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US Energy Secretary Ernest Moniz: the US and China need clean coal

New power plants must be zero emissions

A new study says no more fossil fired plants can be built if the world is to meet its climate change target. But with carbon capture and storage still too expensive, options for coal fired generators are limited. **Junior Isles**

New generating capacity would need to be zero emissions from 2018 onwards if the world is to meet its Paris commitments, according to a recent study by Oxford University.

The finding has come as a surprise, even for those that produced it. Economist Cameron Hepburn, co-author of the peer-reviewed paper said: "I was surprised. I think the general sense is that this is a problem, but not that it would have to be addressed next year," he said. "For policymakers who think of climate change as a long-term future issue, this should be a wake-up call."

The Oxford paper says that to have a

50 per cent chance of limiting climate change to the 2°C agreed by world leaders, there can be no new fossil fuel electricity generation plants built "from 2017 at the latest", unless they are fitted with carbon capture and storage (CCS) technology.

However, although governments have committed \$24 billion to CCS projects over the past 15 years, the high price and power penalty associated with CCS has made the technology commercially unpalatable.

China and the US, the world's two largest emitters, nevertheless remain keen to pursue development of technology that will allow coal to be

burned cleanly.

Speaking in Beijing last month, US Energy Secretary Ernest Moniz called for a focus on developing clean coal technologies. Moniz said the two countries' reliance on coal required the development of coal technologies that emit less carbon.

"The idea of having a continued opportunity for coal use in a highly carbon-constrained world is something that's attractive for carbon reasons. It's also attractive in addressing the coal country, the dislocations that otherwise would become even greater," he said.

In recent times the two countries

have reached a series of deals to curb emissions and build domestic political support for lower-carbon industrial policies to help meet the commitments made late last year in Paris.

The US is promoting pilot projects in China, including CCS. Chinese construction companies have been involved in planning coal-based projects in the US, including the energy department-backed Texas Clean Energy plant, although many of those projects have stalled.

The prospects for clean coal in the UK are even worse, where the country

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Climate change claims Peabody

The impact of climate change policy on coal is being held up as a major factor in the demise of US coal giant, Peabody.

In April the Missouri-based company said it filed for bankruptcy protection under Chapter 11 in an effort to reduce its overall debt level, lower fixed charges, improve its operating cash flow and "position the company for long-term success." But the news was widely seen as a sign that the end of coal mining is fast approaching, at least in the developed world and especially following December's Paris climate agreement.

"Be in no doubt; this is very big news," said Richard Black, director of the Energy and Climate Intelligence Unit (ECIU). "The coal industry around the world has been under sustained pressure for a number of years now due to a range of factors, including a glut of coal pushing prices down and the increased availability of natural gas.

"But environmental pressures are the biggest factor. In many countries, air pollution is now a major concern, governments are becoming more and more concerned about the climate impacts of coal; and now the biggest private company of all has succumbed."

Peabody blamed "unprecedented" factors affecting the global coal industry, including a sharp drop in the price of coal, weakness in the Chinese economy and problems in its domestic market. Coal's share of the US electricity market slumped from 45 per cent in 2010 to 33 per cent last year – coal-fired power plants accounted for more than 80 per cent of the 18 GW of US generation capacity shut down last year.

The US mining company reported a net loss of \$2 billion for last year and is labouring under a net debt pile of about \$6 billion. Five years ago it was worth almost \$20 billion, now the company has become the 50th US

coal company to file for bankruptcy since 2012.

The filing under Chapter 11 is intended to allow Peabody to restructure its debt while continuing to operate. Its US operations, which Peabody said were cash flow positive last year, will continue to run, as will mines in Australia that were excluded from the Chapter 11 filing.

Black said: "Phasing out coal in favour of cleaner forms of energy, like natural gas or renewables, is a process which is accelerating around the world. US companies are going bankrupt, European countries including the UK are phasing it out, and our research also shows that talk of a coal renaissance in Asian countries is likely to be a red herring."

In a report published in March, the ECIU said that the Asian Tiger economies with the world's four biggest coal power project pipelines, China, India, Indonesia and Vietnam, are likely to build far less than half of

their current planned coal fired power plants.

The recent decision by Coal India Ltd (CIL) to cut coal prices is further evidence that even Asian coal companies are struggling with the global slowdown in coal demand.

CIL said the decision "was taken due to the fall in international coal prices, improved supply of coal by CIL, sluggishness in coal demand in general and higher grades of coal in particular".

Elsewhere, some of Europe's last remaining coal producers, in the Czech Republic, Romania and Poland, are grasping for government support to keep from going under and taking thousands of jobs with them.

In April, coal workers in Romania staged a 320 km "desperation march" to Bucharest to pressure the government to rescue coal mine and power plant operator Complexul Energetic Oltenia.

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is to phase out unabated coal generation by 2025 but at the same time has scrapped support for CCS.

In its Autumn Statement the UK government unexpectedly cancelled a £1 billion (\$1.4 billion) competition on the grounds of cost.

The decision has left coal fired generators with few options. Drax Group, the owner of Drax, the UK's largest coal fired power station, has been converting its coal fired stations to burn biomass. Its planned CCS White Rose Project, which had been awarded EU funding, was scrapped after the UK government decided to cancel the CCS competition.



Thompson: Drax could phase out coal use with government support

Dorothy Thompson, chief executive of the Drax group, recently said the company could still beat the 2025 deadline for phasing out coal power that ministers set in November, by converting more boilers at its 4000 MW North Yorkshire power plant so they burn wood pellets instead.

The company has already converted its 42-year-old power station into one of the world's biggest renewable generators over the past four years, by upgrading nearly half of its six coal-fired boilers to burn wood pellets, mostly imported from the US.

Speaking to the *Financial Times* ahead of its annual shareholder meeting last month Thompson said: "We have project plans that we could execute within three years, so you could take our coal units off the system by 2020 if not before."

The company says, however, it needs government support to make further conversions. The conversions so far have only been possible with subsidies and other support worth £451.8 million in 2015, or 17 per cent of revenues at the power plant, which supplies around 7-8 per cent of the UK's electricity.

Thompson would like to see conversion of the remaining boilers supported by the government's Contract for Difference scheme, which guarantees long-term power prices for renewable power companies. "We couldn't do it without CFDs, it's too expensive," she said.

Drax was awarded one CFD contract for its third boiler conversion two years ago but is still awaiting state aid approval for it.

Drax has completed conversion of two boiler lines and a third is operating primarily on biomass with a full conversion awaiting a green light from the European Commission. Approval is widely expected because Brussels waived through support in December last year for a coal-to-wood pellet conversion at the smaller Lynemouth power station. According to analysts, a positive decision could make a £70 million difference to Drax's annual revenues from 2017.

Countries move forward on climate change

Industry observers are analysing the implications of the Paris Agreement following the historic signing by 175 countries in New York in April. **Junior Isles**

While the signing of the Paris Agreement could bring trillions of dollars in opportunities for businesses, it will hit already hard-pressed utilities that own generating assets that are largely fossil fuelled.

A new analysis, 'What Paris means for business' – published just hours before world leaders from 175 countries convened at the United Nations headquarters in New York city to sign the historic Paris Climate Agreement – highlights market opportunities arising from the agreement and urges the private sector to take action now.

Experts from We Mean Business – a coalition of organisations working with thousands of the world's most influential businesses and investors – have analysed the details of the Paris Agreement to identify key policies relevant to global business and translated it into an accessible form for a private sector audience.

With the world's major economies

committing to restructuring their energy systems, the report notes that collectively, the national climate plans under the Paris Agreement represent at least a \$13.5 trillion market for the energy sector alone in energy efficiency and low-carbon technologies through 2030.

Michael Terrell, Head of Energy Policy, Google Inc. said: "Companies are making big bets in clean energy to fight climate change and because it makes business sense. At Google, we have committed to purchase over 2 GW of renewable energy and are the largest non-utility renewable energy purchaser in the world. We believe we can tackle climate change in a way that will spur innovation and growth and benefit us all."

The agreement, however, will have a negative impact on those generating utilities that are largely dependent on fossil fuels.

Commenting on the credit implica-

tions of the Paris Agreement, Paul Marty, Moody's Vice President and Senior Credit Officer, said: "We believe that the uncertainty driven by political and regulatory policy changes and the risks arising from the conflicts between EU and national policies will likely continue to make the operating environment challenging for European unregulated utility companies and negatively affect their credit quality."

"Conventional generation utilities will continue to see their volumes reduced as new renewable capacity further pushes thermal generation out of the merit order."

He added, however, that the push for new renewable capacity would partly replace the lost earnings from declining thermal generation.

Just ahead of the signing ceremony organisations that collectively represent more than 400 institutional investors with \$24 trillion of assets

under management called on world leaders to not only sign, but accede to the Paris Agreement and implement it into national law as a matter of urgency.

The Paris Agreement enters into force when 55 countries representing 55 per cent of global emissions have deposited their instruments of accession with the UN. The agreement, opened for signature on April 22nd at the UN in New York and will stay open for signature for one year.

The Agreement has the long-term goal of limiting global temperature rise to 1.5°C. The science indicates it cannot come into force soon enough. Shortly after the deal was reached at COP21 in December, scientists confirmed that 2015 was the warmest year on record. While last year's temperatures were influenced by a strong El Niño, scientists have found that climate change was the key driver of the record warm temperatures.

Climate finance gaining traction

Clean energy investment is gaining momentum as both the private and public banking sectors announced major financing pledges last month.

The International Finance Corporation, a member of the World Bank Group, announced plans to expand its climate investments from the current \$2.2 billion a year to a goal of \$3.5 billion a year, and lead on leveraging an additional \$13 billion a year in private sector financing by 2020.

In its new Climate Change Action Plan the World Bank Group said it intends to help developing countries add 30 GW of renewable energy to the world's generating capacity by 2020. To maximise impact, the Action Plan is focused on helping countries shape national policies and leverage private sector investment.

The new plan aims to accelerate efforts to tackle climate change and help developing countries deliver on their national climate plans.

As well as its own financing, the World Bank also intends to mobilise \$25 billion in commercial financing for clean energy over the next five years, while continuing to deepen its work to help countries put a price on carbon pollution and create incentives for public and private sector decision makers to make the right climate choices.

In early April, a group of nine banks, investors and public sector lenders committed \$8 billion to a collaboration that they say will allow them to address some of the world's toughest sustainable development issues.

The Catalytic Finance Initiative (CFI) launched by the Bank of America Merrill Lynch includes HSBC and Crédit Agricole as well as investors such as Babson Capital and MassMutual and public sector lenders including the European Investment Bank and an arm of the World Bank. Launched in 2014, it promised to raise

at least \$10 billion to accelerate clean energy investments that reduce carbon emissions.

According to the banks, the collaboration will make sure that "hard things get easier to solve".

Having investors, public banks and investment banks all in the same group allows the CFI to split the risk in projects in a way that allows all three groups to participate. An example is BofA's credit lines for energy efficiency investments, which is part of \$800 million in financing announced with New York State Green Bank.

Purna Saggurti, Chairman of global corporate and investment banking at BofA explained: "The regulators will only let us lend money to a certain tenor. Some of these projects are very long tenor projects, unless we have... the public sector banks to adjust and manage that tenor risk there's a regulatory impediment."

The World Bank said last year that

the global economy needed \$89 trillion in infrastructure investment by 2035 to achieve internationally agreed goals of capping climate change at a 2°C temperature rise. The CFI is just one initiative that banks are using to satisfy this financing demand.

April also saw the signing of a new cooperation and support agreement between the Abu Dhabi Fund for Development (ADFD) and the Abu Dhabi-based International Renewable Energy Agency (IRENA) to ensure the effective allocation of the \$350 million of funds pledged by ADFD for renewable energy projects in developing countries.

A recent report from IRENA said the world's renewable electricity capacity increased at a record-high rate of 8.3 per cent in 2015 as falling technology costs spurred solar and wind deployment. The report noted that the fastest growth in renewable generation capacity came from developing countries.

Wärtsilä moves into solar, as energy market "remains tough"

Wärtsilä is entering the solar energy business by offering utility-scale solar photovoltaic (PV) solutions. The new solutions include solar PV power plants of 10 MW and above, and hybrid power plants comprising solar PV plants and internal combustion engines. Both solutions are offered with full engineering, procurement and construction (EPC) delivery.

Explaining the move, Javier Cavada, President of Wärtsilä Energy Solutions said: "Utility-scale solar PV is big business that is growing fast, with the installed base expected to grow four-fold to 450 GW by 2025.

We think we have a good opportunity in it. Retrofit engine-solar hybrid plant opportunities look especially promising, since we have dozens of gigawatts of installed engine power plant base in areas with plenty of sunshine."

Wärtsilä's first solar project is a retrofit hybrid plant in Jordan. It combines a solar PV farm with IPP4, a 250 MW Smart Power Generation plant comprising 16 Wärtsilä 50DF engines, delivered to AES Jordan in 2014. Wärtsilä's EPC scope includes 46 MW of solar modules, covering an area of 81 hectares, as well as inverters, switchgear, control systems and

overhead transmission lines.

Wärtsilä will acquire the solar PV modules for its projects from leading module suppliers. "We will hire local contractors to install the solar modules in the EPC projects. The procedure is similar to our engine power plant EPC projects," said Cavada.

Wärtsilä expects rapid growth in its solar business, predicting annual sales of €300 million in 2020. The addition of the new business will help the company, which recently reported difficult market conditions. Its Q1 Interim report showed its Energy Solutions order book revenues fell by 8 per cent to

€1491 million compared to €1619 in Q1 2015.

