp when completed.

It will be constructed and commissioned by ib vogt GmbH as the engineering, procurement and construction (EPC) contractor and O&M services provider. Commercial operation is scheduled for the end of 2017, when the plant's output will be sold to EETC under a 25-year power purchase agreement.

Floating wind interest grows

The demand for offshore wind projects using floating foundations is growing as developers seek new areas for development. Bloomberg New Energy Finance (BNEF) says that as much as 237 MW of floating offshore wind energy capacity could be installed globally by 2020.

The appetite for the technology is being driven by the need to open up new areas for development in waters deemed too deep for traditional, fixed turbine foundations. Both established offshore wind energy markets such as Europe and emerging offshore wind markets in Asia are interested in the technology.

Scotland has granted planning permission for as much as 92 MW of floating offshore wind capacity. French firm Ideol – a specialist in floating offshore wind energy – has agreed deals with both Gaelectric and Atlantis to develop large-scale pipelines in Ireland and the UK, respectively.

"Floating wind has the potential to bring clean energy to island nations that might not have much land and the seabed is too deep for normal offshore wind," said Tom Harries of BNEF.

The technology could play an important role in the offshore wind sector's efforts to cut costs because it will enable developers to access good wind sites previously thought to be too expensive to develop.

Projects in Japan include the Fukushima Hamakaze demonstration project, installed in 2016, and the Kitakyushu project, which is due to start construction this year.

France has a total of four pilot floating wind projects, including a 24 MW pilot floating wind farm in the Gruissan area and another 24 MW project planned by Eolfi and CGN for the Groix area.

In November 2016, Portugal gave the green light to the development of the 25 MW WindFloat Atlantic (WFA) project in Viana do Castelo, 20 km off the coast of Northern Portugal, which is scheduled to be operational next year.

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Egypt's 'Megaproject' delivers 4.8 GW in 18 months

Phase 1 of Egypt's 'Megaproject' has been officially inaugurated. The connection of 4.8 GW to the grid in record time is a significant milestone in the construction of three massive combined cycle plants that support the country's plans for sustainable development through a stable energy infrastructure. **Junior Isles**

Burullus at night: one of three giant 4.8 GW CCGT plants under construction in Egypt

On March 2, German Chancellor Angela Merkel and Egyptian President Abdel Fattah El-Sisi officially inaugurated the first phase of a 'megaproject', which when completed will boost Egypt's generating capacity by 45 per cent. The inauguration is a significant milestone in what is essentially the simultaneous construction of three massive combined cycle gas turbine (CCGT) power plants at separate locations. Most notably, however, it also sets a new industry benchmark in terms of modern power plant construction – the connection of 4.8 GW of new capacity to the grid in only 18 months.

The megaproject will see Siemens and its local partners, Orascom Construction and Elsewedy Electric, build three 4.8 GW plants at Beni Suef, Burullus and New Capital for Egypt Electricity Holding Company. Siemens has overall responsibility for the design, delivery, supervision of installion and commissioning of the power plant equipment – 24 gas turbines, 12 steam turbines, 36 generators, 24 heat recovery steam generators, instrumentation and controls and 3 x 500 kV gas insulated substations (GIS) – while Orascom and Elsewedy are responsible for overall construction, engineering and procurement of most of the balance-of-plant (BoP).

As part of the megaproject, Siemens will also deliver 12 wind parks with up to 600 wind turbines and a capacity of 2 GW. At a combined cost of €8 billion, the 16.4 GW megaproject represents the biggest ever order in Siemens' history.

More importantly, however, the megaproject will bring much needed power to 45 million people by boosting the country's installed generating capacity by 45 per cent. For Egypt, the massive increase in new capacity is crucial. The country's major urban centres started to experience power cuts in 2011, particularly in summer, and the situation reached a peak in September 2014 when the country faced an almost total blackout.

At the end of 2012/beginning of 2013 the worsening situation led Siemens to look at how it could support the government in overcoming the energy challenge.

Emad Ghaly, CEO, Siemens Egypt, recalled: "We developed a concept which we called the 'Trusted Advisor' where, together with our customers and the government, we worked on various energy mix scenarios that could fit the availability of natural gas and other domestic natural resources… we believed the energy landscape had to be transformed so it was sustainable, affordable and efficient."

It was a detailed exercise lasting about 18 months, at the end of which Siemens recommended a couple of scenarios based on introducing high efficiency combined cycle gas fired plant based on Siemens H-class technology as well as on renewables, i.e., wind and solar.

"These were the two energy sources we thought would help Egypt overcome the power cuts while optimising the use of fuel in the overall power generation landscape," said Ghaly.

The proposal ties in with the government's plans for diversifying its energy mix. Currently, more than 90 per cent of electricity generated in Egypt comes from fossil fuels, with the bulk – 70 per cent of the total – coming from gas fired plants. Less than 8 per cent is produced by hydropower, while wind and solar represent just 1 per cent. The government, however, has adopted a strategy aimed at boosting the use of renewables – mostly wind, as well as concentrated solar power (CSP).

Egypt's gas resources received a huge boost in August 2015 with the discovery of the Zohr gas field, the largest gas discovery made in the Mediterranean. Some 1 billion ft^3 of gas from the field is expected to come on stream by the end of this year and produce 2.7 bcf/day by the end of 2019. With the development of the field, it is expected that this will boost the country's gas export capabilities.

Ghaly commented: "This will be a massive benefit to the economy and the energy system at large."

The Zohr field will certainly provide a cheap source of gas for the three combined cycle power plants, which will be the most efficient in the country.

The three power plants have an identical design – each comprises four 1200 MW combined cycle blocks in a multi-shaft, or 2-on-1 configuration, i.e. two SGT5-8000H gas turbines, each with its own generator and HRSG, with steam from the HRSGs feeding a single steam turbine with its own generator.

Each plant will have an electrical efficiency of over 61 per cent, which will improve plant economics. The more than 61 per cent efficiency of the CCGT blocks is significantly higher than the current efficiency of the installed capacity average and is expected to save around $1.3 billion per year in natural gas consumption. High efficiency also ensures low emissions. At base load, guaranteed values for NO_x and CO are 25 ppm and 80 ppm, respectively.

The high efficiency of the combined cycle blocks can be largely attributed to the H-class advanced gas turbines, which form the heart of the power blocks.

The SGT5-8000H is a single- or mulit-shaft machine of single-casing design. It is one of the world's most powerful gas turbines in commercial operation, designed to deliver about 400 MW in simple cycle operation and over 1200 MW in multi-shaft combined cycle operation.

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Exhaust gas from the gas turbine, at a temperature of about 630°C, is fed to a three-pressure HRSG. The HRSG is a Benson-type boiler also supplied by Siemens (following its acquisition of NEM).

The HRSG supplies 107 kg/s of high pressure (HP) steam at 589°C and pressure of 178 bar[g]; 122 kg/s of reheat steam (RH) at 585°C/34.5 bar[g] and 11 kg/s of low pressure (LP) steam at 247 °C/4 bar[g]. Steam from the HRSG is combined with expanded RH steam so total flow to the steam turbine is 133 kg/s.

Steam from the HRSG is fed to a 400 MW steam turbine that features a HP section and a combined intermediate pressure/low pressure (IP/LP) section.

Completion of all 12 combined cycle bocks is scheduled for 2018, at which time they will be the largest CCGT power plants ever built and operated in the world.

Construction of the plants has been a monumental task, one that has called for close collaboration between Siemens and its Egyptian partners and customers from the outset. Although Siemens has the biggest share (62 per cent) of the contract and is consortium leader, it was paramount that the companies worked seamlessly.

turbines, 12 steam turbines, 36 generators, 24 heat recovery steam generators, 24, bypass stacks, 24 stacks, four air-cooled condensers and 36 transformers).

Ullrich was full of praise for the EPC core team and all units that contributed to the timely delivery of all key components. "I must say they did a fascinating job; I am proud of their dedication, flexibility and excellence."

The delivery of 36 generators meant Siemens had to call on both its generator factories in Mülheim, Germany, and Charlotte in the US. "Twenty of the generators were manufactured in Mülheim and 16 were manufactured at our Charlotte premises," said Ullrich.

At the same time, NEM had to manufacture the biggest 24 HRSGs in the history of gas fired power plants – a huge undertaking. "You cannot imagine how many tons of steel, the amount of piping, welding and fabricating this requires," noted Ullrich.

He stressed that global sourcing was one of the early challenges. "When you purchase and import in total over 1.6 million tons of material with 7000 containers from all over the world, then you face a great challenge to find qualified suppliers that can provide

Steam turbine components being lifted on to the transport vessel. The first steam turbine arrived at North Sea port in December 2016

One of four 400 MW gas turbines arriving at the Beni Suef power plant

"From the beginning while we were preparing contract documentation, we worked as one team together with our partners and customers," said Ghaly. "And we are still working as one team at all levels."

The official contract for Beni Suef, Burullus, New Capital and the wind farms was signed in June 2015 at a ceremony in Berlin attended by President Al-Sisi. In December that year the government signed the six substations contract with Siemens to distribute part of the 14.4 GW of power, which will be generated from the three power plants.

In essence, however, the project started before contract signing. Peter Ullrich, Project Director for the three CCGT plants said: "The project started during the last phase of negotiations, which in this case was a very short phase."

Once the contract for the three power plants was concluded, instructions were given to Siemens manufacturing facilities worldwide that they would have to work around the clock to meet the delivery schedules for the main equipment (24 gas

the required quantities at the highest quality and transport them in a very short time in order to meet our fast-track schedule. Managing the whole logistics process has been a huge challenge.

"After manufacturing the goods, the whole delivery and logistics process, outside and inside of Egypt, was a great challenge but we managed," said Ullrich. "This was only possible by relying on responsible teams and partners thanks to all stakeholders and local authorities in Egypt."

While Siemens has total responsibility for the manufacture, delivery, installation of equipment and commissioning of the plants, the tremendous work and effort of managing civil, construction and erection works was down to the local partners, who "excelled in doing a remarkable job".

Ullrich said: "We did not need to import civil engineering, since this was a great strength locally."

Orascom Construction and Elsewedy Electric were therefore responsible for all site preparation work, e.g. fencing, site levelling and

huge investments in training of local people, e.g. in welding schools to maximise the local added value and knowledge transfer.

The footprint of each power plant

piling where necessary; and subsequent civil works, which includes concreting, steel erection and the construction that is still ongoing. Orascom and Elsewedy have made

is 1200 m x 600-800 m, depending on the location. Roughly the same space is needed during the construction phase for laydown area and preparation.

Civil works and site preparation was by no means plain sailing. Burullus is located in a nature reserve between Burullus Lake and the Mediterranean Sea, which meant the ground conditions were very swampy. This meant 18 400 piles, each with a diameter of 1 m and 30 m long, had to be driven into the ground in order to stabilise the site.

Ullrich explained: "The site is right on the beach, so to speak – you would be constantly building on a swamp area into the water. So first we had to raise the whole level by 2 m to drain the site, and then pile in order to support the thousands of tons of concrete."

Beni Suef presented a different set of challenges. As Ullrich explained: "We had to excavate 1.6 million m^3 of rock – the size of the small pyramid in Giza – in order to level a 40 m slope between the Nile and the entrance to the site. The slope is in a rock formation, which you can't build on, so you have to build terraces. There are five different terraces at five different heights. We had to use 120 rock excavation machines to form the terraces on which the power plant components are placed."

Although a significant distance, Beni Suef is also reachable – either from the Port of Alexandria on the Mediterranean coast or from the port on the Red Sea. Each are approximately 300 km away.

Accessibility, however, was an issue that had to be addressed at Burullus. There is just one road to the Mediterranean harbour, which was not in the

One of the HRSG modules for Beni Suef combined cycle power plant being loaded on to a vessel in South Korea

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The first H-class gas turbine being loaded in Rotterdam on to a heavy load carrier before starting the journey to Egypt

necesary condition to withstand the massive loads of up to more than 600 tons for some equipment brought to site. Siemens therefore decided to refurbish and develop a nearby fishing port in less than six months so it could accept the larger ships used for transporting equipment. "The advantage of this is that it is only 16 km from the site with no bridges to cross. This has really paid off," noted Ullrich.

The location of the plants has presented a challenge in terms of manpower. There are currently around 20 000 workers across the three sites and this number is expected to peak to around 25 000 during this upcoming summer. Yet sourcing workers has not always been easy – the remote location of Burullus has been a challenge. For New Capital, a commutable distance from Cairo, it has been easier. There is also a larger pool of skilled workers to choose from. Ullrich added: "It is only 40 minutes from Cairo and it is also easier to obtain the tools, etc., that might be needed for construction on a daily basis." Beni Suef is a larger town and, likewise, sourcing workers is not too difficult.

Notably, Siemens is supporting the training of a local workforce of 600 engineers and technicians that will run the plants after handover. In addition, at the beginning of March Siemens announced details of a strategic alliance agreement with Germany's Federal Ministry for Economic Cooperation and Development (BMZ) to support occupational training of around 5500 Egyptian workers over the next four years. The agreement aims to create a new sustainable training platform that will be servicing many industries and SMEs in Egypt.

As part of the agreement, Siemens will join forces with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of BMZ, for the establishment and the operation of a joint training centre as well as the strengthening of one selected Egyptian public vocational training institute. The programme is designed in line with Egypt's objectives outlined in 'Egypt Vision 2030' to promote long-term economic growth, create new jobs and increase the competiveness of Egyptian industries.

The challenge of training workers and constructing the three CCGT plants is being done under tremendous time pressure. Certainly the schedule is ambitious. The first 4.8 GW has been brought on line in a record-breaking 18 months – with an over-achievement of 400 MW on top of the projects' contractual time schedule – and most of the remaining 9.6 GW will be close to completion by summer 2018.

At Beni Suef, for example, the first gas turbine (designated GT42) arrived at North Sea Port in March 2016 and was connected to the grid by the end of November. Following performance testing and its reliability run, it was handed over for commercial open cycle operation at the end of March, 2017. The first steam turbine arrived at North Sea port in December 2016 and was placed on its foundation in January 2017. Chemical cleaning of the first HRSG will start at the end of July and first steam to the steam turbine is scheduled for mid-October this year. The reliability run of the combined cycle power plant is planned to begin in early 2018, before commercial handover of the first CCGT block (CC block 30) in April.

The CCGT power plants for Egypt's megaproject have set all kinds of records and milestones and will no doubt continue to do so. The project is not only the biggest in Siemens' history but proves Siemens is able to execute these giant projects on time.

"For Siemens, it's an iconic project," said Ghaly. "As a company we are very proud of it. Internally we have created new benchmarks to reach what we have already achieved in Phase 1, and hopefully will achieve in Phase 2. Having overcome the challenges of Phase 1, we are confident we will do the same in Phase 2."

The megaproject will supply the electricity needed for Egypt's economic growth and meet the needs of a population that will grow from nearly 95 million today to 109 million in 2025 (based on UN estimates).

"Forecasts show it will provide enough power to meet demand up until 2022/23, said Ghaly. "With the commissioning of the 14.4 GW, Egypt's electricity challenges will be solved for the foreseeable future."

H.E. Dr. Mohamed Shaker, the Egyptian Minister of Electricity and Renewable Energy, commented: "Siemens power projects will definitely make an important contribution to our power strategy. I believe these projects are a great example of how Egypt recognises the importance of working with international long-term partners, like Siemens, to drive the country's sustainable economic growth."

At the inauguration of Phase 1, Joe Kaeser, President and CEO of Siemens AG was understandably proud of the efforts made in order to fulfil the company's commitment to the Egyptian government. "We made a promise to Egypt and we kept our word. And by doing so, we not only over-achieved in performance, we also broke all records in modern turnkey power plant construction," he said.

"This was only possible by the outstanding collaboration between the government, the Ministry of Electricity, the Egyptian Electricity Holding Company and a dedicated and competent Siemens team. This underscores that Egypt and its people, and any other nation or partner, can count on Siemens to support mission-critical developments in their economy and society. Siemens is the best partner for such megaprojects, which can make a difference for entire nations."

In reflecting he concluded: "There have been a lot of historic moments and a lot of highlights, and it is a day that will be remembered… I am very proud of the Siemens team and of course of our partners. It has been a good day today, and now tomorrow we have to continue with the second phase."

Beni Suef: Only 18 months after the signing of the contract, Siemens has set a new worldwide benchmark for the execution of fast-track power projects

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A prosperous future will soon become a reality as Egypt's power generation capacity is increased by an astounding 50%. To achieve this, Egypt is joining forces with Siemens to bring a reliable and stable energy mix to the grid. Three combined-cycle power plants will supply clean energy produced by the world's most powerful gas turbines. Additionally, up to 600 wind turbines are expected to turn desert wind in Egypt into sustainable energy. Siemens has been in Egypt for 115 years and is committed to improving the future for businesses and people alike. Including those enjoying concerts at the pyramids. And that's Ingenuity for life.

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CGCB-A10140-00-7600

Inter RAO closes in on 2020 targets

■ EBITDA up 33 per cent ■ Installed capacity reaches 34.6 GW

Junior Isles

Financial results issued by Inter RAO Group, one of Russia's largest energy export and import operators, show it is well on its way to becoming one of the world's top 10 energy company's in terms of installed production capacity by 2020.

Key targets the group has set itself under its 2020 strategy are to reach an installed production capacity of 34.6 GW and an EBITDA (earnings before interest, tax, depreciation and amortization) of Rubles100 billion ($1.75 billion). In its end of year figures for 2016, Inter RAO reported EBITDA of Rubles96.3 billion – a 33 per cent increase over 2015. This was on consolidated revenues of Rubles868.2 billion. Installed capacity reached 32.5 GW, and the company noted that an additional 1.7 GW would be commissioned in 2017.

The impressive results saw Inter RAO pay its shareholders their biggest dividends in the company's history.

The group's financial performance was significantly influenced by several key factors and events, including: improved operational efficiency across all of its business segments; the addition of 325 MW of new and rehabilitated generation capacity, and re-certification of existing units built to support Capacity Delivery Agreements (CDAs); an increase in average heat sales prices for end consumers across the group's Russian assets; and optimisation of fuel purchase prices across its Russian assets.

Ilnar Mirsiyapov, Member of the Management Board and Head of Strategy and Investment Division told *TEI Times*: "The company is in peak performance form… Our high EBITDA can be explained by the fact that we are getting a [good] return on investment for new capacity built, as promised by the government under the CDA."

Commenting on the optimisation of fuel prices, he noted that a new gas contract with Rosneft provided significant savings. "It is a unique 25-year contract for gas delivery, he said. "As the second largest gas consumer in the country, it's in our best interest to have the best delivery and payment terms possible. The contract allowed us to save almost $150 million in 2016."

Inter RAO says it is the only Russian company that is "truly trans-national and international", with overseas assets and engineering and export divisions in Latin America and Asia. In 2014, under a joint venture with GE, the company opened a facility in Russia for manufacturing GE 6FA gas turbines.

The company noted, however, that it has stopped its international expansion, due to political turbulence. "Two or three years ago we were eyeing Turkey with great optimism and bought an asset there. But due to well-known events, we have suspended our expansion. Today the Russian market offers more opportunities than foreign markets."

Siemens and Gamesa gain merger approval

Siemens and Gamesa will create the world's largest wind turbine company after gaining approval from the European Commission to merge their wind energy businesses.

Europe's competition regulator last month gave the transaction unconditional approval and said that it had no concerns over the deal because "a number of credible competitors would remain in the market".

The two companies expect to close the deal in early April. "This merger is designed to combine the complementary strengths of both companies to benefit our customers, shareholders, employees, and suppliers. I'm excited about bringing the new company to the market very soon," said Lisa Davis, member of the Managing Board of Siemens AG.

The deal is a response to challenging conditions in the global wind energy sector that has brought a wave of consolidation activity as companies seek to cut costs and become more efficient.

The newly merged Siemens-Gamesa wind company will have an installed global base of around 75 GW worldwide, and will have a 12 per cent share of the global wind turbine market, according to 2016 data from FTI Consulting. It will have a market capitalisation of about €10 billion, and will be the largest wind turbine company on the market in terms of order backlog and revenues, according to Gamesa.

Other antitrust authorities have also cleared the deal, which will result in Siemens holding a 59 per cent stake in Gamesa and consolidating the company in its financial statements. Iberdrola SA, currently the largest investor in Gamesa, will in turn own an 8 per cent interest.

Siemens and Gamesa announced the merger in June 2016. Their wind energy businesses are highly complementary in terms of geography and technology, with Siemens' strength in offshore wind and Gamesa's presence in emerging markets.

■ The European Commission has approved the acquisition of LM Wind Power by GE. The Commission said that it examined the impact of the deal on the upstream manufacture and supply of wind turbine blades, and on the downstream markets for the manufacture and supply of wind turbines, and said that the merged entity would continue to face effective competition in Europe.

Westinghouse troubles Toshiba

■ Kepco shows interest in NuGen
■ Toshiba ponders value of Landis+Gyr

Siân Crampsie

A number of nuclear power plant projects around the world have been thrown into uncertainty because of financial troubles at Toshiba's nuclear arm.

The Japanese conglomerate has twice delayed the publishing of its financial results following the disclosure in February of a $6.3 billion write-down at Westinghouse. It confirmed at the end of March that Westinghouse had filed for Chapter 11 bankruptcy protection in the US.