Announcing its first quarter results, Jaakko Eskola, President and CEO, said: "Ordering activity was solid in the Energy Solutions business, but the reduction in power plant deliveries and price pressure in the power generation markets affected Wärtsilä's overall financial performance."

"We have seen market conditions weakening in our equipment businesses. Despite the somewhat improved sentiment in the power generation markets, the competitive environment remains tough."

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Transition law boosts Mexico renewables

A stable regulatory regime and growing energy demand are attracting international renewable energy developers to Mexico.

Siân Crampsie

Mexico's renewable energy market looks set to surge after the country concluded its first long-term power auction since implementing sweeping reforms to the energy sector.

The March auction generated 227 bids from 69 groups, and awarded 1800 MW of wind and solar capacity, equivalent to 85 per cent of the energy on offer, spread between 12 solar plants and six wind farms.

Winning bidders included Enel Green Power, SunPower, Jinko Solar, Acciona Energia and Envision Energy. Mexican utility CFE will purchase energy from the projects under 15-year contracts.

Eleven packages of wind and solar projects and certificates were sold at an average price of \$41.80/MWh. Prices for solar averaged \$40.50/MWh, while prices for wind averaged \$43.90. Solar energy accounted for 1100 MW sold, and 620 MW of wind projects were awarded long-term contracts.

The 18 projects also were awarded

a total of 5.38 million Clean Energy Certificates, or CELs, per year. Under Mexican law, CELs are issued for each megawatt-hour of electricity that is generated without using fossil fuels.

Enel Green Power was the largest winner, receiving three contracts across northern and central Mexico for a total capacity of nearly 1 GW. The company will invest approximately \$1 billion in the construction of the new solar PV facilities, cementing its status as the largest renewables operator in Mexico.

US-based SunPower is a notable runner-up, coming away with nearly 500 MW in power purchase agreements (PPA). SunPower and its local subsidiary Vega Solar will install roughly 400 MW of PV in Yucatan and 100 MW in Guanajuato.

Jinko Solar won 188 MW of capacity in the auction, which the government hopes will attract additional investment.

In the wind sector, Acciona Energia received the largest wind contract at 168 MW, and Chinese firm Envision

Energy won 90 MW. Completion deadlines for the projects are set as early 2018.

Cesar Emiliano Hernandez, Mexico's deputy electricity minister, said that a second auction would be held in April in order to buy the remaining energy CFE needs.

Mexico is seeking to add 20 GW of clean energy in the next 15 years, according to the National Electricity System Development Program released in June. The country has forecast as much as \$62.5 billion in private investment in the energy industry by 2018.

Enel Green Power CEO Francesco Venturini said that Mexico is "a key market" for the company due to its "enormous potential in the clean energy field and stable regulatory framework".

Iberdrola was recently awarded a contract to construct the 890 MW Combined Cycle Northwest power plant in Mexico's Sinaloa state. The Spanish firm will operate the new plant and sell the output to CFE for 25 years, starting in January 2019.

USA, China issue climate declaration

US President Barack Obama is pressing on with his climate and green energy policies in spite of a growing divide in the country over the Clean Power Plan.

The US and China made a joint presidential statement on climate change at the end of March, announcing they would join the Paris Agreement this year and pledging continued collaboration to drive climate action forward on the global stage.

Between them the two nations account for 38 per cent of global emissions, and said in their joint statement that they had "taken strong measures at home to build green, low-carbon and climate-resilient economies". They called for other nations to join them in signing the Paris Agreement "to win the fight against the climate threat".

At home, Obama continues to face criticism from energy companies and politicians in coal-mining dependent states of his Clean Power Plan, the centrepiece of his climate policies.

The Clean Power Plan is intended to cut carbon dioxide from US electricity generation by 32 per cent from 2005 levels by 2030. Some 27 mostly Republican-controlled states, led by West Virginia, have filed a lawsuit seeking to block the implementation of the regulations, arguing that the

administration is trying to exceed its powers to control pollution under the 1970 Clean Air Act.

The states and the business groups that are supporting them won a significant victory in February, when the US Supreme Court ordered a halt to implementation of the plan until it had been fully considered by the courts.

Conversely, several US companies have filed what are known as "amicus briefs" to the court, in support of the EPA's position. Amazon, Google, Apple and Microsoft said that they were "uniquely positioned" to give a view on the case, as some of the largest purchasers of power in the US who had committed to taking a significant proportion of that electricity from renewable sources.

They said they planned to use more renewable electricity because "delaying action on climate change will be costly in economic and human terms, while accelerating the transition to a low-carbon economy will produce multiple benefits".

They added that they believed the Clean Power Plan's requirements for increased use of renewable energy were achievable and economically viable, with the cost of electricity from wind and solar power falling sharply.



Obama: pressing on with climate and green energy policies

Sumitomo commissions PJM battery

An innovative battery-based energy storage system has started operating in Ohio, providing supply-demand balancing services for the frequency regulation market operated by PJM.

Sumitomo Corp. of Americas announced in March that it had started operating the 6 MW, 2 MWh Willey Battery Utility system, which comprises three containers of lithium-ion batteries manufactured by Toshiba, and three inverter units manufactured by Parker Hannifin.

"As a developer of wind and solar power plants which are unavoidably

intermittent generation sources, we think it is quite important that we also contribute to the stabilisation of power grids through balancing services," said Mick Hagiwara, Director, Power and Infrastructure group, Sumitomo Corp. of Americas.

"Understanding that energy storage service is indispensable for further penetration of renewable energy, we will keep trying to expand our footprint in the energy-storage space, not only in frequency-regulation but also in other types of storage services," he added.

Belo Monte starts up

- Two units commissioned
- A-5 auction attracts bids totalling 17 GW

Brazil's 11.2 GW Belo Monte hydro-power plant has started operating, supplying electricity to the nation's grid for the first time.

According to the Brazilian mining and energy ministry, Operator Norte Energia has commissioned two turbines at the plant, which lies on the Xingu River in the northern state of Pará.

It will sell energy to 27 distributors in 17 states, and was due to start operating in February 2015. However, it was beset by delays caused by labour issues, protests and licensing problems.

Belo Monte is a key part of the Brazilian government's plan to boost generating capacity in the country. According to the mines and energy ministry, Brazil will add 7.223 GW of capacity to the grid this year, and has already commissioned 1.873 GW of that capacity so far in 2016.

The ministry also said the risk of an electricity shortage was now zero, as heavy recent rain had allowed grid operator ONS to deactivate the



country's most expensive backup thermopower plants.

As *TEI Times* went to press, Brazil was due to hold the A-5 energy auction for renewable energy and thermal power plant capacity.

According to research firm EPE, some 17 131 MW of wind energy projects were licensed to participate in the A-5 auction, scheduled for 29 April, 2016. Wind power accounted for the majority of the projects registered for the tender.

Overall, 802 projects of renewable and conventional sources totalling 29 628 MW will compete in the auction, EPE said.

Last month Enel Green Power said it had begun construction work on its 90 MW Cristalândia wind farm project in the northeast state of Bahia.

The \$190 million project is due on line in the second half of 2017, when it will supply several Brazilian electricity distributors with energy under 20-year power purchase agreements.

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India's ambitious plans for the solar sector look slightly less certain following SunEdison's decision to file for bankruptcy protection. **Syed Ali**

Industry observers say news of the bankruptcy of US-based solar giant SunEdison is causing Indian lenders to become more reluctant to finance solar projects by foreign companies.

Experts say the demise of the world's biggest solar company combined with record-low Indian solar tariffs has stoked concern that projects could struggle financially. At the beginning of April, SunEdison announced it was looking to sell as much as 1 GW of unfinished projects in India.

India estimates it needs to invest up to \$100 billion in solar power in the next 6-7 years to meet its ambitious target of boosting capacity from the current level of 5800 MW to 100 GW by 2022.

Although several tycoons have pledged billions of dollars in clean energy investment, there are infrastructure financing hurdles in India and Central bank data shows that about 14 per cent of total loans have soured or been written off.

India is in talks with the World Bank, the Asian Development Bank (ADB), Germany's KfW and the New Development Bank, set up by big emerging economies that form the BRICS bloc, to raise more than \$3 billion in the current financial year.

Last month officials said the country hopes to receive one of the first loans issued by the China-led Asian Infrastructure Investment Bank (AIIB) later this year, as it looks to raise \$500

million for solar power projects from the newly created lender.

There was further good news last month with the announcement that independent renewables developer Mytrah has received approval from the ADB for a direct loan facility of up to \$175 million. The loan will help fund the development of its 1000 MW portfolio of new wind and solar projects currently in the pipeline.

However, India's solar ambitions are not being helped by the ongoing solar panel dispute with the US.

Last month India said it would file an appeal against the World Trade Organisation's (WTO) ruling that the country's power purchase agreements with solar firms are inconsistent with

international norms.

In 2014 the US brought a case to the WTO alleging that the clause relating to domestic content requirement (DCR) in the country's solar power mission was discriminatory in nature and "nullified" benefits accruing to the American solar power developers.

China, the largest solar panel exporter to India, recently voiced its support for India's decision to appeal. Xie Zhenhua, Special Representative for Climate Change of China, who was in India for the 22nd BASIC Ministerial Meeting on Climate Change, said: "We support the position of India. Most of the countries globally are giving subsidies for development of renewable energy."

Australia comes clean

Australia's recent launch of a new renewable energy fund marks a major shift in the country's climate policies. Prime Minister Malcolm Turnbull says the government will channel A\$1 billion (\$771 million) towards clean technology innovation.

The move signifies a departure from former Prime Minister Tony Abbott's approach to clean energy development and environmental issues. Turnbull himself has also been criticised for his strong support for the fossil fuel industry and for scrapping an ambitious carbon tax and emissions trading scheme in 2014.

The Clean Energy Innovation Fund will support the commercialisation of emerging technologies, such as large-scale solar with storage, offshore energy, biofuels and smart grids.

The fund will be jointly managed by the Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency (ARENA), and will provide both debt and equity for clean energy projects. It will be established from within the CEFC's A\$10 billion allocation, making available A\$100 million a year for 10 years.



About turn: Turnbull channelling money towards clean technology innovation

Japan's GHG emissions hit three-year low

The growing use of renewable energy and greater energy efficiency saw Japan's greenhouse gas emissions (GHG) fall by 3.1 per cent in 2015 to a three-year low.

According to data from the Ministry of Environment, GHG emissions fell for the first time in five years to 1.364 billion tonnes of CO₂ equivalent from 1.408 billion tonnes the year before, which was the second highest on record.

The figure was down by 2.4 per cent compared to 2005 levels but up 7.3 per cent compared to data from 1990.

The Ministry of Environment said the reduction is due to energy saving measures, significant investment in renewable energy, as well as fuel switching and enhanced fuel efficiency of coal-fired power plants.

It is the first decline in carbon emissions since the 2011 Fukushima disaster forced the closure of nuclear power

plants and an increased reliance on gas and coal.

In December, the Institute of Energy Economics Japan forecast that a gradual restart of reactors and growing development of renewable energy would reduce the country's energy-related CO₂ emissions for a third straight year to 1.131 billion tonnes in fiscal 2016 from a record 1.235 billion tonnes in 2013.

The slow pace at which reactors are

coming back on line, however, could challenge those forecasts. Only two reactors at Sendai have been restarted so far.

The situation was recently compounded by the decision to retire the No. 1 reactor at the Ikata power plant in Ehime Prefecture. This means 12 of the 54 nuclear reactors that were operating prior to the Fukushima nuclear disaster in March 2011 will never come back online.

Indonesia advances renewables

Indonesia's plans to increase its use of renewables moved forward at the start of April with the inauguration of several renewable projects in the eastern part of the country.

Indonesia has said that a significant portion of its plan to add 35 GW of new capacity in the next five years will be in the form of renewables.

Announcing the inauguration of the new projects, Sudirman Said, Minister of Energy and Mineral Resources said: "The government is committed to realising the supply for 35 000 MW and 25 per cent [8800 MW], of the target will be from new renewable energy."

Those plans received a boost last month as the Overseas Private Investment Corporation, a US government development agency, announced it will finance Indonesia's largest wind power project. The \$120 million investment will fund the development, construction, commissioning and op-

erations of the 70 MW wind farm in Sulawesi.

Many of the renewable projects are for distributed generation, which is important to the rural electrification of the country.

In April Siemens signed two Memorandums of Understanding (MoUs) with state power company Perusahaan Listrik Negara (PLN) for the development of 500 MW of distributed power generation and transmission and distribution grid development.

Atlantis, a global leader in the tidal power sector, has entered into a MoU with SBS, a privately owned international marine, subsea and renewable energy developer. Under this Agreement, Atlantis and SBS will work together to establish a joint venture to develop a 150 MW tidal stream site. The total cost of this commercial array has been estimated at \$750 million and will be constructed over a number of stages.



China's energy regulator has confirmed it will stop the construction of coal-fired power plants in 15 regions as part of its efforts to tackle overcapacity in the power sector.

The National Energy Administration (NEA) confirmed a report in *The Southern Energy Observer*, a magazine run by the state-owned China Southern Power Grid Corp, which said regulators had halted the construction of coal fired plants in regions where capacity was already in surplus, including the major coal producing centres of Inner Mongolia, Shanxi and Shaanxi.

The report, citing documents issued to local governments by the regulator, said China would also stop approving

new projects in up to 13 provinces and regions until 2018. Greenpeace said the rules, if fully implemented, could involve up to 250 power projects with an estimated total generating capacity of 170 GW.

China has been making a concerted effort to clamp down on its coal-derived emissions in an attempt to cut air pollution and meet its climate change commitments.

In late March, Beijing secured support from the World Bank in the form of a \$500 million loan to support air pollution control projects in the Chinese capital.

About 70 per cent of the China's electricity is generated by coal fired power plants, which are a major source

of carbon emissions. China aims to cut its reliance on fossil fuels by increasing the share of wind and solar energy, as well as nuclear and hydropower. It has a target of reducing emissions of major pollutants in the power sector by 60 per cent by 2020.

The country recently said it will spend \$4.8 billion this year to build two more nuclear power reactors, as part of its plan to expand clean energy production. The money will be spent on two units to be built by China National Nuclear Power Co, which start construction this year.

At the end of March, the NEA said China will triple its solar photovoltaic generation capacity by 2020, and is aiming for a total of 143 GW.



Hinkley Point C decision delayed once more

A final investment decision is now unlikely to be made before the summer, and opponents are questioning the legality of financial assistance for EDF from the French government.

Siân Crampsie

Pressure from unions and the threat of legal action have caused EDF to yet again delay a final investment decision on the controversial Hinkley Point C nuclear power plant in the UK until September.

EDF's board was widely expected to approve the project in May, but the French firm has bowed to pressure from unions to hold a consultation, a process that will take at least two months.

The news came as UK green energy

company Ecotricity and Greenpeace jointly announced they would launch legal action in the UK and in France if EDF received further state aid for Hinkley.

EDF says that there will be no final investment decision on the controversial £18 billion power project until the summer while it consults CCE, its central works council. It has also announced plans for a €4 billion capital raising needed for it to continue with its strategic investment programme, of which Hinkley is part.

The €4 billion recapitalisation is part of a wider financing plan that includes

€10 billion of asset sales by 2020 and €1 billion of cost savings.

The French government, which owns 85 per cent of EDF, says it will provide up to €3 billion in the capital raising.

Opponents of the Hinkley C project says that further help from the French government for EDF amounts to illegal state aid.

Ecotricity and Greenpeace wrote last month to the UK and French governments and to EDF Energy warning that they are prepared to challenge further state funding for Hinkley in the courts.

The UK government has awarded Hinkley C a contract that guarantees EDF £92.50/MWh for energy generated for 35 years. This contract has been approved under the European Commission's state aid rules, but there remain concerns over the project's financial and technical viability.

"Illegal state aid is one thing, and we'll work with Greenpeace to challenge that if it happens – but it's not just financial issues, there are technical problems with Hinkley Point too," said Dale Vince, Ecotricity founder.

"EDF are yet to build one of these reactors, their first two attempts are,

between them, sixteen years late and billions over budget – nobody in a normal business would attempt a third with the first two so woefully out of control."

The UK government has also expressed concerns about the impact of delays to the project, which it sees as being essential for plugging a looming energy crisis in the country.

Last month a leaked letter between the UK Energy Secretary, Amber Rudd, and a parliamentary committee indicated that delays to the project would push up energy prices for consumers.

Offshore wind tenders prepare for launch

Offshore wind energy in Europe is set for further growth with the prospect of several new offshore tender rounds.

Ségolène Royal, French Minister of Environment, Energy and Marine, has launched the latest offshore wind tender for an area off the coast of Dunkerque in France, while in Germany, draft plans released by the economics and energy ministry (BMWi) call for two tenders for offshore wind capacity totalling 2.92 GW in 2017.

In the Netherlands, meanwhile, the senate has approved an amendment to the Stroom bill (Electricity Act) that will pave the way for investment in an offshore grid.

The French tender is the third in the country for offshore wind and will include a number of new innovations aimed at reducing costs for developers

and simplifying procedures, according to Royal.

These include a tendering procedure called a 'competitive dialogue' that will allow communication with bidding candidates to enable them to improve their offers. Potential developers will also be able to take advantage of studies related to wave conditions and sea bed conditions prior to making their bids.

Germany has increased the capacity size of its proposed tender from around 2.4 GW in earlier plans. Each of the tenders, with dates March 1 and December 1 next year, will seek a capacity of 1.46 GW.

Only projects that have been licensed or are in advanced stage of development will be able to take part in the auctions. They will be slated for

installation between 2020 and 2024, BMWi said.

Germany is likely to exceed its target of 6.5 GW offshore wind by 2020 by over 1 GW. It has targeted installing 15 GW of offshore wind by 2030.

In the Netherlands, a tender for Borssele I and II offshore wind farms are due to be launched this month.

The tender procedure was initially planned to launch in December 2015, but was delayed by the rejection of the Stroom bill by the senate.

The senate has now approved an amendment to the Stroom bill, confirming TenneT's role as the developer and operator of the Dutch offshore grid. The new law also provides clarification to offshore wind farm developers on liability for damage from delays and disruptions at the offshore grid.

PTEC gets go-ahead

A 30 MW tidal power project has been given the all-clear, paving the way for construction to start in 2017.

The Marine Management Organization (MMO) has granted approval of the Perpetuus Tidal Energy Centre (PTEC) on the Isle of Wight, making it the largest consented tidal stream energy project in England and Wales.

Operated as a joint venture between private company Perpetuus Energy Ltd and the Isle of Wight Council, PTEC aims to attract a number of international technology companies to demonstrate tidal energy devices in a commercial operating environment. Up to 60 turbines could be deployed at the site, Perpetuus said.

"PTEC is of strategic importance to the UK's tidal industry as it delivers a fully consented site for a range of turbine technologies, deployed in large commercial arrays," said Project Director Mark Francis. "By allowing multiple turbine technologies to use the same site and share the same consents and infrastructure, we can simultaneously bring down the cost of energy and accelerate the growth of the tidal industry."

According to Perpetuus, global turbine manufacturers and supply chain companies are already showing interest in and commitment to the development, which could start operating in 2018.



Showing the way: site of the Perpetuus Tidal Energy Centre (PTEC) on the Isle of Wight

Caithness-Moray link wins EIB support

The European Investment Bank (EIB) has agreed to invest in a £1.2 billion power link project that will boost prospects for onshore wind energy in Scotland.

EIB will invest £500 million in the Caithness-Moray subsea power link, which is being developed by Scottish Hydro Energy Transmission (SHET). The project is the largest investment

in the electricity network in northern Scotland for 60 years and will supply power generated from wind farms to an estimated 2 million people living in Scotland.

SHET Director David Gardner commented that the project would allow "the connection of new generation" and provide "a more resilient power supply".

The project involves the installation of a new 1200 MW subsea cable between Spittal in Caithness and Blackhillock in Moray.

"Investment in energy infrastructure across the UK is essential to harness the full potential of new and future renewable energy schemes," said EIB Vice President Jonathan Taylor. "The European Investment Bank is pleased

to provide £500 million to support essential investment by SHET that will ensure more efficient transmission of green energy, enable increased use of renewable power in Scotland and secure energy supply to the Highlands and Scotland's cities."

As part of the project, SHET also plans to build a switching station at land between Wick John O'Groats

Airport and Noss Farm. The new switching station will accommodate power generated from the Viking Wind Farm in Shetland when construction is completed.

The station, which still has to receive planning permission, would allow power generated from Shetland to be added to the national grid for the first time.

EU, India step up fight against climate change

The EU and India have agreed to strengthen their cooperative efforts in the fields of clean energy and climate change.

At a recent summit held between the EU and India in Brussels, Jean-Claude Juncker, President of the European Commission, Donald Tusk, President of the European Council, and Narendra Modi, Prime Minister of India, agreed to adopt a joint declaration on a clean energy and climate

partnership.

The declaration will be key to the implementation of the Paris Agreement, and would trigger a renewed climate dialogue with India, the European Commission said in a statement. It came just a few weeks before the EU, its member nations and India signed the Paris Agreement at a signing ceremony in New York last month.

Miguel Arias Cañete, European Commissioner for Climate Action and

Energy, said: "As a major world player, India is a crucial partner for the EU on energy and climate matters. Together, the EU and India can boost energy security and fight climate change through a clean and sustainable energy system."

According to the International Energy Agency (IEA), India is set to contribute more than any other country to the projected rise in global energy demand. Steep rises in power production

and consumption are expected to accompany India's economic growth.

The EU and India's cooperation will include work on energy efficiency in buildings, development of renewable energy sources including solar and offshore wind, smart grids, energy research and innovation.

The EU and India will also explore opportunities for collaboration to further the objectives of the International Solar Alliance, which was launched by

India and France at the COP21 climate summit in Paris last year.

Furthermore, the EU and India will work together to advance the implementation of the intended national climate plans (INDCs) put forward in the lead-up to the Paris climate summit. They will also cooperate on the transparency and accountability framework for climate action, and ways to lessen and adapt to the adverse impacts of climate change.

Egypt boost generating, network capacity

- Boost to renewable energy capacity
- Hollande visit bears fruit

| Siân Crampsie

Egypt is discussing a \$2.2 billion deal with Danish wind turbine firm Vestas for the construction of wind farms in the country, it has been reported.

The Ministry of Electricity and Renewable Energy is set to sign a memorandum of understanding (MoU) with Vestas this month that would result in the development of 2200 MW of capacity.

In April a senior official in the ministry said Minister of Electricity Mohamed Shaker met with Denmark's ambassador to Cairo and a number of officials from Vestas to discuss the deal. The official added that Vestas has a number of banks in mind that could finance the project, including HSBC, EKF Denmark, EulerHermes, IFU Denmark, DANIDA, and CDP Banco, local media reported.

The deal would form part of wider plans in Egypt to boost generating capacity and develop the electricity network.

In April Egypt's New and Renewable Energy Authority (NREA) signed an MoU with the Saudi company Acwa Power to establish solar and wind plants in the West Nile area.

The signing of the agreement occurred during Saudi Arabian King Salman bin Abdulaziz Al-Saud's recent visit to Cairo. Acwa Power has said it is planning to invest \$10 billion in Egypt over the next five years.

Bahrain-based firm Terra Sola is also reported to be in talks with the Egyptian government to build solar plants in the country with a combined capacity of 2000 MW.

The plants would require \$3.5 billion of investment and could be built in regions including Aswan and Luxor on the Nile and Salloum and Masrah Matruh on the Mediterranean coast, according to the *Gulf Times*.

Last month GE signed a contract worth \$250 million with the Egyptian Electricity Transmission Company (EETC) to provide advanced grid solution technologies to substations in

Mostathmereen, Beni Suf Industrial, Ismailia East and Temay Alemdeed.

These four gas-insulated substations (GIS) will help connect 7 GW of power to the national grid, and will be crucial to reinforcing Egypt's network during periods of peak demand.

GE's contract is part of the Protocol of Cooperation signed during the French Presidential visit to Egypt in April. The project is being executed in a consortium with Rowad Modern Engineering, a leading Egyptian contractor, for the construction work of the substations.

The first phase, which includes the Mostathmereen substation, will be connected to the grid within six months, and the remaining three substations will be completed by the end of 2017.

H.E. Dr. Mohamed Shaker, Egypt's Minister of Electricity and Renewable Energy, said: "Egypt's generation capacity has significantly increased over the last two years, additionally we're moving towards a more diversified energy mix which drives us to find ways to boost the efficiency and stability of Egypt's national grid."

Overall, Egypt's ministry of electricity signed 11 MoUs with France during Hollande's visit, including agreements on the development of the electricity sector, efficiency, and renewable energy. The French Development Agency (AFD) also authorised an agreement worth €50 million with the Ministry to finance the construction of a wind farm in the Gabal Elzeit area, and two other agreements to finance the Delta Electricity Control Center, worth €50 million, and to construct a solar power plant with a capacity of 100 MW.

Other agreements signed during Hollande's visit include MoUs between the Egyptian Electricity Holding Company (EEHC), NREA and EDF on training, while Alstom was also due to sign an agreement with EEHC to implement an electricity project and to construct a solar power plant with a capacity of 50 MW in Sharm El-Sheikh.

Eskom submits nuclear application

- Government issues RfP
- Maintenance programme boosts plant performance

South Africa's National Nuclear Regulator (NNR) is currently reviewing an application by state utility Eskom to build two new nuclear plants.

Eskom submitted the nuclear installation applications in mid-March for licences to build a nuclear power plant at Duvnefontein, next to the existing Koeberg plant, and another at Thyspunt in the Eastern Cape.

At the same time the government issued a request for proposals to be submitted by the end of March to add 9600 MW of nuclear power to the

national grid by 2030.

The applications have sparked a debate in the country over the need for and safety of nuclear energy, which already delivers around four per cent of South Africa's electricity needs. The government is keen to boost nuclear energy resources due to the availability of uranium in the country and growing electricity demand.

In March Eskom said that it had been able to avoid load shedding for over seven months, and that it had stepped up its maintenance regime in

preparation to meet increased winter demand.

Its maintenance regime, implemented in 2015 in response to falling plant availability and several unplanned outages at key generating units, has helped to reduce plant breakdowns, the firm said.

Over the medium term, Eskom is aiming to achieve 80 per cent plant availability, ten per cent planned maintenance and ten per cent unplanned maintenance over the medium term.

International community courts Iran

With most of the US sanctions lifted, Iran's power sector is becoming a magnet for international investors.