In March Toshiba said it was seeking an extension until April 11, 2017, after an internal investigation indicated that Westinghouse executives had exerted "inappropriate pressure" over the accounts of Stone & Webster, the US nuclear construction company it purchased in 2015.

Westinghouse said in a statement that it would undertake a strategic restructuring "to resolve … AP1000 financial challenges while protecting our core business".

Westinghouse is involved in a number of nuclear power projects in markets around the world, including the proposed 3.8 GW Moorside plant in the UK and a deal to build six AP1000 reactors in the southern Indian state of Andhra Pradesh.

Last month South Korea's Kepco said it had ruled out buying Toshiba's controlling stake in Westinghouse, but said that it was interested in NuGen – Westinghouse's joint venture with Engie for the Moorside project.

The South Korean company is keen to enter the UK nuclear market as part of a goal to become the world's third largest exporter of nuclear reactors by 2030. It has not sold a reactor since 2009, when it won a $20 billion deal to supply four reactors to the UAE.

It is also thought that potential Russian and Chinese suitors for Westinghouse would be rejected on the grounds of security.

Westinghouse's financial troubles stem from a general downturn in the nuclear sector since 2011 and cost overruns at the Virgil C. Summer nuclear plant in South Carolina, USA, and the Vogtle nuclear project in Georgia, USA.

The huge loss at Westinghouse has led Toshiba to raise new capital. The Japanese firm is reported to be pondering the sale of its 60 per cent stake in Landis+Gyr, the smart meter and grid solutions company.

Reuters reported that UBS Group has been hired to study potential options for the business, including a sale or an initial public offering (IPO).

The sale of Toshiba's stake in Landis+Gyr could fetch up to $2 billion, *Reuters* reported.

Wood Group makes offer for Amec FW

A £2.2 billion ($2.76 billion) offer for Amec Foster Wheeler by rival firm Wood Group will help both companies achieve vital cost savings, according to analysts.

The all-share takeover offer was agreed last month by the two firms and came just days ahead of an announcement by Amec FW of a plan to shore up its finances with a rights issue.

The deal will create a new firm with expertise in oil, gas, power, chemicals and mining that would be "a global leader in project, engineering and technical services delivery", according to Wood Group Chairman, Ian Marchant.

The combined group would have revenues of over $12 billion. Wood Group has identified "sustainable cost synergies of at least £110 million" per year, as well as significant additional revenue growth opportunities, it said in a statement.

Amec Foster Wheeler shareholders will own 44 per cent of the combined group under the terms of the deal. Wood Group has offered 0.75 of new shares for each Amec FW share.

"This is a significant transaction which comes at a time of continued oil price volatility," said Philip Barker, partner and head of industrials at Cavendish Corporate Finance. "The £2.2 billion deal will provide greater scale and enhanced capability as both companies search for sustainable cost synergies.

"Continued weakness in the oil and gas market was partly responsible for a fall in profit by both companies, which have been looking for ways to increase savings. The transaction will provide important benefits for both groups, which will be able to cut costs up to £110 million, diversify their offering, cross-sell to the wider client base and become more competitive."

Amec FW has been struggling against a tide of £1 billion of net debt – partly caused by Amec's takeover of Foster Wheeler in 2014. Annual revenues in its oil and gas business have fallen almost 31 per cent since 2014.

Amec Foster Wheeler has now cancelled a planned £500 million rights issue designed to help it cut debt. It also announced an eight per cent drop in 2016 revenues to £5.4 billion and a £56 million slide in profits to £318 million.

Americas

Iberdrola selects J Series gas turbines

Iberdrola and Mitsubishi Hitachi Power Systems (MHPS) have signed a deal for the supply of two M501J gas turbines and other equipment for the El Carmen combined cycle power plant in Nuevo León, Mexico.

The order includes a steam turbine, a spare gas turbine rotor and a long term service agreement. It brings the number of MHPS J-class gas turbines ordered by Iberdrola in the last two years to six.

The 850 MW combined cycle plant is part of Iberdrola's strategic plan to supply electricity to the growing energy market in Mexico.

Power Electronics gets 275 MW Mexico order

Spanish solar inverters manufacturer Power Electronics is to supply 275 MW of the HEC V1500 model for two of Iberdrola's Mexican solar photovoltaic (PV) projects.

The PV plants are being developed by Iberdrola Renovables with Iberdrola Ingenieria responsible for the engineering, procurement and construction (EPC). Both are expected to be up and running by 2018.

The projects are the 136 MW Hermosillo project in Sonora state and the 231 MW Santiago plant in San Luis de Potosi state.

ABB substation for NY power grid

Bechtel Infrastructure and Power has awarded ABB a contract for a turnkey substation to enhance the reliability of the New York power grid.

The 345 kV gas insulated switchgear (GIS) substation will integrate electricity generated by the Cricket Valley Energy Station, a new combined cycle natural gas fired power plant located in Dover.

"This advanced GIS substation will boost transmission capacity, improve efficiency and enhance power reliability for millions of New Yorker consumers," said Patrick Fragman, Managing Director of ABB's Grid Integration business.

Capstone secures New York order

Capstone Turbine Corporation has received an order for a C1000 Signature Series microturbine to upgrade an industrial customer in upstate New York, USA.

The order was secured by Capstone distributor, GEM Energy, and comprises a single microturbine that will be fuelled by natural gas. The microturbine will provide continuous electrical power year-round as well as high-temperature hot water using Capstone's integrated heat recovery modules.

The 1 MW combined heat and power (CHP) system will operate in parallel with the utility grid and be capable of providing power to a large portion of the critical process loads during utility outages, Capstone said.

It will be commissioned in July 2017.

GE signs Latin American cyber security deal

GE Power Systems has signed a multi-year service agreement with Centrais Elétricas de Sergipe S.A. (CELSE) covering a new combined cycle power plant in northeastern Brazil.

The agreement includes operations, maintenance, repairs and digital solutions as well as GE's first order in Latin America for its OpShield cyber security solution. The solutions in the agreement will help improve the plant's performance and availability and enable safe operational technology connectivity.

The 1516 MW Porto de Sergipe plant is expected to meet an estimated 15 per cent of the energy needs of northeastern Brazil. It will be Latin America's largest gas power plant when it begins operating in January 2020.

Asia-Pacific

HE Corp orders China's first HA gas turbine

China's Harbin Electric Corporation (HE) has awarded GE a contract to provide its 9HA gas turbine technology for the 650 MW Huadian Tianjin Junliangcheng VI gas combined cycle power plant project.

Set to be one of the most efficient power plants in the country upon completion, Junliangcheng is expected to achieve a combined cycle efficiency of over 62 per cent. Delivery of the gas turbine – the first HA to be installed in China – is scheduled for the third quarter of 2018.

The facility is being converted from a coal fired to a gas fired power plant and will reduce coal consumption by over one million tons annually.

Doosan bags Indonesian contract

South Korea's Doosan Heavy Industries & Construction Co. has secured a Won300 billion ($262 million) contract to upgrade an existing power plant in Indonesia.

Under the deal with the state-run Indonesian utility PLN, Doosan Heavy and a state-run Indonesian construction firm will upgrade the 1150 MW gas powered Muara Tawar power plant's capacity to 1800 MW.

Doosan will provide three steam turbines and eight boilers for the project, located 40 km east of Java, the company said.

Leader Energy signs up Pöyry

Leader Energy has awarded Pöyry the owner's engineer services contract for Cambodian Energy II, a 150 MW coal fired power project in Cambodia.

The Cambodian Energy II project will be built in Sihanoukville adjacent to the existing 100 MW Cambodian Energy I coal fired unit. Pöyry's contract is for three years, it said.

Pöyry will provide assistance in project management, review of the plant design, supervision services of the location, quality assurance and quality control services, and also in commissioning of the power plant.

The contract is an extension of a previous task assigned for the same power plant where Pöyry worked as owner's engineer in the development stage.

Valmet to supply multi-fuel boiler to Japan

Valmet will supply a multi-fuel power boiler and a flue gas cleaning system to Kushiro Thermal Power Plant Inc. located in the city of Kushiro, Hokkaido, Japan.

This boiler delivery will be done by Valmet in cooperation with its local Japanese partner JFE Engineering (JFEE). The new boiler plant will enable Kushiro to achieve a stable power supply at extremely high thermal efficiency, Valmet said.

Valmet's multi-fuel boiler and flue gas cleaning system delivery will be part of the 112 MWe power plant delivered by JFEE. Installation works will start in 2018. Commissioning and start-up are scheduled for the second half of 2019.

Europe

Deutsche Windtechnik wins V90 contract

Deutsche Windtechnik has won its first contract to provide maintenance for Vestas wind turbines.

The company will carry out full maintenance on 22 Vestas V90 units for a period of four years, starting in June 2017.

The turbines covered by the contract are located in the Picardy, Centre and Brittany regions of France.

SgurrEnergy secures Race Bank contract

SgurrEnergy has been awarded a construction monitoring contract for the Race Bank wind farm, one of the largest offshore wind farm projects in the United Kingdom.

Located around 27 km off the Norfolk coast, Race Bank will comprise 91 Siemens 6.3 MW wind turbines and is being developed by Dong Energy and its partner, Macquarie Capital.

SgurrEnergy, a unit of Wood Group, will provide regular monitoring of construction and installation, checking progress and confirming consistency with the final design and undertaking site visits including factory and a construction site visit.

The firm has already undertaken technical advisory work for the project's owners, helping them to achieve financial close.

EDF Luminus orders Siemens wind turbines

EDF Luminus has placed an order with Siemens for wind turbines for two projects located in the Belgian municipalities of Beveren and Dessel and Mol.

A total of nine 3.2 MW machines from Siemens' D3 product platform will be installed at the Sibelco and Katoen Natie-Loghidden City. The order includes a service and maintenance agreement for a period of 15 years.

The two wind power plants have a combined generation capacity of 28.8 MW. The 19.2 MW Katoen Natie wind farm is located in the port of Antwerp in Beveren municipality. The 9.6 MW Sibelco wind farm is located in Dessel and Mol.

EDF awards TSA contract

Amec Foster Wheeler has been awarded a contract worth £125 million to deliver long-term support to EDF Energy in running its nuclear power plants in the UK.

Under the Technical Support Alliance 3 (TSA3) agreement, Amec FW will continue offering operational support for EDF's reactor fleet across the country.

The agreement is for a five-year period and includes an option to extend by a further five years. It follows earlier TSA agreements between the two firms and includes activities relating to compliance, upgrades, improvements and fleet-critical projects.

MAN to expand Sund plant

MAN Diesel & Turbo is to supply four MAN 9L51/60 gensets to the Faroe Islands in the North Atlantic to expand the Sund power plant.

Sund, located near the capital, Tórshavn, will run on heavy fuel oil (HFO) to generate both electrical power and heat for the district heating network on the island. Danish plant engineering supplier BWSC will perform engineering, procurement and construction on the project.