Last month a number of South Korean firms visited the country to examine prospects for power plant projects in Arvand Free Zone, western Iran, according to the Deputy Head of Arvand Free-Industrial Zone Organization, Reza Motamedi.

The zone is trying to attract foreign and local investors, Motamedi said, with investors from China, Iraq, Russia, Poland, Germany, Holland and Turkey making investments in the zone.

Earlier in April Iranian Deputy Energy Minister for Planning and Economic Affairs, Alireza Da'emi, announced that Iran and Italy had signed a memorandum of understanding (MoU) to build renewable energy

power plants in Tehran with a combined capacity of 500 MW.

The MoU was signed in the wake of a visit to Tehran by the Italian Prime Minister Matteo Renzi, who held discussions with Iranian officials on means of developing bilateral relations following the lifting of international sanctions.

Turkey is also interested in Iran's power sector. Mohammad Reza Morvarid, governor general of Ilam, said that a Turkish economic delegation recently expressed readiness to build a 480 MW combined cycle power plant, *Shana* news agency reported. Some €300 million would be invested in the project by Turkey, Morvarid said.

The European Union is also attempting to improve cooperation with Iran, particularly in the field of nuclear

energy.

Last month a delegation from the EU visited Tehran to discuss cooperation in the civilian nuclear industry with the head of the Atomic Energy Organization of Iran (AEOI) Dr. Ali Akbar Salehi.

AEOI Spokesman Behrouz Kamalvandi said that Tehran and the European Union would sign a document to increase cooperation in the field of civilian nuclear technology.

"Cooperation (with other countries) has started in practice and we have exchanged delegations with the EU, China, South Korea, Japan, the far East and countries which enjoy nuclear technology, whose number is not so high; we will interact with all of them and a document is due to be endorsed with the EU which is being compiled," Kamalvandi said.

A platform for cutting the cost of offshore wind

Offshore wind substations are large, heavy and expensive pieces of equipment that are a significant contributor to the capex and opex of offshore wind farms. But a new transformer module designed by Siemens with reduced size and weight looks set to drastically cut the cost of energy from offshore wind farms. **Junior Isles**



Turbines and substation at London Array.
Copyright London Array Limited

The offshore wind industry has made tremendous strides over the last two decades or so. Since the first offshore wind farm in Vindeby, Denmark in 1991, about 12 GW has been installed globally, nearly half of which has been in the UK.

At the same time, turbine sizes have increased dramatically. Turbine capacity has increased from the 450 kW units installed at Vindeby to the 6-8 MW sizes now being commercially deployed.

Yet despite the progress made, the high cost of electricity from offshore wind remains one of the key challenges facing the sector. In order to be competitive without subsidies, the industry has set itself a target of reducing the levelised cost of electricity (LCOE) from offshore wind from around €150/MWh to €100/MWh by 2020.

Apart from turbine design, one key area where it is possible to reduce cost is in the grid connections to the wind farm. In the past, the industry has struggled to cut costs in this area but a recent development by Siemens Energy Management could have a significant impact.

Last year, the company unveiled a lightweight AC grid access solution that can help cut the cost of connecting near-shore wind power plants to

the grid. Known as the offshore transformer module (OTM), the new grid access solution has a drastically reduced weight and size, which helps to lower capex by up to 40 per cent.

The new solution – capable of replacing conventional AC transformer platforms that can weigh 1000-4000t and cost up to €100 million – consists of an OTM attached directly to a wind turbine, and acts as a distributed transmission asset. Nominally rated in incremental 250 MW blocks, they can be linked together to provide the required transmission capacity even for very large wind parks.

Commenting on the challenges that the industry has faced and the need for a new approach, Steve Aughton, Head of Sales AC Grid Access Solutions, Siemens Energy Management, said: “Reducing opex and capex has been a problem due to different strategies. While we have a huge amount of experience in the UK market, what we were finding was that each of our customers had different requirements and therefore different electrical designs for each project. This was stifling innovation and the ability to make cost savings.”

Essentially, the inability to standardise meant companies were unable to take advantage of the accumulative lessons learnt from previous offshore

platform constructions. In addition, the different operation and maintenance strategy required for each solution made it difficult to reduce operating costs.

Siemens therefore decided to come up with an innovation whereby it could leverage standardisation to achieve the cost savings in the offshore transmission system that the industry required.

Although the company has a conventional style offshore platform reference design, which is being deployed on projects such as Statoil’s Dudgeon wind farm, Siemens decided that a step-change was needed in its approach. As Aughton put it: “We needed a revolution rather than an evolution”.

But introducing revolutionary technology usually goes beyond simply developing a new solution and putting it out there. Siemens therefore worked with key stakeholders to demonstrate that it was a technical solution that could be rolled out across the industry.

“It was not typical of the solutions that had been deployed in the past. It’s not a multi-deck solution; it’s a much simplified solution, so we had to speak to all the key stakeholders – certifying bodies, customers, insurers, cable installers, fabricators,

regulators, etc. – to ensure it was fit for purpose,” said Aughton.

Development of the new platform began in 2014, with the goal of creating a simplified, standardised solution that provided a more fundamental cost saving. Siemens Energy Management worked with Siemens Wind Power on concepts that drive costs downwards. It also worked with key stakeholders, including customers, on the functional requirements and specifications of a product that eventually came to be called the OTM.

Delivering a solution to the industry’s problem was no small task. Although the cost of offshore wind energy has fallen over the years, the trend in the industry has been that the cost of offshore wind connections has become more expensive as a proportion of the overall costs.

Alastair Mills, Business and Development Sales Manager, Siemens Power Transmission, noted: “Previously we have seen offshore grid connections rise as a proportion of total wind farm capex from 8 per cent to around 10-12 per cent, and even higher for DC connections.”

In its effort to reverse this trend Siemens decided to look at the system from the viewpoint of the central electrical system design and therefore the central electrical system

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components. Engineers essentially looked at how they could “design out” any system components that were not absolutely necessary for the operation of the wind farm.

“The transformer is always the focal point for the design of an offshore wind substation because it is the largest and heaviest piece of equipment that is placed directly on the platform. It therefore has the greatest influence on the weight and size of the platform,” explained Mills. “The very clear trend you could see in the market was that the platform and its associated ancillary systems accounted for the lion’s share of the cost. The weight was also driving the need for specialist heavy installation vessels.

“We knew that if we wanted to reduce these costs, we had to attack the weight of the platform and get it down to sub-1000 tonnes.”

This resulted in a careful assessment of what was absolutely necessary on the platform. In addition to the key electrical equipment, engineers looked at what other equipment – in terms of ancillary services or ancillary products – had to be there to support those key components.

Mills said: “We had to look at the specifications of the ancillary equipment and ask whether we could get the same functionality from the equipment with a reduced amount of ancillary services and ancillary equipment, and specify the equipment in a better way.”

With the transformer as the focal point, the key things Siemens looked at were how it could remove moving parts such as fans and pumps, and use a synthetic ester as the insulation oil.

The result was two versions of the OTM, both of which are lightweight distributed substation solutions. One is integrated with the turbine, wherein the modules share the wind turbine substructure. The other is a standalone solution, where the module has its own substructure. The substructure can be a jacket, a monopile or, in principle, an adapted form of any substructure suitable for a 7-8 MW wind turbine.

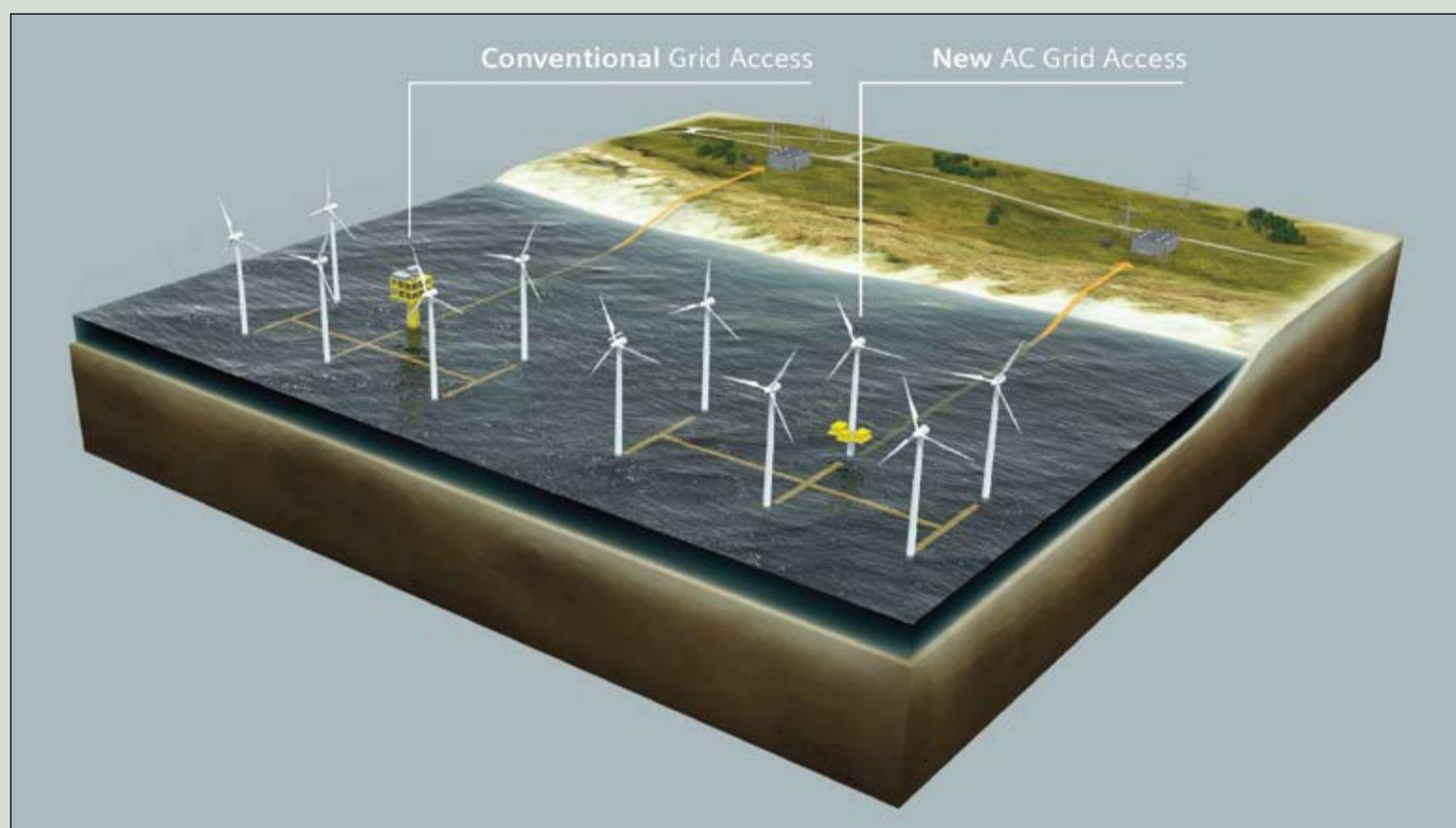
It can incorporate a shunt reactor where necessary (e.g. when there are very long export cables) and can feature various “optional extras” such as lifting frames, louvered walls around the transformer, or larger platform cranes. These extras can be incorporated without affecting the main design of the OTM.

The “base design cases” that have received the bulk of the design work are the standalone and integrated versions of the OTM, without reactors or optional extras, on four-legged jacket substructures. Siemens has undertaken considerable development work on these base designs, noting that its development work has spanned 130 technical deliverables and 12 months of design work using real project site conditions.

“One of the design drivers for the OTM,” explained Aughton, “was to see if we could design a solution that was physically capable of first, sharing the same foundation that the turbine already used instead of having to build a separate bespoke foundation. And secondly, whether we could develop a solution where the weight was such that it could be installed by the existing vessel spread that was already doing installations across the rest of the wind farm. All the previous solutions, such as the multi-deck platforms, which weigh 2000 t and above, require a specialist vessel for a one-off mobilisation and lift.”

He added that such specialist vessels are typically only used for a small period, which has to be planned for years ahead. Avoiding the use of these specialist vessels not only reduces costs, but risks as well.

Coming up with the new substation



design called for a completely different approach. Although offshore wind farms have been around for about 25 years, the need for large connections with offshore platforms started around 2008. Using early experience from both the oil and gas and utilities sectors meant there was a tendency towards increased functionality for the assets – this resulted in platforms generally growing in size, weight and cost. Simplification was therefore a key goal for engineers.

The OTM basically consists of the transformer, with the high voltage switchgear, medium voltage switchgear and control and protection equipment each housed in their own separate containers.

Most transformers are oil-filled for insulation, with pumps and fans to provide air-cooling. These ancillary systems, however, add weight and, as they have moving parts, increase opex. The goal was therefore to design a transformer with no moving parts or forced cooling.

Replacing conventional mineral oil with a synthetic ester oil – which has a high flash point and is thus less susceptible to catching fire – allowed the removal of complex fire suppression systems and buildings surrounding the transformer.

The need for cooling fans has also been eliminated. Traditionally, large fans located under the radiator banks of the transformer provide cooling but Siemens has taken a different approach.

Mills explained: “These fans – being moving parts offshore – are one of the components that has the potential to require increased maintenance. So we decided to look at how to design the transformer and its radiator. The transformers get warm when the turbines are spinning with a wind blowing. By allowing the wind to access the transformers radiator banks easily, we can use free energy to cool the radiator banks instead of powering a fan. By utilising this no-fans concept and synthetic ester oil we believe we have come up with the best transformer solution for the grid access connection.”

This not only reduces maintenance and opex, it also reduces the power demand for the fans and the size of the platform for the fans. Indeed the whole topside and crane are designed holistically to reduce platform opex during day-to-day, month-month operation.

For example, large traditional multi-deck platforms typically require extendable boom cranes, which are expensive and specifically designed for each platform. Further, each crane also has to be certified on an annual basis.

Siemens looked at whether it was possible to utilise a standard Davit crane on the new platform instead of a bespoke boom crane. “This means that if the crane requires maintenance, it could be maintained as part of a number of similar pieces of equipment in the wind farm,” said Aughton. “It also begged the question of whether O&M across the wind farm could be carried out using a smaller, simpler crane.”

Siemens therefore performed maintainability assessments of all the equipment on the platform to ascertain the heaviest equipment to be lifted, how often it had to be lifted and how it would be lifted.

A typical example is the radiator bank, which is made up of individual fins.

Aughton explained: “Radiator banks are likely to be replaced due to

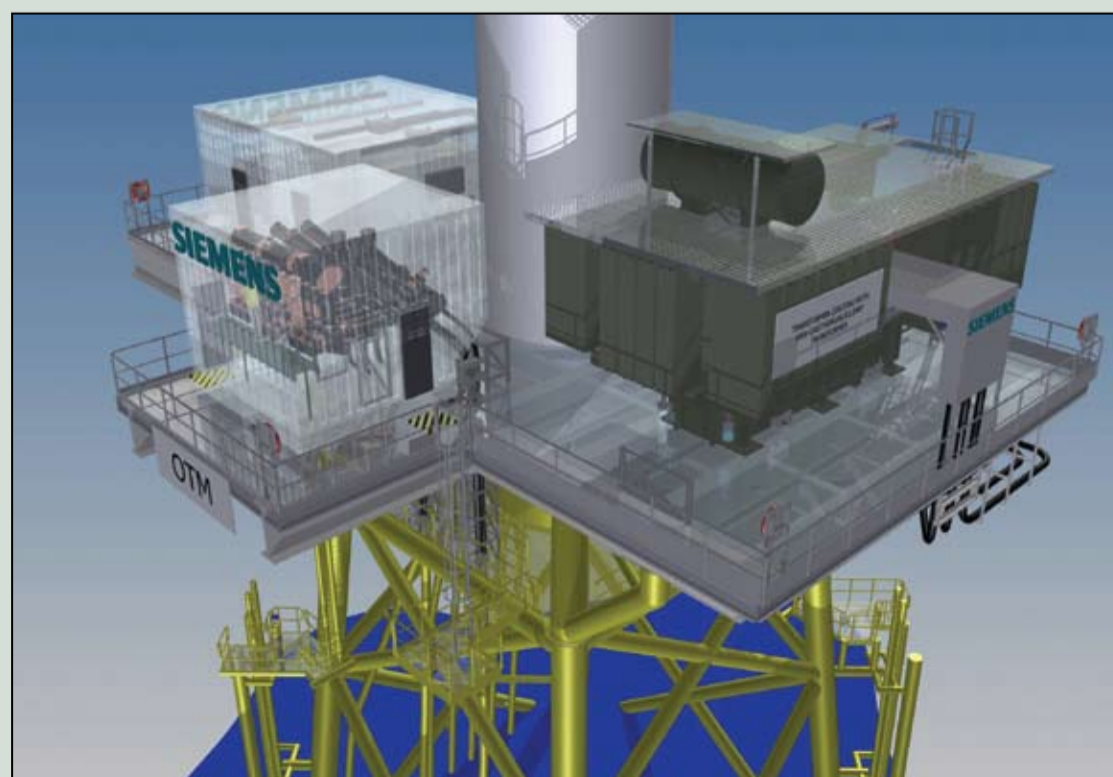
corrosion during the lifetime of the asset, given the nature of their design to dissipate heat quickly and efficiently.

“Previously, radiator banks were generally removed in entire banks. These banks are large and heavy, requiring a large boom crane or a specialist vessel offshore. To remove this element, and major cost challenge, we re-designed the radiator banks so that individual fins can now be removed instead, when and if they corrode. This means a smaller crane can be utilised for this operation.”

The decision to use containers for the rest of the key equipment outside of the transformer also helps to cut opex by giving plants owners the flexibility of how they want to maintain their wind farms.

“If there is a failure in one of the containers, for whatever reason, as a customer you can now decide whether to fix it offshore or onshore,” said Mills. “If you have a spare container, you can essentially decouple the cables, replace the container and fix the fault onshore where it is considerably cheaper and safer [to carry

First and second generation AC technology. The new AC access grid solution is small enough to be attached to a wind turbine, eliminating the need for an extra platform



CAD drawing of the OTM module

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The London Array offshore wind farm where Siemens supplied the turbines and provided the grid connections

Siemens solutions for grid access: AC and DC, first and second generation solutions

out repairs].”

According to Siemens, this “containerised substation” approach is something that is also now being seen onshore.

Although the OTM represents a new and innovative approach, all of the technology is essentially tried and tested. Although it has a base case size of 250 MW, with one OTM for each export cable, like all transformers it is

designed to match the power that can be transmitted down the export cable.

This power can be transmitted by a module weighing about 630 tonnes sitting on top of a 30 x 15 m ‘balcony’. Although transformer weight-to-power is not a linear relationship, Aughton noted that there is roughly a 2:1 ratio in terms of equipment to the structure. If there is 400 t of equipment, there is 200 t of structure.

“On a conventional platform there is typically 2000 t of structure compared to 1000 t of equipment,” he said. “So what we have essentially done is reverse the equipment-to-steel ratio, and the steel cost is one of the things we were fundamentally trying to address.”

One of the key goals was to reduce the weight to at least 800-900 t, which falls within the liftable limit of standard lifting vessels.

Apart from reduced weight and size, according to Mills there is nothing fundamentally new with regards to the OTM.

“We looked at the design and performance of the transformer and decks we have put offshore already and have specified a transformer that can come from our factories to meet the wind farm connection requirements.

“What we have done is look at things like the radiator banks – how can we avoid sharp edges on the radiators, which is where corrosion always starts – and optimised the design on that side of things using the experience of our factories and design teams, which design hundreds of units every year.

“The application of ester oil is new for offshore wind but the technology has been around for some time; there are products in Finland and Sweden and units within the [UK] national grid.”

The use of proven technology meant there was no need for any special testing; it was more about integrating proven components into an optimised space. Siemens therefore made use of state-of-the-art technology in designing the OTM.

“Because we were starting with a blank sheet of paper, we looked at what tools and techniques were being used in the industry. One of the things we found very useful was the use of virtual reality,” said Mills.

The University of Salford helped Siemens with the design. “We would do our conventional designs, i.e.,

layouts and configuration but worked with the University on how we could better do the drawings produced by our conventional software. They were able to take our designs, map them into a virtual reality concept so we could essentially interact with the designs as if it were a computer game.”

This gives operation and maintenance, and commissioning engineers the possibility to ‘walk around’ a platform in order to determine how much space they have to work, and comment on the positioning of certain pieces of equipment prior to construction.

“The adoption of the technique and the tool lets us change some elements of the design. We put some greater spacing between the crane and transformer, for example. We also made some of the access routes a bit bigger and optimised cable routings,” said Mills.

According to Mills, Siemens is likely to implement this approach much more widely going forward.

This combined with the ability to use existing foundation installation vessels allows significant time saving in terms of installation and commissioning. From its experience in constructing platforms, Siemens estimates that transport and installation time could be cut by up to 20 per cent compared with a traditional multi-deck platform.

This, notes Siemens, is critical for its customers, especially when considering the overall programme.

“It allows the critical path of the project to be moved away from the offshore substation, towards the onshore substation. Effectively, we’ve taken the risk away from the structure to more what you would see in an onshore substation,” said Aughton. “We would be able to cut several months from what might typically be a 30-month programme.”

Potential savings in terms of installation time, capex and opex are sure to make the OTM an attractive solution to offshore wind farm developers.

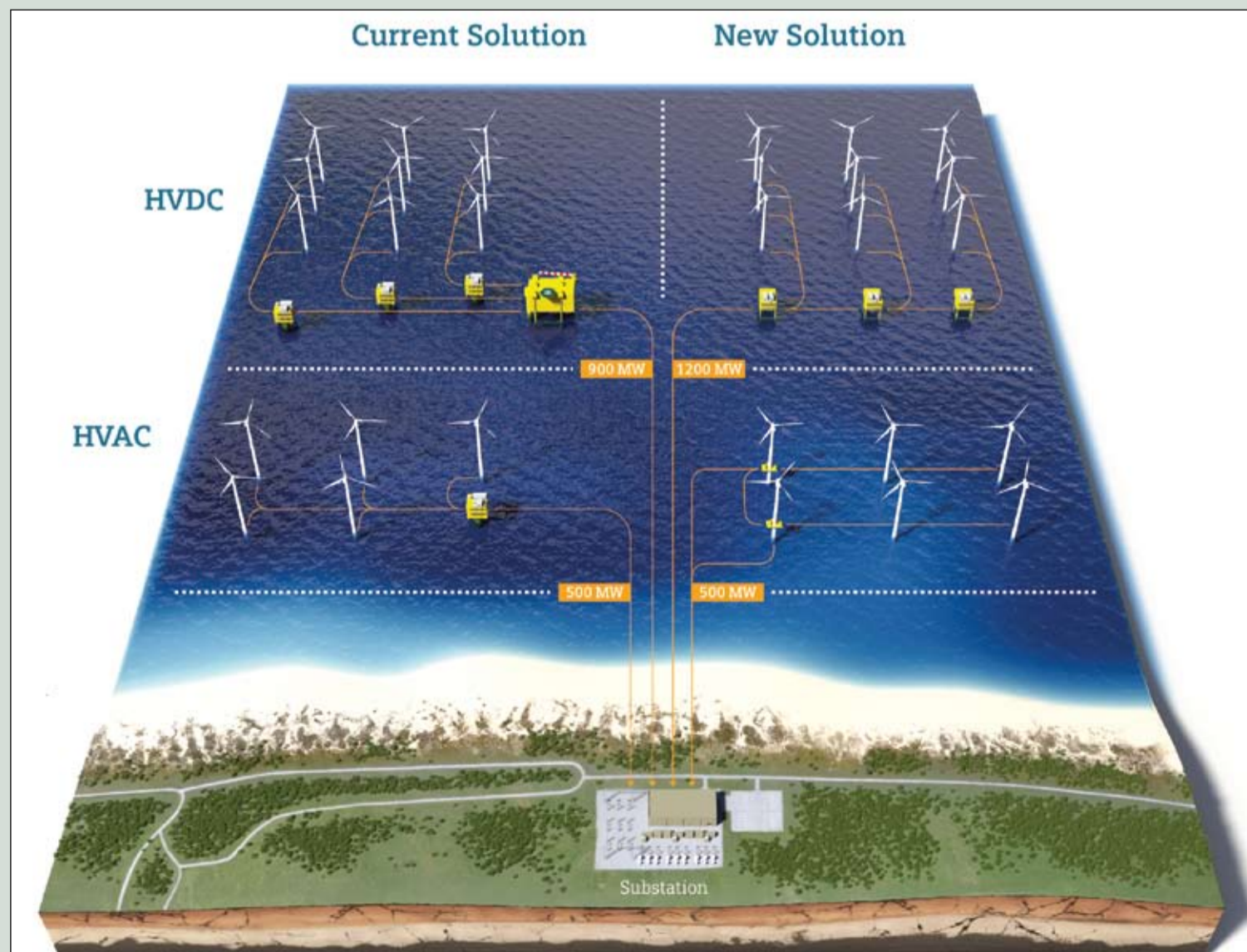
A report published in January by the Offshore Wind Programme Board concludes that the OTM concept can be expected to reduce costs by £1.7/MWh (in 2015 prices). This is based on the integrated OTM design. It would be about a third less for the standalone design, while a higher value is likely if the OTM is applied alongside an array design that had been optimised for OTMs.

Siemens says the OTM has already been selected as the primary base case solution on a number of projects in the UK and overseas. Whether a wind farm developer opts for an OTM or traditional multi-deck solution for AC grid access will depend on the project specifics.

Mills said: “The decision of whether we deploy an OTM or our multi-deck solution will be taken on a case-by-case basis. We recognise that there will be some circumstances or countries where there are requirements that make it sensible to deploy a multi-deck solution; the conventional style offshore platform reference design multi-deck solution remains part of our portfolio. We can use whichever is the most technically appropriate and cost-effective solution.”

This, says, Siemens makes it a “full-scope supplier” for any wind farm – whether far shore or near-shore – offering AC and DC grid connections as well as wind turbine generators and servicing.

Aughton concluded: “We’ve seen huge interest [in the OTM] from the industry. It has caused immediate debate on the use of lightweight distributed substation solutions. It’s recognised as one of the key contributors to potential cost reduction in order to get to the target of €100/MWh.”





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[siemens.com/energy/dccs](https://www.siemens.com/energy/dccs)

SunEdison makes Chapter 11 filing

Experts believe SunEdison's complex financial structure allowed it to overstretch itself, resulting in the renewable energy industry's largest ever bankruptcy.

Siân Crampsie

Solar energy giant SunEdison has begun a process of reorganising its business after announcing it had filed for Chapter 11 bankruptcy protection in US courts.