With a power output of 37 MW, Sund is the largest of the three thermal power plants on the Faroe Islands. The engines ordered represent its third expansion. In the 1980s, BWSC and MAN Diesel and Turbo boosted the capacity of the plant by 25 MW with two MAN engines.

International

Elsewedy-Marubeni ink MOU for 500 MW

Elsewedy Electric Co and Marubeni Corp have signed a memorandum of understanding (MOU) with the Egyptian Electricity Transmission Company (EETC) covering the development of a wind project with a capacity of up to 500 MW.

The companies are working in a consortium to build the wind power complex at Gabal Elzeit on the Red Sea coast. The MOU gives them access to the site, so that they can complete studies and prepare a firm project proposal, Egypt-based cable maker Elsewedy said in a statement.

The project will be developed on a build-own-operate basis in two 250 MW phases. Commercial operation will be achieved in stages starting from mid-2020.

PV-engine hybrid for Burkina Faso

Wärtsilä is to supply a 15 MW solar photovoltaic (PV) farm to Essakane Solar SAS in Burkina Faso, creating Africa's largest engine-solar PV hybrid power plant.

The PV plant will be built next to a 55 MW Wärtsilä power plant currently running on heavy fuel oil. The solar PV plant and the engine power plant will be controlled and operated in synchronization as a single hybrid facility.

Wärtsilä's scope covers the engineering, procurement and construction of the solar PV plant, including the control system for the hybrid plant. The power plant is scheduled to be operational in late 2017.

Essakane Solar SAS, 90 per cent owned by global independent power producer EREN Renewable Energy (EREN) and 10 per cent by its development partner African Energy Management Platform (AEMP), will operate the solar PV plant and sell the energy to IAMGOLD's Essakane off-grid gold mine.

SK E&C to build power plants in Iran

Korean firm SK Engineering & Construction has partnered with major Belgium-based Turkish energy firm Unit International for a multi-trillion-won project to build and operate five new gas fired power plants in Iran.

The project will involve Iran's largest privately developed power plants, as it is anticipated to have a combined generation capacity of 5000 MW, said SK E&C officials. The local firm also added that SK E&C will most likely be in charge of the building process of the new plants.

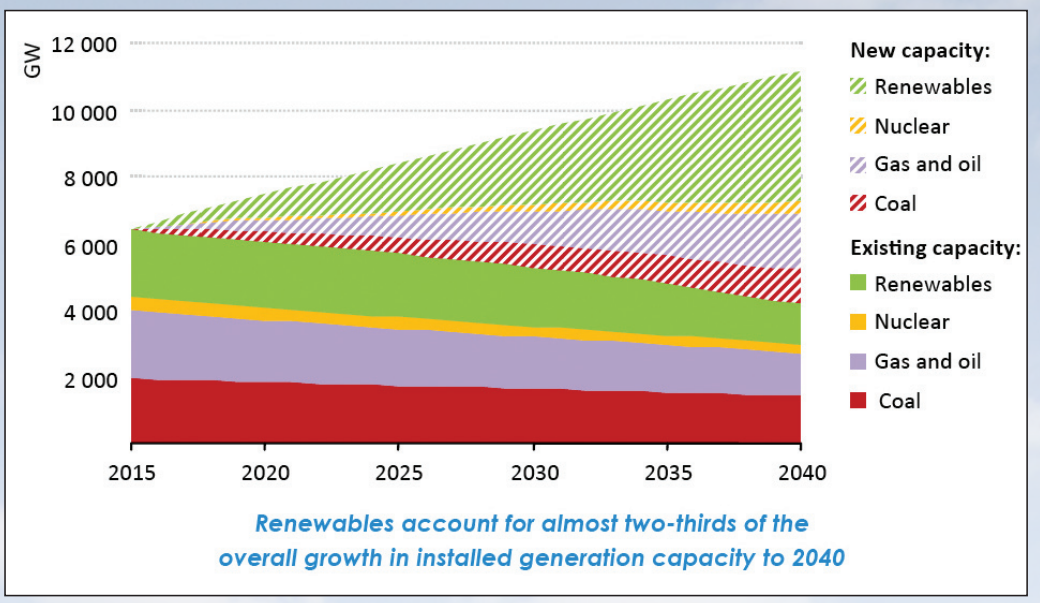
SK E&C said it plans to begin construction of 1200 MW and 880 MW power plants in Saveh and Zahedan next January. The plants are expected to start operation in the latter half of 2020.

Hanwha to lead 1 GW solar project

A Hanwha Group-led consortium has won a contract to build a 1 GW solar power plant in Turkey.

The Hanwha Q Cells-Kalyon consortium will build the plant in the Konya province over the next three years. Local media reports put the contract value at $1.3 billion.

Global installed generation capacity in the New Policies Scenario



Renewables account for almost two-thirds of the overall growth in installed generation capacity to 2040

World Energy Outlook 2016, © IEA/OECD, Figure 6.10 , page 258

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Cumulative power plant capacity retirements by region and source in the New Policies Scenario, 2016-2040 (GW)

	2016-2025						2026-2040						2016-2040
	Coal	Gas	Oil	Nuclear	Renewables	Total	Coal	Gas	Oil	Nuclear	Renewables	Total	Total
OECD	**124**	**87**	**117**	**52**	**74**	**455**	**156**	**163**	**49**	**52**	**511**	**931**	**1 385**
Americas	64	62	56	13	25	221	41	89	15	12	167	325	545
United States	62	55	45	10	19	191	33	85	7	12	137	275	466
Europe	47	4	28	27	42	148	86	44	19	35	276	459	607
Asia Oceania	13	22	32	12	7	86	29	30	15	5	68	147	233
Japan	7	18	29	11	5	71	10	22	12	5	49	98	169
Non-OECD	**91**	**90**	**53**	**14**	**17**	**266**	**165**	**136**	**97**	**29**	**327**	**754**	**1 020**
E. Europe/Eurasia	53	66	10	9	0	139	45	48	7	25	16	140	279
Russia	22	50	2	8	0	81	21	39	2	12	3	77	158
Asia	29	5	10	4	11	60	93	35	38	1	277	445	504
China	19	0	1	-	4	25	50	1	4	-	218	273	298
India	7	0	0	0	3	11	35	7	9	1	42	93	104
Southeast Asia	0	2	5	-	3	10	5	20	16	-	11	52	62
Middle East	0	11	12	-	0	24	0	30	30	-	1	62	86
Africa	8	3	11	-	2	24	25	15	11	2	9	61	85
Latin America	1	5	9	0	5	19	2	8	11	1	24	46	66
Brazil	0	1	1	-	3	6	1	0	1	1	17	19	24
World	**215**	**178**	**170**	**66**	**92**	**720**	**321**	**299**	**146**	**82**	**837**	**1 685**	**2 405**
European Union	49	6	29	26	37	147	86	42	19	34	268	450	597

World Energy Outlook 2016, © IEA/OECD, Table 6.3, page 260

Cumulative power plant capacity additions by region and source in the New Policies Scenario, 2016-2040 (GW)

	2016-2025						2026-2040						2016-2040
	Coal	Gas	Oil	Nuclear	Renewables	Total	Coal	Gas	Oil	Nuclear	Renewables	Total	Total
OECD	**41**	**216**	**13**	**31**	**521**	**823**	**37**	**356**	**7**	**68**	**973**	**1 441**	**2 264**
Americas	3	119	8	8	228	367	4	177	5	22	380	588	955
United States	2	86	7	8	175	279	3	123	4	20	294	444	723
Europe	21	57	1	6	219	303	14	140	2	32	457	645	948
Asia Oceania	17	40	5	18	73	153	19	39	0	14	136	208	361
Japan	4	29	5	3	45	85	3	21	0	3	80	107	193
Non-OECD	**450**	**383**	**45**	**99**	**899**	**1 876**	**494**	**617**	**62**	**152**	**1 720**	**3 044**	**4 920**
E. Europe/Eurasia	42	87	0	19	18	165	34	71	0	34	64	204	369
Russia	13	51	0	15	7	87	12	38	0	22	29	101	187
Asia	379	137	9	72	725	1 323	410	243	31	98	1 288	2 070	3 393
China	190	62	0	59	491	802	108	70	0	68	815	1 062	1 864
India	114	26	4	10	154	308	186	66	15	24	289	579	888
Southeast Asia	54	31	2	1	42	130	82	75	8	4	104	271	402
Middle East	2	82	19	6	21	130	1	131	10	9	100	251	381
Africa	24	53	12	-	56	145	45	109	18	7	140	318	463
Latin America	4	25	5	2	78	113	4	63	3	4	128	201	314
Brazil	1	7	0	1	47	56	-	10	1	3	70	83	139
World	**491**	**599**	**58**	**131**	**1 419**	**2 699**	**531**	**973**	**69**	**220**	**2 693**	**4 486**	**7 184**
European Union	16	52	1	4	187	259	9	121	1	31	429	592	851

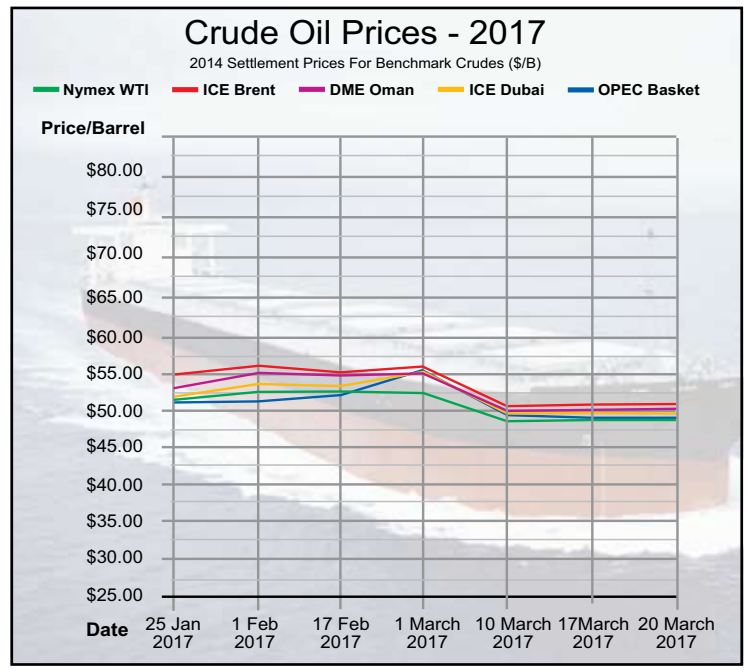
World Energy Outlook 2016, © IEA/OECD, Table 6.4, page 261

Source: World Energy Outlook 2016

Oil

Opec revisits shale dilemma

- Production cuts have so far failed to push stocks down
- Risk of Saudi Arabia losing market share still there



David Gregory

When all this began, the idea was to force high-cost oil producers out of the market. Saudi Arabia opened the taps in 2014 in an effort to defend its market share as oil production – especially shale oil – in the US reached record levels. The tactic worked for a while as it sent crude price plummeting. Last November, after months of discussions amongst Opec and non-Opec producers, and in the face of an ongoing global glut, oil producers agreed to cut back on output starting January in an effort to push prices back up.