The firm said that its publicly-traded "yieldcos", TerraForm Power and TerraForm Global, were not included in the filing, which will allow the firm to address liquidity issues, reduce debt and create a viable business.

SunEdison CEO, Ahmad Chatila, said the move would enable the firm to become a "more streamlined and efficient operator" by shedding non-core assets.

In the long term, Chatila said, SunEdison would "be in an even better

position... to utilise our capabilities in the renewable energy sector in service of our customers, business partners and employees".

SunEdison holds debts of \$16.6 billion and assets of \$20.7 billion. The Chapter 11 filing followed news in March that the US Securities and Exchange Commission (SEC) was investigating whether SunEdison deliberately overstated its liquidity to investors in a 2015 filing.

US courts have approved a \$300 million injection of cash into the business by a consortium of lenders that will help SunEdison continue its normal day-to-day operations. It said in a statement that it "anticipates that work will proceed as planned on all ongoing projects, both in the US and elsewhere".

Separately, Ecotricity, a UK-based green energy provider, has announced it has bought SunEdison's UK residential rooftop solar business.

TerraForm Power and TerraForm Global both say that they have no plans to file for bankruptcy protection and that their solar and wind assets "are not available to satisfy the claims of creditors of SunEdison". TerraForm Global said, however, that SunEdison's situation would "present challenges".

SunEdison's TerraForm subsidiaries are an important part of the firm's structure and strategy, enabling the solar firm to recycle capital for investment into new projects and reduce the cost of capital. SunEdison was one of the first energy companies in the world to implement a "yieldco" structure, an

innovation that attracted investors and enabled SunEdison to expand rapidly in the growing global solar energy market.

Analysts believe, however, that the yieldcos, along with other special project financing vehicles used by SunEdison, added to the complexity of the firm's financial structure and made it hard for investors to adequately assess risk.

Investors began to lose faith in SunEdison in 2015 after a \$2.2 billion bid to buy Vivint Solar started to run into trouble. The Vivint deal was announced just two weeks after SunEdison had announced a \$2 billion deal to buy a portfolio of wind assets from Invenery.

In September 2015, SunEdison said

it had a pipeline of more than 800 projects, and the firm had branched out from its core market into wind power and residential solar.

SunEdison's stock has fallen from a high of \$33.45/share in July 2015 to \$5.09 at the end of 2015 and \$0.34 in April 2016.

Suzlon Energy is diversifying into the solar energy sector with the acquisition of five Indian companies. The companies – Gale Solarfarms Pvt. Ltd, Tornado Solarfarms Pvt. Ltd, Abha Solarfarms Pvt. Ltd, Aalok Solarfarms Pvt. Ltd and Shreyas Solarfarms Pvt. Ltd – do not have any operating assets and have been acquired primarily to be used as special purpose vehicles for the execution of solar projects.



Vattenfall offloads German lignite

Vattenfall says that the sale of its lignite operations in Germany will enable it to accelerate its shift to being a more sustainable company.

The Swedish firm has reached a SEK33 billion (\$4.054 billion) deal with Czech firm EPH to sell four power plants and its lignite mining operations. It said that it was a good move strategically for the company because of lower power prices in Europe.

"This divestment of our lignite assets is good strategically but also financially given current and expected market conditions," said Vattenfall chief executive Magnus Hall. "We are now accelerating our shift towards a more sustainable production. The sale means more than 75 per cent of our production will be climate neutral compared to about 50 per cent today."

EPH will take over operation of the power plants and coal mines with its partner in the deal, PPF Investments. The sale includes liabilities and provisions of SEK18 billion (\$2.22 billion),

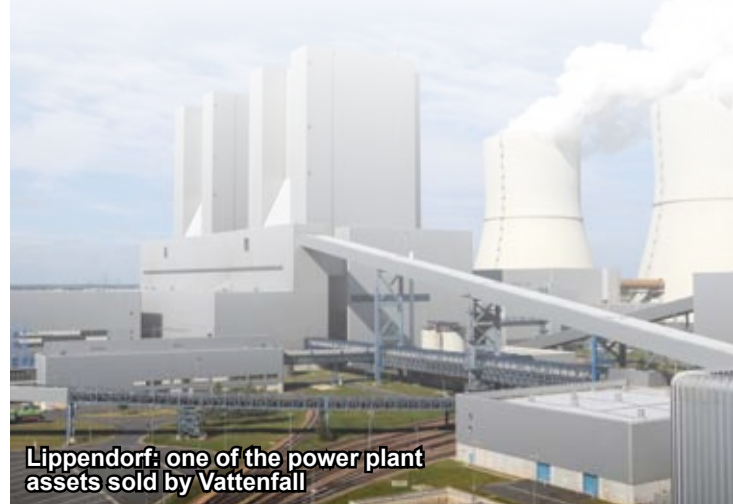
Vattenfall said.

EPH already owns coal firm Mibrag and other generating assets in Germany, and the latest acquisition will boost its power generating portfolio by 7.5 GW to 21 GW.

The assets include the Jämschalde, Boxberg and Schwarze Pumpe power plants as well as Vattenfall's 50 per cent stake in the Lippendorf power plant. The mines included in the sale are Jämschalde, Nochten, Welzow-Süd and Reichwalde, and the recently closed mine Cottbus Nord.

"We want to reduce our CO₂ exposure, so for us this is the right thing to do and it frees up resources to focus more on renewable energy," said Hall. "We see significant risks when it comes to the development of future electricity price levels. There are also regulatory risks to take into consideration."

The operations represent about one-tenth of Vattenfall's power production in Germany, where it is the third-largest energy supplier.



Lippendorf: one of the power plant assets sold by Vattenfall

New RWE takes shape

■ IPO planned for end-2016 ■ RWE, E.On sue government

RWE hopes to launch an IPO of its new subsidiary, RWE International SE, by the end of 2016.

The German utility has formally launched operations of the new company, which will focus on grids, renewables and retail operations, and says it expects the unit to generate annual revenues of around €40 billion.

The new unit will be given a permanent name and branding this summer, CEO Peter Terium said. "We will be fast, decentralised, innovative and close to our customers," Terium

noted. "During this time of far-reaching transformation in our sector, we do not intend to simply keep up with the competition. We want to take a pioneering role and shape the energy market of the future."

RWE is splitting its business in response to challenging market conditions in Europe's sluggish energy markets, where low prices and stagnant demand have eroded utilities' margins.

These challenges have been compounded in Germany with the clo-

sure of nuclear power plants and the country's strategy to shift to renewable energy.

In early April RWE and E.On joined Swedish energy group Vattenfall in launching a claim in the Germany's highest court for compensation from the government, accusing it of expropriating their nuclear plants.

Merkel's government could be forced to pay billions of euros in damages to the power groups, if the constitutional court rules in the companies' favour.

Doosan, Kepco sign MoU on wind energy

Two South Korean firms are to work together to develop wind energy projects in overseas markets.

Doosan Heavy Industries & Construction and state-run energy company Kepco have signed a memorandum of understanding (MoU) under which the two companies will jointly

develop, build and operate wind farms globally.

Under the agreement, Doosan will supply wind power generators for projects won by Kepco. It will also provide engineering, procurement and construction services.

Last year Kepco won an order from

Jordan's National Electric Power Company to build an 89 MW wind project in the Fujeij area in Amman, Jordan.

Doosan has supplied wind power projects with a total generating capacity of 207 MW with its wind turbine technology, it said in a statement.

GE and LSIS collaborate in Korean smart energy

GE and LSIS have discussed future business opportunities after signing a memorandum of understanding (MoU) for comprehensive cooperation in power, smart energy and smart factory solutions in Korea.

The two companies say they will "collaborate extensively" on manufacturing innovation, microgrids, smart energy solutions such as energy

storage, and other eco-friendly power products.

In addition, LSIS plans to develop advanced manufacturing innovation and implement smart factory technologies. This will be based on LSIS' automation technologies combined with GE's digital and Industrial Internet solutions.

LSIS CTO Hahk Sung Lee said, "In

light of the Paris Agreement and the implementation of the emissions trading scheme, this is a great opportunity to cooperatively target the world's eco-friendly energy segment with a global company like GE.

"We will strive to maintain our active and close cooperation so that it will lead to strengthening our competitiveness," he added.

10 | Tenders, Bids & Contracts

Americas

Gamesa secures Rafisa contract

Gamesa has secured a turnkey construction contract from Rafisa, trustee of the Financiero Arias Trust, for the 70 MW Colonia Arias wind project in Uruguay.

Gamesa will deliver, install and commission 35 of its G114-2.0 MW turbines, as well as provide civil activities and electrical installation work. Turbine delivery will take place in December 2016 and commissioning is expected in mid-2017.

Siemens selected for Lordstown

Siemens has been selected as the turnkey supplier for Lordstown Energy Centre, a new 940 MW natural gas-fired combined cycle power plant planned for Lordstown, Ohio, USA.

Siemens will deliver a complete power plant solution for the facility, including two H-class gas turbines, one steam turbine and three generators. The firm has also signed a long term service agreement for the plant, which is scheduled to start operating in summer 2018.

Siemens Financial Services co-funded the development loan and will provide a pivotal 27 per cent equity investment alongside Macquarie Infrastructure and Real Assets to help realise the project. The total order volume for the project including service is more than \$800 million.

Repeat order for Capstone

Capstone Turbine Corporation has received an order for six of its new C1000 Signature Series microturbines for a repeat customer in Cartagena, Colombia.

Supernova Energy Services S.A.S., Capstone's Colombian distributor, secured this new order, which will be rolled out in three phases starting January 2017.

The first phase, which comprises two natural gas-fuelled C1000s, will be installed in a combined cooling, heat and power (CCHP) application and operate in stand-alone mode. The second and third phases, which involve the remaining four C1000s, will be rolled out soon thereafter.

Asia-Pacific

Doosan signs maintenance deal

Doosan Heavy Industries and Construction has signed a memorandum of understanding to provide nuclear plant maintenance for China's state run nuclear plant operator.

China Nuclear Industry Maintenance (CNIMC) is China's biggest nuclear power service provider with responsibility for maintenance of some 30 different nuclear plants.

Under the deal Doosan will provide repair and maintenance services as well as replace steam generators and reactor coolant pumps.

Gamesa secures ReNew order

Gamesa has secured an order from ReNew Power for the turnkey construction of a 40 MW wind farm located in the Indian state of Karnataka.

Gamesa will install 20 of its G97-2.0 MW class S wind turbines at a site in Ron, and will also provide the infrastructure needed to install and operate the facility and will service the wind farm on a long-term basis.

The wind farm is scheduled for commissioning in September 2016.

Siemens wins third Eurus order

Eurus Energy Holdings Corp has placed its third order wind power order with Siemens.

Under the order, Siemens will provide Tokyo-based Eurus with 13 direct drive SWT-3.2-101 wind turbines for the 41.6 MW Eurus Higashi Yurihara wind power plant near Yurihonjo city.

The order includes a five year service and maintenance agreement. Commercial operation of the wind farm is scheduled for spring 2018.

China link set to break records

Two long distance ultra-high-voltage direct current (UHVDC) transmission links planned in China will set a new world record for capacity thanks to the use of advanced converter transformer technology.

ABB says it has won an order worth more than \$300 million to supply advanced converter transformers for the links, which will be capable of transporting up to 10 GW of power at 800 kV.

The 1609 km-long Ximeng-Taizhou and 1231 km long Shanghai-Shandong 800 kV transmission links will deliver 25 per cent more power compared with recent 800 kV UHVDC links.

Recent advances in key technologies like the 509 MVA converter transformers make it possible to increase the power transmission capacity of UHVDC links to an unprecedented level, ABB said.

The links are part of a strategy in China to evacuate power to load centres in eastern regions from energy resource-rich areas such as Inner Mongolia.

Auction win in India for Fortum

Fortum has won a contract to build 100 MW of grid-connected solar photovoltaic (PV) capacity in India after a reverse auction held by NTPC.

The Finnish firm will build a single solar park in Pavagada, Tumkur district, Karnataka. It placed a bid of 4.79 INR/kWh (7.2 cents/kWh).

Fortum currently has 15 MW of solar capacity in India. In January 2016, it won a reverse auction for a 70 MW project with a fixed tariff for 25 years.

Toshiba, IHI win Lontar orders

Toshiba Corp. and IHI Corp. said separately that they have received orders for key equipment for the expansion of a coal fired power plant in Indonesia's Banten province.

The Lontar power plant has a current capacity of 945 MW and will be expanded to 1260 MW with the addition of an ultra-supercritical coal fired unit.

Toshiba is to supply the steam turbine generator for the new unit, while IHI will provide the boiler.

The orders were placed by Sumitomo, which was awarded an engineering, procurement and construction (EPC) contract to build a fourth unit at Lontar by Indonesian utility PLN.

The new unit is expected to start operating in 2019.

Europe

Valmet wins Helsinki order

Helen Oy has placed an order with Valmet for the supply of a new wood pellet heating plant at its Salmisaari power plant in Helsinki, Finland.

The 92 MWth plant will enable Helen to increase the use of biofuels in its district heating operations in Finland, and will also help the city of Helsinki to meet its aim of increasing its use of renewable energy.

The €20 million order includes fuel conveyors, wood pellet grinding and the wood dust equipment, hot water boiler, flue gas cleaning, plant construction, electrification and a Valmet DNA automation system.

The new plant will start operating in 2018.

Gamesa boosts Iberdrola output

Gamesa is to install efficiency-boosting software at 54 Iberdrola-owned wind farms across Europe.