Prices worked their way up into the high $50/b range but with the rising oil prices came the US shale producers, who in the last two years have advanced their technology to the point where they can now produce in some cases at a breakeven price in the $30/b range. Not good for Opec and other countries who rely on oil exports as a primary source of revenue.

In mid-March, the price of Brent crude slipped below $50/b, and in doing so confronted other oil producers with the choice to either extend the six-month period for production cuts or cut output even further in order to force prices up – perhaps something Saudi Arabia should have given more thought to two years ago. Either way, it appears that the risk of losing market share is still there.

The mid-March slip put Brent prices back where they were before Opec and others, including Russia, agreed to reduce output. What Opec and friends decide to do next will be the task at the next Opec meeting in late May, unless some catastrophe in the oil industry comes as a godsend to crude prices.

In an analysis of the oil market issued by Goldman Sachs shortly before Brent went under $50/b, the firm said that shale oil's comeback was made possible by cheap and plentiful credit. But it added: "If and when the Fed's inevitable rate hikes tighten credit access for shale firms, prompting the need for higher margins and profits, the old status quo will revert."

Goldman said easy access to capital fueled the shale revolution, but noted that too much capital led to too much oil production and markets crashed. "The shale sector is now being financially stress-tested, exposing shale's dirty secret: many shale producers depend on capital market injections to fund ongoing activity because they have thus far greatly outspent cash flow."

This could lead to tighter conditions that will remove the structure pressure for lower prices, but this is not an imminent issue, Goldman said, and it leaves Saudi Arabia with only bad options: "either cut production, prompting higher prices and even greater shale incursion and market share loss..., or restore the old status quo, sending prices far lower and in the process collapsing Saudi government revenues, potentially unleashing another budget crisis."

The situation has turned Saudi Arabia away from being the global price setter and into inventory manager, Goldman said.

Media reports have said there is growing doubt amongst analysts about whether the production cuts will be able to quickly restore balance to the oil market as they have so far failed to push stocks down.

There had been talk in Opec circles last month that the organisation would extend cuts and push those non-Opec members that had signed up to the deal to fulfill their pledges. Such talk buoyed prices for a short time, but then prices gave way in the face of physical stock numbers.

Last November's pact called for 1.8 million b/d to be removed from the market, and compliance with this has been reported at 90 per cent, but this was deemed possible by Saudi Arabia cutting back more than it committed to. Non-Opec Russia has yet to hit the 300 000 b/d reduction that it has agreed to.

Despite the willingness of oil producers to agree to output reductions, the International Energy Agency (IEA) said in its latest *Oil Market Report*, released on March 15, that global oil supplies rose by 260 000 b/d during February as Opec and non-Opec members produced more crude.

Opec compliance with its agreement to cut 1.2 million b/d from its aggregate output was 105 per cent in January and 91 per cent in February. The IEA put compliance by the 11 non-Opec countries to cut output by a combined 558 000 b/d at 40 per cent in January, and Saudi Arabia stated recently that non-Opec compliance in February was 64 per cent. Opec's May meeting is facing a tough call.

Gas

Eni and Gazprom eye additional system for Southern Gas Corridor

Construction of the pipelines making up the Southern Gas Corridor is at various stages, but if Eni and Gazprom succeed in routing Russian gas across northern Greece and the Adriatic Sea to southern Italy, it will add another dimension to the idea of transporting European gas supplies through southern Europe.

Mark Goetz

Italy's Eni and Russia's gas giant Gazprom are looking to add an additional pipeline system to the Southern Gas Corridor concept, which currently consists of the $40-45 billion, 3500 km pipeline network that will carry natural gas from Azerbaijan's Shah Deniz gas field to southern Italy by 2019-20.

Construction is at various stages on the South Caucasus Pipeline (SCP), the Trans Anatolian Natural Gas Pipeline (TANAP), and the Trans Adriatic Pipeline (TAP), which have for now been known as the Southern Gas Corridor, but if Eni and Gazprom succeed in routing Russian gas across northern Greece and the Adriatic Sea to southern Italy, it will add another dimension to the overall idea of transporting European gas supplies through southern Europe.

The CEOs of Eni and Gazprom, Claudio Descalzi and Alexey Miller, respectively, signed in Moscow on March 21, a memorandum of understanding (MOU) designed to analyse the "prospects for cooperation in developing the southern corridor for gas supplies from Russia to European countries, including Italy," a statement issued by the Rome-based company said. The statement went on to say that the document would modernise Russia-Italy gas agreements and provide for the consideration of partnership options in the LNG sector.

Eni is keen to secure future supplies for its own markets and to see gas supplies routed through its domestic network into Central Europe, and it is looking forward to a predicted era of greater demand for LNG.

Gazprom said in a statement that the "upgrade of contracts with Eni will only pertain to a change in delivery destinations in the context of the southern supply corridor".

For Russia, the deal with Eni will enable it to pursue its TurkStream gas pipeline project, which it proposed to Turkey after Moscow's South Stream gas pipeline failed to abide by EU gas transport criteria. Like South Stream (and the working Blue Stream pipeline), TurkStream will cross the Black Sea, but rather than landing in EU member Bulgaria, it will land in western Turkey. At the Greek border, TurkStream would hook up with the revived Interconnector-Turkey-Greece-Italy (ITGI) pipeline. ITGI, like the proposed Nabucco pipeline, had been one of the original bidders to carry Shah Deniz gas, but lost out to TAP.

The Southern Gas Corridor was conceived as a means of bringing new sources of supply to Europe and reduce reliance on Russian supplies, but in recent weeks, Gazprom officials have spoken of shipping Russian gas through TAP, which is designed to eventually boost its 10 billion cubic metres (bcm) per year capacity to 20 bcm/year. Such a development would essentially negate the corridor's original purpose of transporting gas from other than Russian sources.

Gazprom, in a meeting with Italy's Edison and Greece's DEPA early last year, discussed the prospect of reviving ITGI. Edison and DEPA are partnered in the IGI Poseidon project, which proposes to transport gas across the Adriatic. They are also in the Interconnector-Greece-Bulgaria (IGB) pipeline that is to link up with TAP and transport Azeri gas into Bulgaria and eventually further into East Europe. IGI Poseidon is also proposing a 1900 km subsea gas pipeline that would link East Mediterranean gas to Crete, mainland Greece, and then Italy. But this project is seen by many analysts as something that is many years away from feasibility.

Russia is also keen to secure its position in the European market. Russia accounts for about 34 per cent of the EU's gas purchases, which in 2016 amounted to 120 billion m^3. While gas demand has fallen in Europe and renewables have made gains, European gas production is going into decline. Gazprom's North Stream I pipeline through the Baltic Sea is in operation, and it is now pushing for the second phase of Nord Stream to receive EU approval.

Gazprom's agreement with Eni follows an announcement by the European Commission that it is launching a market test for Gazprom's commitments to EU antitrust regulations in Central and Eastern Europe where the EU has long complained about Gazprom's use of its influence to charge higher prices and demand political concessions. The EC filed charges against Gazprom in April 2015 for breaking regional antitrust regulations.

An EC statement in mid-March said it had provisionally accepted commitments by Gazprom to adjust its practices. Among the steps Gazprom agreed to take is remove all provisions from its contracts barring the reselling of Russian gas, adjust gas prices to competitive benchmarks, and not take advantage of its dominant market position to obtain rights and access to infrastructure. The EC will accept comments from Gazprom customers until May 4.

Europe rethinks its energy policies

The European Union's policies to meet its energy and climate goals are in constant flux. A recent meeting of EU research consortium, Insight_E, highlighted the difficulties facing policymakers and revealed some of the research that could affect policies impacting energy companies and users. **Vic Wyman reports.**

This year will see further battles in the moves to make energy in the European Union (EU) more secure, affordable and sustainable, while tackling climate change and underpinning job creation and economic growth.

The European Commission, the EU's executive arm, claims steady progress in its Energy Union initiative, which it launched three years ago to achieve its energy and climate aims. But technological and political developments could derail some initiatives, or force changes to policies that national governments oppose.

For example, member states have already pressed ahead with support for projects such as Hinkley Point C nuclear station in the UK, the Paks nuclear plant in Hungary and German lignite-fired power plants, despite opposition by Brussels.

Also, the Commission's recent Winter Energy Package of proposed legislative reforms accepted the idea of generation capacity mechanisms, which are used in France, the UK and other states, but are seen widely as hidden subsidies for fossil fuels and distorting to markets.

However, also in the spotlight are measures on: the integration of energy markets; district heating; coal-fired generation; energy storage and hydrogen; curtailment of generation for the integration of renewables; carbon pricing and the Emissions Trading System (ETS); and energy for transport. All must be juggled for a viable and thriving European energy system, while keeping the lights on.

A recent meeting of Insight_E, an EU-wide research consortium, which advises and is funded by the Commission, highlighted the difficulties for policymakers. For example, high greenhouse gas emissions often embedded in imports into the EU need to be reduced in order to meet the Paris Agreement target on global warming. As Francesco Fuso Nerini, a research associate at the Energy Institute of University College London (UCL), noted: "Domestic [EU] action might not be enough."

Yet experts at the Insight_E meeting could not give much practical substance to the idea. And, in moves to update the ETS from 2021 onwards, the European Parliament has recently dropped a proposal to include imports of cement and some other products in the ETS, which would have in effect raised their prices. The move has provoked strong industry opposition and the European Council of member states must now decide on the ETS proposals.

It is widely accepted that the ETS, a cap and trade system covering more than 11 000 installations in the power sector and energy-intensive industry, is not cutting emissions strongly. "It does not deliver because the price is too low," said Manfred Hafner, Enerdata's consulting Vice President.

ETS implementation is also widely seen as having been poor. "There is a serious challenge for policy development to effectively drive the necessary changes [on climate change]," added Insight_E's Steve Pye, a senior research associate at the Energy Institute of University College London (UCL). "While carbon pricing does have an important role, it is insufficient on its own, and there needs to be a strong focus on other policy mechanisms." Those include technology- and behaviour-based instruments, he said.

The Insight_E meeting also highlighted concerns surrounding security of supply, particularly of gas. Today natural gas from Russia largely fills the gap between EU production (140 billion m^3 in 2015) and consumption (440 billion m^3). Controversial proposals yet to be implemented include greater solidarity between EU countries in the face of threatened or actual cuts to supplies from Russia, and gas contract information being passed to the Commission so that it can have the chance to manage supply security.

Other solutions could include more imports of liquefied natural gas (LNG) and more natural gas import links. The Commission stated in February that the East Mediterranean is "a promising source of gas supply" for the EU. But Insight_E's Constantinos Taliotis, a researcher at the Royal Institute of Technology in Sweden, told the Commission that, although Cyprus, Israel and the Lebanon, for example, could produce gas surpluses by 2020 from the estimated 3400 billion m^3 of recoverable gas in the Levant basin off Israel, they lack export infrastructure. One potential market, Egypt, has also found its own gas field, reducing the viability of Levant basin investment.

In an Insight_E study, Marie-Claire Aoun, director of the energy centre at the French research organisation Ifri, says that EU short-term gas measures could include EU-wide cooperation on LNG and on storage. Medium-term measures could include identifying priority projects, particularly reverse-flow pipelines that could export as well as import gas.

However, there is not likely to be any contribution to supply from EU shale gas. Insight_E's Mélodie Mistré, a market analyst at the energy consultant Enerdata in France, cites high transport and distribution costs (as in the US), scattered EU sites in high population density places, high costs in the immature EU industry, and environmental hurdles including opposition to heavy truck traffic. She told the Commission: "The full-scale development of shale gas in Europe is not expected to take place before 2030."

According to one Commission official, "shale gas in Poland is pretty dead". Noting that Poland and Ukraine were once keen on shale gas, the official said: "If they are doing nothing, no one else is likely to."

Like gas, coal is also a concern but for different reasons. An Insight_E study says coal fired generation must be phased out if the world is to avoid breaching the Paris Agreement's 2°C limit. Hasan Ümitcan Yilmaz, of the Karlsruhe Institute of Technology in Germany pointed out that a phase-out of EU coal and lignite plants by 2040 would mean closure of about 2.3 GW of capacity a year.

In February 2017 as the EU's Energy Council met to discuss the Winter Energy Package, the influential MEP Claude Turmes warned: "One of the key measures proposed in the energy package is the establishment of emissions performance standards to prevent public financial support for new coal installations (a cap is set at 550g CO_2/kWh). In the wake of the Paris Agreement, the EU will lose all credibility if it does not actively ban the construction of new coal fired power plants."

Keeping the lights on at reasonable cost also requires updated regulation of the electricity markets, especially as the growth of renewables has cut the marginal cost of wholesale electricity and made much investment in generation uneconomic.

Manuel Sánchez, team leader for smart grids and the internal energy market at the Commission's energy arm DG Ener, promised the Insight_E meeting "evolution" rather than "revolution". For example, to boost flexibility and to strengthen short-term wholesale markets prices would no longer be set every hour, said Sánchez. "We are proposing that they change very 15 minutes."

Transmission and distribution companies would also normally be banned from owning energy storage facilities. The aim is to ensure strong customer participation, protection and benefits.

To improve system stability, Insight_E recommends that the Commission assesses the economically optimal use of curtailment, or limiting the output of renewables for system security reasons. An associated optimisation model could ensure fair curtailment between countries and still ensure investment in renewables, Paul Deane, a research fellow at University College Cork in Ireland, told the Insight_E meeting.

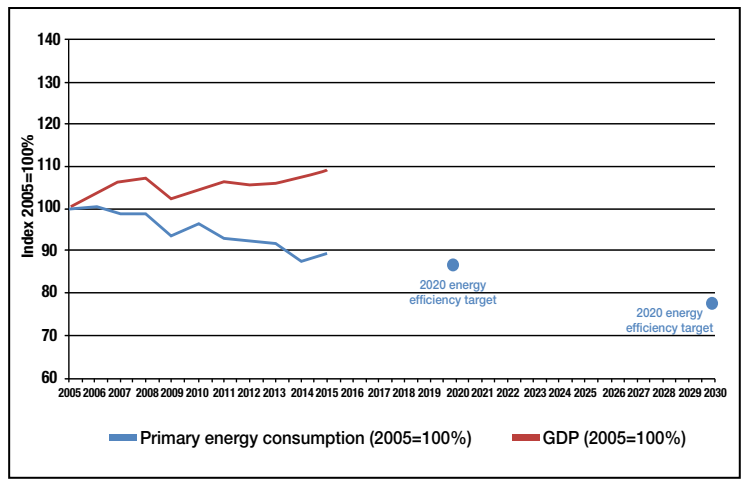
The Commission is promising to use "all available instruments in a coherent way" to boost investment in electricity systems, to about €379 billion each year in 2020-30, to reach the EU's 2030 climate and energy targets. That could include more energy funding by the European Fund for Strategic Investments and a new Innovation Fund for the power sector.

Yet Insight_E has warned that heavy investment in climate-friendly plants and infrastructure could result in stranded fossil fuel assets. Also, as fossil fuel loses favour, economically powerful financial firms are likely to sell their shares in firms holding fossil fuel reserves and commodities (about 5 per cent of EU pension funds, 4 per cent of EU insurance company assets and 1.4 per cent of EU bank assets), for transparency as part of climate-related financial disclosures.

Another concern for the electricity industry could be the Commission's push for greater consumer involvement, rights and protection. The industry can expect a new legal framework for aspects such as demand response and industry aggregators, said Sánchez, along with a common EU data format and procedures for sharing consumer data.

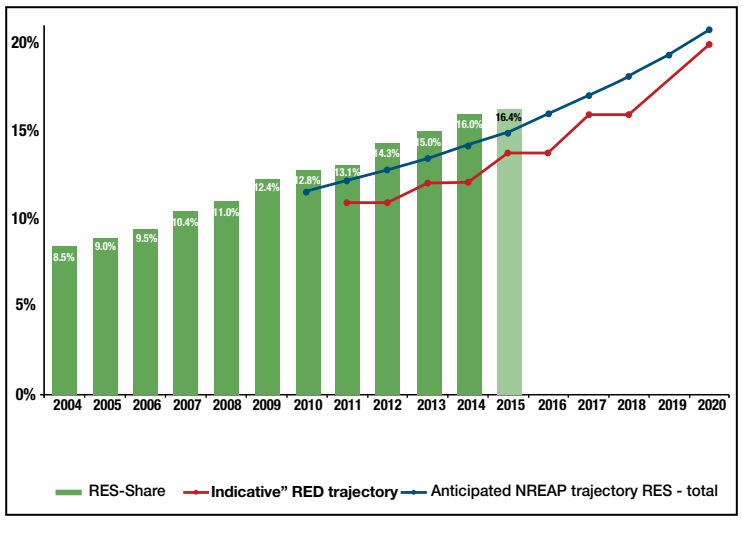
As distribution system operators start to store smart meter data derived from flexible power sources, such as photovoltaic cells, electric vehicles and storage units, they face rules to guarantee their neutrality.

The Commission's ideas for action on energy poverty, which affects an estimated 54 million people in the EU, or 11 per cent of the population, include disconnection safeguards, social tariffs and financial transfers, all of which would require changes and investment by electricity firms.



Primary energy consumption and GDP developments
Source: European Commission

Renewable energy shares in the European Union vs renewable energy directive and National Renewable Energy Action Plan Trajectories
Source: European Commission



Small developments may lead to big things

Moves are being made on both sides of the Atlantic to speed up the development of small modular reactors, partly to address the issues facing large nuclear projects.

David Flin

There have been moves to develop small modular reactors (SMRs), partly due to the high capital cost and timescale of constructing large nuclear reactors, and to some extent because of the need to service small electricity grids. SMRs can be built independently or as modules in a larger complex, with capacity added incrementally as required. They would also be useful for use in remote sites. The numbers of SMRs produced should generate economies of scale, and small units are a more manageable investment than large units, where the cost of investment can be prohibitive.

In the USA, 10 nuclear companies are developing designs for SMRs, with modules ranging up to 300 MW. To speed up development and licensing of new reactors, especially SMRs, the US House of Representatives passed the Advanced Nuclear Technology Act in January 2017. The Act is to: "Foster civilian research and development of advanced nuclear energy technologies and enhance the licensing and commercial development of such technologies."

David Blee, Executive Director of the United States Nuclear Infrastructure Council, said: "We believe that trailblazing the advance of nuclear energy technology, including SMRs, is one of the key imperatives of US market competitiveness."

There are a number of advanced new SMR designs. In March, the Nuclear Regulatory Commission (NRC) granted certification for a design by NuScale Power from Oregon. It is the first design to be approved for any SMR in the USA. It is scheduled to be built in the early 2020s.

Terrestrial Energy has notified the NRC of its intention to license its Integral Molten Salt Reactor (IMSR). It plans to submit its licensing application in 2019.

Norman said the UK government was in the middle of consultations on SMRs

In January 2016, developers and potential customers of SMRs signed an MOU to set up the SMR Start consortium to advance commercialisation of SMR designs. Its members are: Areva, Bechtel, BWXT, Dominion, Duke Energy, Energy Northwest, Fluor, Holtec International, NuScale Power, Ontario Power Generation, PSEG Nuclear, Southern Nuclear, the Tennessee Valley Authority, and Utah Associated Municipal Power Systems. The US Nuclear Energy Institute (NEI) is working closely with the consortium on policies and priorities relating to small reactor technology.

The intention is to help develop the new technologies by using public-private partnerships. The goal of SMR Start is to ensure that SMRs are cost-competitive, with the first units operating by the mid-2020s.

According to the NEI, SMR Start aims to "help accelerate the commercialisation of SMRs by creating an industry-driven entity whereby potential reactor owners/operators would be a unified voice in a variety of policy and regulatory issues and in creating cost-share funding structures." The consortium will focus on SMR designs based on light-water reactors.

DOE is supporting preparation and review of the design certification application for NuScale's SMR, the NuScale Power Module. It is also supporting two SMR site licensing and permitting projects. A five-year agreement with the TVA to support an early site permit application, to be followed by a combined construction and operating license (COL) application, was finalised in July 2015. The DOE said a final SMR design is necessary for the first power plant to begin construction and to take advantage of factory fabrication. Even after an SMR design certification application has been submitted to the US Nuclear Regulatory Commission, there is still significant cost and uncertainty involved in the design certification approval process, as well as work to finalise the design.

In February 2017, SMR Start called on the US government to establish public-private partnerships to support development of at least two SMR designs, deployment of at least four commercial SMR facilities domestically, and development of a domestic supply chain to support the SMR market. It said the US DOE's SMR Licensing Technical Support (LTS) programme, providing initial funding of up to $452 million on a cost share basis was "much appreciated, but not sufficient in the current business environment to achieve large-scale commercialisation". It called for the LTS programme, scheduled to end in fiscal 2017, to be expanded to cover design finalisation as well as licensing, and to be extended to fiscal 2025.

The policy statement said that investment tax credits (ITC) could support investments in SMR design and construction, and kick-start a supply chain and the manufacturing of components for SMR markets. It said: "One SMR designer has invested in excess of $300 million in a state-of-the-art purpose-built SMR manufacturing facility in the USA. An SMR ITC should be established to incentivise investments in US manufacturing facilities."