Gamesa's Energy Thrust software improves wind turbine efficiency and, in turn, production ratios, and will be implemented at wind farms in Spain, Portugal, Italy, Hungary, Romania, Greece and Cyprus with an aggregate capacity of 1602 MW.

Energy Thrust enables adaptation of wind turbines to specific site conditions, boosting the volume of power delivered to the grid in all wind conditions. Gamesa developed the software for its 660 kW, 850 kW and 2.0 MW platforms and has already installed it on 1967 turbines.

Aggreko powers Galloper construction

Aggreko has signed a contract to provide power generation during the construction of the 336 MW Galloper offshore wind farm in the UK.

The contract was awarded by James Fisher, the offshore and marine services contractor to Galloper Wind Farm Limited (GWFL), which is providing key elements of marine services and support during the construction phase.

Aggreko will supply 56 new lightweight 20 kVA wind-charged generators, plus a standby machine, to provide power during the 40-week plus construction phase, starting in July 2016.

The Galloper offshore wind farm is scheduled to begin operation in March 2018. It is an extension of the existing and fully operational Greater Gabbard offshore wind farm, off the east coast of England.

TenneT issues amended switchgear tender

Dutch TSO TenneT has issued an amended call for tender for switchgear for five offshore substations.

TenneT is expecting to build five offshore platforms connecting offshore wind farms with the Dutch grid between 2017 and 2023. For the connection of the platforms to the grid, TenneT plans to equip five landstations with a total of ten 33 kV switchgears for indoor application.

Each switchgear should consist of a single busbar and four bays, and not six bays as announced by TenneT in its original call for tender.

TenneT expects to order the first two switchgears in the first half of 2017.

Austrian firms look for smart solution

Austrian power utilities Kärnten Netz GmbH and Stadtwerke Kapfenberg have asked Siemens to supply hardware and software solutions for a smart meter project.

Under Austrian law, at least 95 per cent of Austrian homes must be equipped with smart meters by the end of 2019. Siemens will provide a complete system made up of smart

meters, secure transmission technology, and IT systems for collecting and processing the measured data.

The order also includes interfaces to the existing infrastructure of Kärnten Netz GmbH, such as the SAP system and the online customer portal.

International

Clarke chosen for Tanzania plant

Clarke Energy has won an order to supply a GE Jenbacher gas engine to a combined heat and power (CHP) plant in Dar es Salaam, Tanzania.

The CHP plant will support operations at the Azam flour mill and help the owner, Said Salim Bakhresa & Co. Ltd., to reduce operating costs.

Clarke will provide a J612 gas engine capable of generating 1.82 MWe to the plant, which will operate on newly available natural gas.

Egypt orders Gamesa technology

Gamesa has secured two new engineering, procurement and construction (EPC) orders for two wind farms in Egypt.

The company will install 80 of its G80-2.0 MW turbines in the Gabbal El Zayt region, located along the Red Sea coastline, after securing orders from Egypt's New & Renewable Energy Authority (NREA).

The first contract encompasses the supply, installation and commissioning of a total of 60 G80-2.0 MW wind turbines at a new project which is being funded by the Spanish government through its Fund for International Business Expansion (FIEM). Delivery of the wind turbines is scheduled to begin in October 2016, while the facility is slated for commissioning in the third quarter of 2017.

The second order is for the supply of 20 of Gamesa's G80-2.0 MW turbines (40 MW) in order to expand an existing operational 200 MW complex. These 20 new turbines will be delivered during the last quarter of this year for commissioning in early 2017. The expansion will be financed by the German development bank, KfW.

MAN modernises AKSA energy supply

Turkish company Aksa Akrilik Kimya Sanayii A.Ş. (AKSA), the world's biggest manufacturer of acrylic fibres, has placed an order with MAN Diesel & Turbo for the supply of a 99 MW steam turbine generator set.

The new genset will replace an existing installation at AKSA's main site in Yalova, Turkey, providing both electrical energy and process steam from 2017 onwards.

Turkmenistan orders MHPS GTs

Sumitomo has placed an order with Mitsubishi Hitachi Power Systems (MHPS) for the supply of three M701 DA gas turbine-generators to be installed at the 400 MW Zerger gas fired power plant in Turkmenistan.

Sumitomo is building the Zerger plant for Turkmenenergo, Turkmenistan's national utility, in the Lebap province, 600 km northeast of capital Ashgabat. Once on line, the Turkmen government will export power to Afghanistan for 10 years based on a power purchase agreement with the Afghan Government, as part of a project to assist in reconstruction of the country after the damage suffered in the civil war.



Oil

Doha failure leaves oil market to own devices

- Iran refuses to attend Doha meeting
- Freeze would not make much difference

David Gregory

The failure of the much anticipated meeting of Opec and non-Opec oil producers in Qatar last month did not result in the immediate collapse of crude prices, rather, it leaves the market to the forces of fundamentals. Furthermore, the failed gathering in Doha on April 17 completely dislodged any remaining notion that Opec is capable of acting as a cohesive organisation.

Iran's refusal to attend the meeting, which brought 18 of the world's major oil producers together for a rare attempt to coordinate output, left no doubt that Tehran is unwilling to recognise Saudi Arabia as Opec's uncontested leader.

Having finally shaken off international sanctions, Iran is trying to revive crude production and recapture markets that it lost to Saudi Arabia and Iraq during the years of disrupted oil sales. Iran's production during March averaged 3.3 million b/d, according to the International Energy Agency's (IEA) latest monthly report. The country is looking to boost

output to 4 million b/d by the end of this year and to 5.7 million b/d in 2018.

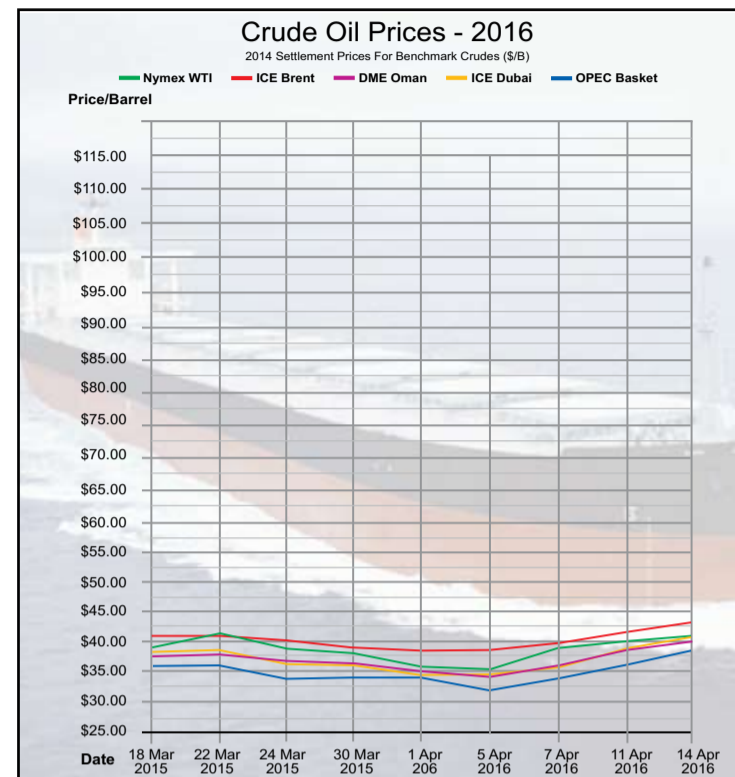
Freezing oil production is not an idea that Iran disagrees with but has urged other, bigger oil producers to initiate the move. Speaking to Iran's *Shana* News Agency on April 18 following the Doha meeting, Iran's representative on Opec's governing board, Hossein Kazempour Ardebili, said: "The Islamic Republic has not ceased to support the move, however small and late it is, to stabilise the crude oil market, but has insisted that it cannot join the freeze plan before it reaches its production level to the pre-sanctions setting."

Without openly referring to Saudi Arabia, Kazempour said that countries that had attempted to derail the negotiations with the UN and EU on ending sanctions had worked to prevent the success of those negotiations in order to prevent Iran from regaining market share, "believing that Iran would be doomed to keep its production at the sanctions' level by accepting the freeze plan," *Shana* reported him as saying.

Iran has yet to say so openly, but it would likely suggest that Saudi Arabia and Russia, both of which average production of some 10 million b/d, initiate a production freeze by paring down their own production. But with Saudi Arabia capable of producing oil at less than \$10/b, Riyadh is expected to remain resilient on its current course, even if it creates risk for its own economy.

Faced with sliding oil prices in a market with an over-supply of around 2 million b/d, oil producers Saudi Arabia, Qatar and Venezuela, all Opec members, and non-Opec Russia, agreed earlier this year to hold a meeting to discuss freezing oil production at January levels in order to gradually reduce the overall volume.

Production has been falling in North America, where shale oil producers are targeted by Saudi Arabia which began in mid-2014 to implement a strategy of over-producing in order to force oil prices down and thus force high-cost oil producers out of the market. Many US and Canada shale producers have been forced out, but there is no guarantee they



will stay out. Analysts predict that once oil returns to more than \$50/b, many shale oil producers will be tempted to get back in production. Should this happen, then it is likely that the market will see an extended period of low prices in the range of \$40-60/b.

The outcome of the Doha meeting was not a surprise. Iran had earlier called the meeting ridiculous and said it would not participate, and as Saudi Arabia insisted that it would not freeze production unless Iran did so shows the animosity between the two states runs deep. But the fact that virtually every oil producer is pump-

ing at capacity means that a freeze would not make much difference, with the exception of Saudi Arabia where capacity is more than 12 million b/d.

With no agreement in Doha, the oil market will shift to fundamentals and the gradual 'sopping up' of excess oil though oil demand growth and a decline in non-Opec supply, a forecast the IEA has made for the past several months. "The oil market looks set to move close to balance in the second half of this year," the IEA report said, but there is no promise that oil producers will see higher prices in the months ahead.

Gas

Years of work ahead on Iran's massive gas reserves

Iran is determined to boost its natural gas production for local distribution and export but the massive investment needed will not be easy to come by.

Mark Goetz

With international sanctions no longer obstructing the development of its hydrocarbon industry to the degree that they once did, Iran is embarking on a drive to not only increase its crude oil production target – 4 million b/d by the end of this year – but to also boost its natural gas production for local distribution and export.

Iran has 150 billion barrels of crude, ranking it fifth in the world for oil reserves, but in gas reserves it ranks as the world's second largest, with 29.6 trillion m³ (1046 trillion ft³).

Several hundred billion dollars are needed to carry out Iran's gas development plan, according to government data reported recently in *Natural Gas Europe*. Some of this money will come from Iran's own financial resources but the bulk will have to come from foreign banks, institutions or investors.

It will not be an easy task for Tehran

to bring either oil or gas fields to development, as obstacles still remain. The contracts that Iran has to offer foreign companies will not be as attractive as they could be. At least 51 per cent of any joint venture would have to be held by an Iranian entity. Furthermore, the US still maintains a primary sanctions list that prevents business from being done with a number of Iranian companies and individuals. Iran is also unable to clear dollar transactions. On top of this and other snags, some analysts argue that low oil and gas prices make this a bad time to invest in Iranian projects.

But with its hydrocarbon industry having fallen behind other major oil and gas producers, Iran appears determined to push forward with developing this under-utilised resource.

Sixty-seven per cent of Iran's non-associated gas reserves are offshore and most of that is in the South Pars gas field, the northern side of the huge

gas dome that exists in the Persian Gulf. The southern side of the dome is Qatar's North Field, which has been responsible for Doha's success as the largest producer of LNG in the world with 77 million tons annually.

Speaking during a recent visit to Tehran, European Commissioner for Energy Miguel Arias Cañete said Iranian LNG could begin to play a significant role in the European Union's energy mix after three or four years. The EC has estimated that by 2030, the EU could be importing as much as 25-35 billion m³ annually from Iran, most probably in the form of LNG.

Iran already has three LNG projects in the early phases of construction, started before sanctions were imposed.

"For the medium term it is very clear that LNG will be a possibility," Cañete said while meeting government officials to discuss commercial and political ties. "That fits with the security

and supply strategy of the European Union."

Cañete went on to say that Iran expressed no interest in building gas pipelines to Europe as they took too long and would involve trade deals with some of its regional rivals. That would leave a pipeline across Turkey to Europe, which has often been discussed as a possibility, out of the picture.

Turkey is one of a few customers that Iran currently has for its gas, which is delivered by pipeline, but Iranian domestic consumption is so high that in some winters, Iran has had to halt supply to Turkey in order to meet domestic needs.