In the UK, delays in plans for development of new large nuclear power plants is a big driver for SMRs. Hinkley Point C has been struggling with uncertainties over EDF's financial difficulties, and the project is already well behind the originally proposed schedule. Meanwhile, Toshiba has said that it will not take on any of the financial risk of construction of the Moorside plant, and this project will only proceed if new investors can be found. Some sources have said that the plans by the UK to leave Euratom as a result of Brexit will make it difficult for the UK to employ staff for projects such as Wylfa Newydd.

SMRs therefore take on an increased significance if the country is to continue with new nuclear development. In 2014, the UK government published a report on SMR concepts, with a second phase to provide the technical, financial, and economic evidence base to support a policy decision on SMRs.

In March 2016, the UK Department of Energy & Climate Change (DECC) called for expressions of interest in a competition to identify the best value SMR for the UK, and said the government would invest £250 million over five years in nuclear R&D, including SMRs. DECC said the objective was "to gauge market interest in developing, commercialising, and financing SMRs in the UK".

In 2015, Westinghouse presented a proposal for a shared design and development model, under which it would contribute its SMR conceptual design for a 225 MWe integral PWR, and then partner with UK government and industry to complete, licence, and deploy it. In October 2016, Westinghouse announced it would work with Cammell Laird and the UK's Nuclear Advanced Manufacturing Research Centre (NAMRC) on a study to explore potential design efficiencies to reduce the lead times of its SMR.

NAMRC conducted an advanced manufacturing research study on the Westinghouse SMR reactor pressure vessel, and concluded that the design had the potential to be efficiently manufactured in the UK.

NuScale said that it plans to deploy its SMR technology in the UK with UK partners, including the UK government, various companies, universities, and other institutions. It said the first of its 50 MWe units could be in operation by the mid-2020s. The UK's National Nuclear Laboratory (NNL) has concluded that the NuScale Power Module is a credible technology, feasible for deployment within a 10-year timeframe.

NuScale Power said that it has entered into collaborative agreements with other key parts of the UK nuclear sector, including the NAMRC at the University of Sheffield. Ultra Electronics Nuclear Control Systems successfully conducted acceptance testing of the protection system for the NuScale Power Module in February this year.

The NuScale design is an Integral Pressurised Water Reactor (IPWR) based on light water reactor technology. The design features a triple-lock passive safety system enabling it to safely shut down and self-cool indefinitely with no operator action, no power, and no additional water.

NAMRC said in January that it would support the development of an SMR of between 220 MWe and 440 MWe, developed by a consortium led by Rolls-Royce, and also including Amec Foster Wheeler, Nuvia, and Arup. NAMRC said it will carry out desktop studies on potential methods of manufacture for the design, and assess the UK supply chain's capabilities to ensure the reactor can be built to the required standards.

In its 2016 Budget, the British government expressed support for SMRs, and is seeking to identify the best-value design through an open competition. The 2016 Budget included an allocation of £30 million for an SMR-enabling advanced manufacturing R&D programme to develop nuclear skills capacity.

The UK's House of Lords Science and Technology Committee took evidence from experts on nuclear technologies on February 28th. It was told that the decision on whether the UK government should focus attention on the development of SMR technologies was a policy decision. Dr Richard Savage, Chief Nuclear Inspector of the Office of Nuclear Regulation, said that a decision on priorities was a matter for government policy, but that the regulators can respond to any technology. He said the field should be narrowed down.

Jesse Norman, the UK Minister for Industry and Energy, told the Committee that the government was in the middle of consultations on SMRs, and before making a decision, needed the report on the competition results. The results had been due to be published in November 2016, but other political events, such as the referendum on the UK leaving the EU, had caused a delay.

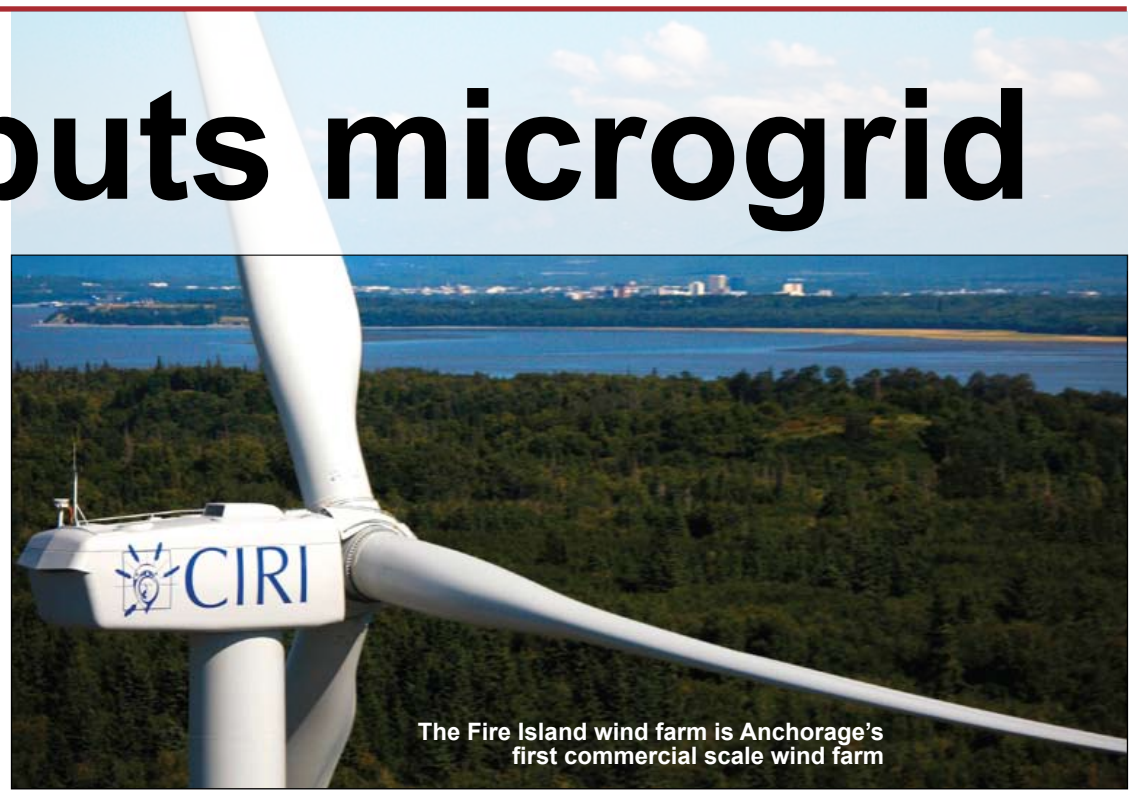
This delay has slowed down progress. It was not yet certain how the UK's relationship with Euratom would change, and if there was a change, what implications this might have on the nuclear industry as a whole and SMR in particular.

Norman said that SMR development, both in the UK and around the world, are predicated on their being able to demonstrate technological capability, economic viability, and a clear route to a strong market. If this happens, then SMR progress will be rapid.

Chugach puts microgrid to the test

An Alaskan utility is demonstrating an innovative solution to help it cope with grid stability issues.

Siân Crampsie



The Fire Island wind farm is Anchorage's first commercial scale wind farm

In 2012, Alaska-based Chugach Electric Association introduced electricity from wind energy to its customers for the first time. Five years on, the utility is about to attain another first in its service territory by installing an innovative microgrid and energy storage system.

Chugach Electric serves around 83 000 customers in the Anchorage area and operates some 530 MW of installed capacity. Like many utilities, the company faces the challenge of managing variable output from renewable energy facilities such as wind farms.

However Chugach Electric faces the additional challenge of managing high variable loads due to the presence of a port and other industrial facilities in its service area.

This combination of variable generation and variable loads has led the firm to seek innovative solutions to help it manage its grid, and it is now implementing a project with ABB to install a microgrid and energy storage system.

The Fire Island wind farm, located west of Ted Stevens Anchorage International Airport in Cook Inlet, is Anchorage's first commercial-scale wind farm. The wind farm is a 17 MW installation that sells all of its output – around 44 000 MWh/year – to Chugach Electric under a power purchase agreement. Although this equates to just three per cent of Chugach Electric's annual energy sales, the prospect of greater wind energy penetration is growing thanks to a number of local and state-wide initiatives.

Chugach Electric itself has formally adopted sustainability into its business management philosophy. In a February 2017 announcement, Chugach said that its board of directors had adopted a new, triple bottom line approach that takes "consideration of sustainability impacts in business decisions, to create greater business value and enhance the Association's position as a long-term viable organisation for the benefits of its members and the community".

"Making sustainability a focus and priority makes good business sense," said Chugach CEO Lee Thibert. "Focusing on the fair treatment of employees, members, and stakeholders; reducing environmental impacts; while evaluating financial performance; all equals a better outcome for everyone."

In the state of Alaska, several initiatives are under way to encourage the deployment of renewables – and other innovative technology solutions – to help cut energy bills and promote energy efficiency. The Alaska Energy Authority's (AEA) Renewable Energy Fund has disbursed $257 million in support of renewable energy projects since 2008. These projects helped the state's utilities to displace the use of over 21 million gallons of diesel fuel (equivalent) in the first three quarters of 2016, AEA says.

AEA has also launched a Wind Working Group to guide the development of wind energy projects in Alaska, as well as an Emerging Technology Fund.

"In places like Alaska, fossil fired power generation is being displaced by renewables," said Massimo Danieli, Managing Director of ABB's Grid Automation business unit. "When you start pushing the envelope and the penetration of renewables becomes high, i.e., over 50 per cent of electricity, you start getting stability and power quality issues. Utilities such as Chugach Electric are currently investigating and experimenting with the point to which they can push renewables integration."

To demonstrate how renewable energy can be integrated with grids, Chugach Electric devised a project that combines two types of energy storage technologies with a sophisticated control system. It is the first hybrid installation of its kind with both flywheel and battery combined. Other microgrid installations use either battery or flywheel storage.

This "microgrid" solution will, hopes Chugach, enable it to manage grid stability issues caused by variable generation and loads and also manage more efficiently the resources in its portfolio.

The project site will be next to a power plant owned by Chugach in Anchorage and the storage devices will monitor the actual wind output on Fire Island, which is many miles away, and react to the ups and downs in wind generation to "smooth" output. Chugach intends to explore the ability of this hybrid storage solution to mitigate wind ramp rates, help stabilise system frequency and provide system voltage support.

For the project, ABB is providing its PowerStore technology, a containerised microgrid solution combining flywheel and battery storage systems, with software and controls. The firm has installed around 40 PowerStore systems around the world, most of them based on flywheel technology and used in remote or industrial locations to help with the integration and management of renewable energy resources. It launched a battery-based version of PowerStore in 2016, according to Danieli.

At the Chugach project, the PowerStore system will comprise two main modules. The first is a flywheel with containerised controls. It has an output of 1 MW and a capacity of 16.5 MW per second. The second is a 500 kWh, 2 MW lithium-ion battery, with power conversion and controls.

ABB is also providing a Microgrid Plus control solution that will control the two PowerStore modules and integrate their operation with the Fire Island wind farm and the Chugach electric power grid. "The Microgrid Plus control system coordinates actions across the whole system," said Danieli.

In addition to supplying the main components, ABB supported Chugach in the initial design and specification phase and was responsible for the overall design of the microgrid system. It will also undertake commissioning of the microgrid later this year when the project is completed in the second quarter.

According to Danieli, combining the flywheel and battery technologies will enable Chugach Electric to achieve a high level of stability and control of its grid. The flywheel acts as a first stage response to grid instability issues, such as frequency regulation and voltage support, while the battery provides other services, such as curtailment avoidance and peak shaving support.

"Batteries don't cope well with very frequent and high peaks and dips of electrical request so they are better used for long term storage," Danieli noted. "When you have conditions like this [in Alaska] with high variability of the wind and high variability of loads because of cranes at the ports, for example, you would typically have very frequent requests for the batteries to continuously sync power or release power. This would, over a very limited amount of time, wear and damage the battery.

"So the flywheel is basically used to compensate for the high frequency and high variability so that the battery can do its job of accumulating power and releasing power over a longer period of time."

The role of the control system is to correctly dispatch the flywheel over the battery and vice versa. Its functions are complex but ABB's modular approach makes the design and construction of the control system easier, said Danieli: "ABB's technology is often used in remote areas where you need to build the system in the shortest possible time. It is therefore highly modularised and highly complex functions are split into smaller modular pieces, which are fully coordinated with each other. The commissioning of the system is therefore simplified and shorter in time."

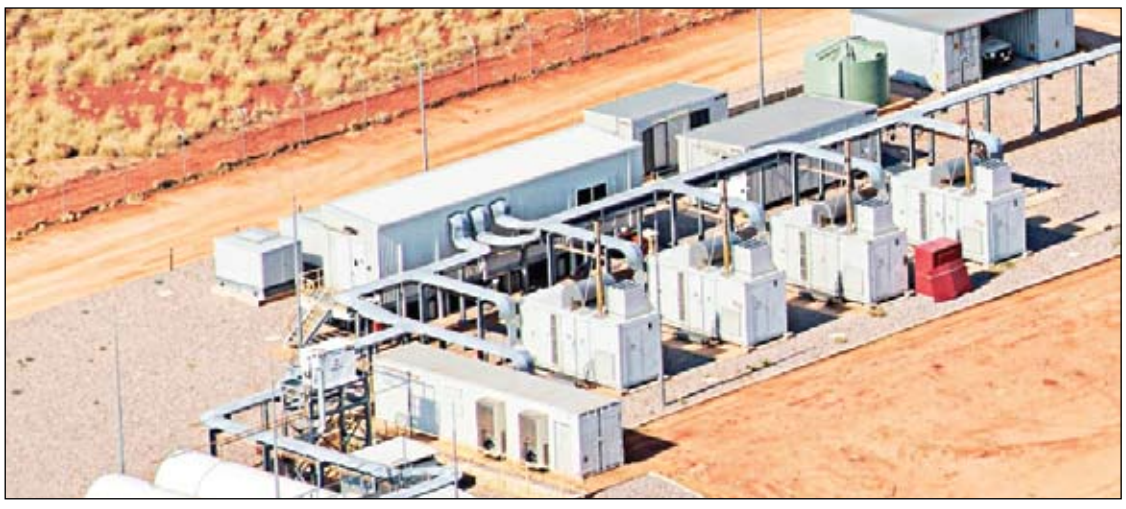
The microgrid has a load sharing and load shedding capability, said Danieli. "The control system aims to control and stabilise the grid by maintaining the generators, flywheel and battery system in line with the required energy. When this is not possible, for example because there is a lack of wind, or because the battery is discharged, it will implement a load shedding capability."

The microgrid is also enabled for remote monitoring, although Chugach Electric has not yet said whether it will make use of this function in this particular project.

"This facility is available in all our microgrid systems," said Danieli. "There is a gateway that provides access to remote cloud software enabling the operator to view all the variables on the system, for example the status of the batteries, as well as external elements such as the status of PV panels or wind turbines. ABB is therefore able to monitor the condition and performance of the equipment, access diagnostics, and detect the overall performance of the microgrid.

"In very remote locations," he concluded, "this is an obvious advantage, and can help the customer with planning maintenance."

Marble Bar, Australia microgrid solution: Chugach Electric has opted for an ABB microgrid and storage system to manage wind energy from Fire Island



Junior Isles

Moving with the times

Moving with the times can be painful, especially if your timing is off. In the energy industry it is a bit more serious than the embarrassment of wearing flares when your peers have progressed to straights and skinnies. Being slow to adapt can cost billions.

German utility E.On recently reported a loss of €16 billion for 2016, more than double the loss for 2015, on the back of write-downs on power generation and higher provisions for Germany's nuclear clean-up.

The company said the fall was mainly attributable to a loss from discontinued operations. While about 60 per cent of this can be attributed to the German government's decision last year to make the utilities pay €23.6 billion towards the cost of disposing and storing the country's nuclear waste, it is a one-time payment. The loss due to the write-downs is in many ways a more significant challenge.

E.On, along with RWE and its other domestic rivals, has been hit hard by the *Energiewende* – the country's accelerated transition to renewables, following the decision to close its nuclear plants. This has seen coal and gas fired generation squeezed out of the market by low priced electricity from subsidised wind and solar.

Germany's transition prompted E.On and RWE to restructure their organisations. E.On split into two, pooling its coal and gas-fired power stations, energy trading and gas production units into a separate company, called Uniper. RWE made a similar move; it spun-off its green energy and grid businesses into a newly-created subsidiary, Innogy, which floated in October last year.

The transformation of the two companies is not just the result of domestic market changes but is a reflection of the global climate change movement driven by the Paris Agreement. The agreement on limiting a rise in global temperature to less than 2°C has seen a global shift to a greener economy, which in turn has in turn pushed down the levelised cost of energy from wind and solar to levels that are in some regions below the cost of conventional generation.

For example, the UK's offshore wind sector has already achieved its target of getting below €100/MWh by 2020 – four years ahead of schedule. The solar story is even more impressive. In March the Abu Dhabi Water and Electricity Company (Adwec), the procurement arm of the Abu Dhabi Water and Electricity Authority (Adwea), signed a 25-year power purchase agreement with Japan's Marubeni and the Chinese firm Jinko Solar for a 1.17 GW solar power plant in Sweihan. Marubeni and Jinko submitted a record-low bid of 2.42 US cents/kWh for electricity from the plant.

The increasing affordability of renewables is having a big impact on the makeup of the power generation landscape – not just in developed countries but globally. A recent report by Greenpeace, the Sierra Club and research network CoalSwarm revealed that the amount of new coal plant being built around the world fell by nearly two-thirds last year.

It noted that the dramatic decline was overwhelmingly due to China and India, where work has been frozen at over 100 sites. In January, China's energy regulator halted work on a further 100 new coal fired projects, suggesting the trend is not going away. Researchers for the groups also said a record amount of coal fired capacity was retired globally last year, mostly in the US and the EU.

Like the coal industry, oil and gas are also under threat from the low carbon energy agenda. Last month the International Energy Agency estimated that a step-change in climate policy away from fossil fuels and towards cleaner sources of energy would leave a total of $1 trillion of oil assets and $300 billion in natural gas assets stranded.

There is little doubt many big energy companies might be in better shape today, if they had believed earlier that the shift to green energy was here to stay. Like E.On, RWE and others, oil and gas majors such as, ExxonMobil, BP, Shell, Statoil and Total are now making serious efforts to adapt to the new future in order to combat falling revenues. In the past, some have dabbled in renewables. Today, although perhaps partly forced by low oil prices, almost all are embracing low carbon energy and associated technologies such as storage.

Even Saudi Arabia, the world's biggest oil exporter is now taking its first step towards a goal of generating 9.5 GW of energy from renewables, recently inviting bids for a 400 MW wind farm and a 300 MW solar project.

The transition to a cleaner energy future certainly offers opportunities and has economic benefits both for companies and society. Stressing the case for renewables during the launch of '*Perspectives for the Energy Transition: Investment Needs for a Low-Carbon Energy Transition*', International Renewable Energy Agency (Irena) Director-General, Adnan Z. Amin, said: "Critically, the economic case for the energy transition has never been stronger. Today around the world, new renewable power plants are being built that will generate electricity for less cost than fossil-fuel power plants. And through 2050, the decarbonisation can fuel sustainable economic growth and create more new jobs in renewables."

Danish company Dong Energy, which has its roots in oil and gas, is a prime example of what is possible if you spot and act on trends early.

Since its formation in 2006, the company has transformed from one of the most coal-intensive utilities in Europe to a global leader in renewable energy. Dong Energy's CEO, Henrik Poulsen notes: "We are the company that has come the furthest in the green transformation."

It is a transformation that has been rapid. The proportion of its capital tied up in wind farms has jumped from 16 per cent in 2007 to 75 per cent in 2015. The wind business became its biggest contributor to earnings in the first half of 2016, overtaking oil and gas with 42 per cent of operating profit.

Notably, the company is now the world's largest offshore wind farm company, having built more than a quarter of the capacity in operation globally. Marking a major milestone, in October last year it installed its 1000th offshore wind turbine.

Dong Energy is also investing in pioneering technology that turns waste into electricity. It is building the world's first commercial full-scale waste-to-energy bio plant in Northwich, UK. The plant will use enzyme treatment to convert household, municipal and some commercial waste into biogas, as well as recyclable plastics and metals (see *TEI Times* January 2017).

Further, the company has been converting coal power stations in its utility subsidiary to burn wood pellets and in February announced its power stations would stop using coal altogether by 2023.

Now, it is preparing to sell off its oil and gas business by the end of this year, after floating on the Copenhagen stock exchange in 2016. The move follows the divestment of its ownership shares in five producing Norwegian oil and gas fields to Faroe Petroleum Norge AS (Faroe) last July.

Dong is betting big on offshore wind. It says it plans to install more offshore wind capacity between 2016 and 2020 than it has in the last 25 years. Some may see it as a risky strategy, considering the construction risk associated with the sector. Nevertheless, the company continues to bet on the future. So far, acting early has proven to be sound judgement. And regardless of the outcome, excessive delay is not an option for energy companies.

In a research paper published last year by UK-base think-tank Chatham House, Professor Paul Stevens warned that if large oil companies did not change their business model, what remains of their existence will be "nasty, brutish and short". The same goes for power generators and integrated energy companies.

Wearing flares when they are out of fashion might be seen as retro at best or embarrassing at worst, but standing still in the energy industry while the world around you changes could be suicide.

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