Iran recently opened a gas pipeline to Iraq and is hoping to conclude a pipeline project to Pakistan, which was stalled due to international sanctions. It would have a capacity to carry 21.24 million m³ (750 million ft³) daily by 2019 to energy-strained Pakistan, which has been unable to finance

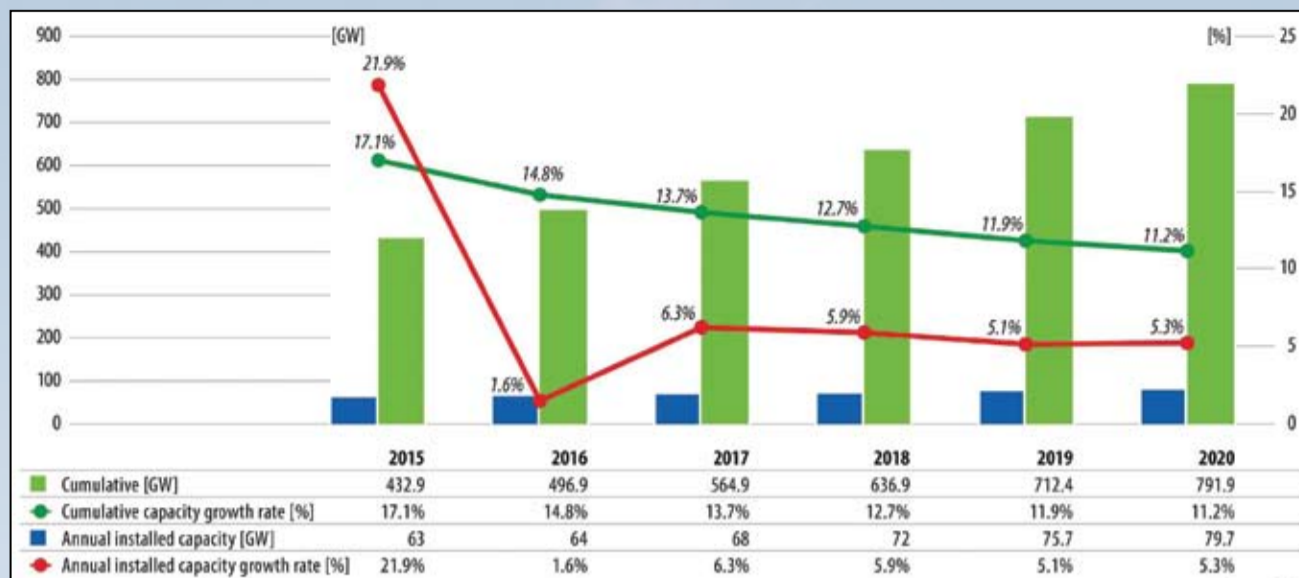
its side of the pipeline because of the sanctions. Total cost for the pipeline could hit \$7 billion, \$2 billion of that paid by Pakistan.

Meanwhile, Iran has promised India that it will reserve the Farzad-B gas field, with a resource estimate of 362.45 billion m³ (12.8 trillion ft³), for a joint Iranian-Indian project.

Over the next 10 years, Iran is going to need \$289 billion in investment in its gas projects, according to the government data cited in *Natural Gas Europe*. Of this, \$137 billion will go to upstream projects, \$27 billion is needed for domestic distribution, and \$56 billion estimated to expand the national gas grid, including several major pipelines. A further \$44 billion will go towards gas processing and gas storage facilities and another \$25 billion for gas-related mid-stream and downstream projects.

That's a lot of money, but it's a lot of gas. We will see where Iran stands when 2025 gets here.

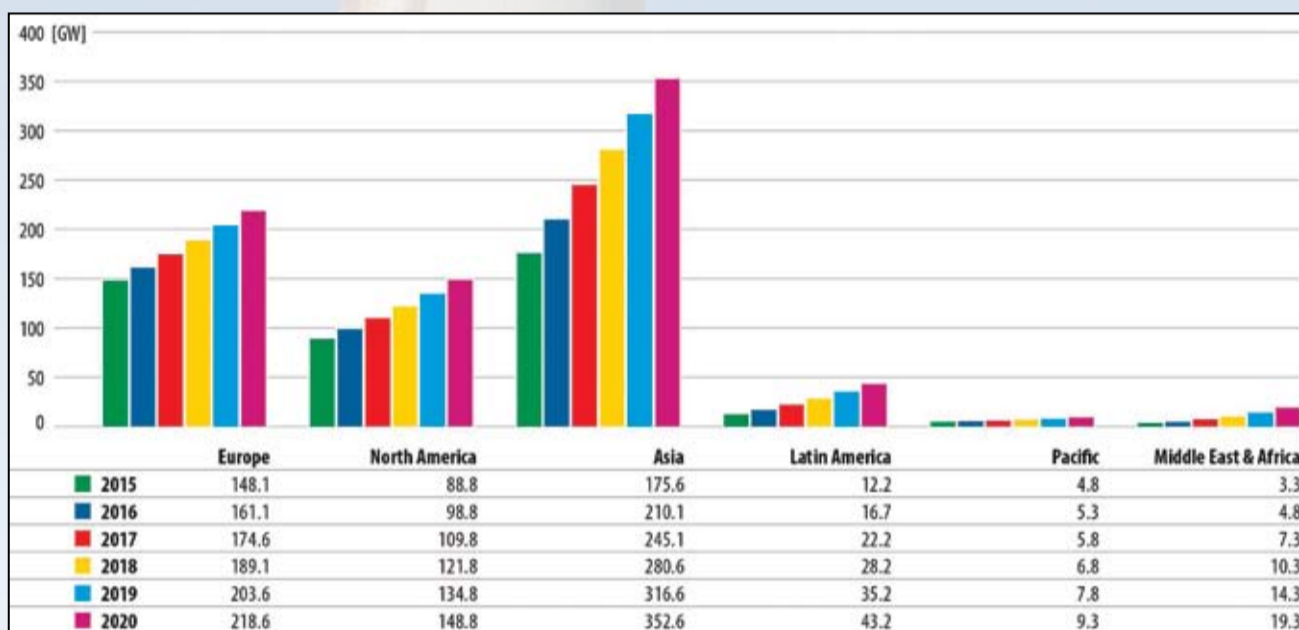
Global wind power market forecast for 2016-2020



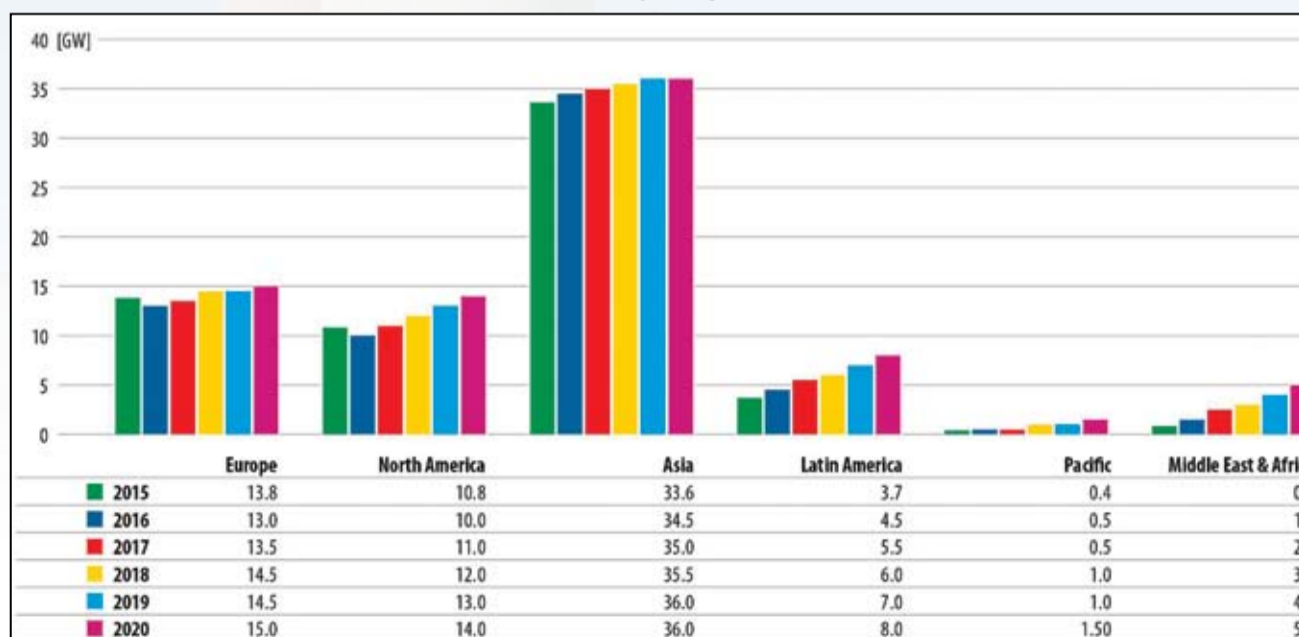
For more information, please contact:

Lauha Fried
 Communications Director
 Global Wind Energy Council
 Rue d'Arlon 80
 1040 Brussels, Belgium
 Tel + 32 2 213 18 98
 Email: lauha.fried@gwec.net

Cumulative wind power market forecast by region 2016-2020



Annual wind power market forecast by region 2016-2020



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A market design for the low-carbon transition

Market designs should evolve with the energy transition. Eurelectric has put forward its recommendations for an electricity market design that is fit for a cost-efficient, low-carbon transition, proposing overarching principles and no-regret options.

Hans ten Berge

Hans ten Berge: If implemented, support schemes should be cost-efficient, minimise distortions in the wholesale market and be technology-neutral

The European electricity industry is supportive of Europe's decarbonisation agenda and is dedicated to decarbonising electricity production by 2050. This unprecedented transition will bring about innovation, exciting opportunities and challenges. In the midst of this transition, Europe must ensure secure, sustainable and affordable energy for all its citizens and businesses.

In the current environment where large amounts of subsidies and numerous other market interventions distort price formation, the electricity system lacks signals both for short-term operations and for longer-term system adequacy and decarbonisation. The market environment has become increasingly volatile and the risk exposure of investors has increased. In this context, the issues faced by market participants and investors are similar for all assets, be it thermal or renewable generation, storage or demand response. It is necessary to make the power sector investable again, living up to the decarbonisation and renewables targets, while ensuring security of supply. This is the challenge faced by the European Commission when preparing its upcoming legislative proposals.

Eurelectric adopted on March 17th its recommendations for an electricity market design that is fit for a cost-efficient, low-carbon transition, proposing overarching principles and no-regret options. While the European energy panorama is still fragmented and the power sector faces different fundamentals and regulatory frameworks, market designs are not carved in stone and should evolve with the energy transition.

Empowered customers will play a crucial role in addressing the challenges of the energy transition. The

integration of increasing shares of variable renewable energy sources (RES) into the system makes demand response ever more relevant. Consumers are therefore expected to increasingly invest in technological solutions such as heat pumps, electric vehicles, home management systems, home energy devices and connected objects. This will give them unprecedented control over their energy use at the touch of a button – or, increasingly, the swipe of a screen.

Rules enabling customers' participation in the market and ensuring competition between all resources (generation, demand response, storage) on a level playing field must be implemented. For this purpose, clear roles and responsibilities for all market players must be defined, including with regard to balancing responsibility. Retailers should also be allowed to develop innovative products such as dynamic pricing, and the phasing out of regulated prices would enhance competition.

When customers did not have realistic alternatives to the electricity system, policy-makers decided to use electricity bills to bolster public budgets and finance other – sometimes unrelated – policy decisions. On average, taxes and levies on European households' electricity bills rose by 47 per cent from 2008 to 2014. Such developments threaten the competitiveness of electricity against more polluting energy carriers and hampers electrification as an effective way to decarbonise other sectors.

The internal electricity market must be completed. The Third Energy Package and the integration of wholesale markets across all timeframes through network codes is the cornerstone of the electricity market design. We must ensure the

full integration of day-ahead, intra-day and balancing markets, and implement shorter gate closure to effectively make the market fit for renewables.

Wholesale prices must also be allowed to adequately reflect scarcity, thus providing investment signals that can be trusted by market participants. There is also significant scope for electricity transmission networks to be used more efficiently. ACER's market monitoring report 2015 shows that today, in nearly 70 per cent of assessed borders, physical capacity is at least twice as high as tradable capacity.

Decarbonisation, renewables and security of supply must live up to political targets but in a cost-efficient way. Given the binding EU objective to achieve at least 27 per cent of renewables by 2030, some Member States may continue support schemes after 2020. Many countries are also complementing their energy markets with a patchwork of capacity mechanisms to guarantee the desired level of security of supply. Unfortunately, non-market-based interventions have flourished, such as the forbidding of plant closures or the introduction of targeted subsidies, as ill-designed ways of managing security of supply.

Renewables should be fully part of the market. Europe's power generation mix is increasingly low-carbon. In 2014, 56 per cent of the EU electricity came from low-carbon sources and 28 per cent from renewable energy sources. It is thus high time to integrate renewables in the market and to ensure their cost-efficient development. Eurelectric does not see any obstacles to the full integration of all renewable electricity generators into the market as of today, including balancing responsibility.

The post-2020 framework for renewables must ensure a coherent approach that takes into account the contribution of all sectors – heating, cooling, electricity and transport. In the transition phase, the EU ETS should be the main driver for RES investments in the electricity sector. It is an established, technology-neutral instrument that can bring an increasingly EU-wide approach to low-carbon technologies. Strengthening the EU ETS is therefore a no-regret option to increase the competitiveness of renewable energy technologies and encourage fuel-switching to low-carbon sources.

If implemented, support schemes should be cost-efficient, minimise distortions in the wholesale market and be technology-neutral. Auctioning mechanisms and green certificates improve competition between projects and set the levels of support in a competitive way. The projects selected through an auction can be granted energy-based or capacity-based support, including investment aid.

Member States must clearly define the level of electricity security of supply they want. Many Member States do not accept to rely on the level of security of supply delivered by energy-only markets, which includes a certain risk of brownouts. Yet, many of them still do not define clearly their adequacy targets for security of supply.

As a first step, they must define this level, using regionally harmonised metrics. Member States should then

decide how to ensure regional security of supply in cooperation with their neighbours, while ensuring the availability of contracted cross-border capacity. In case of common scarcity events, TSO actions should be clarified and factored in the adequacy assessment.

Meanwhile, security of supply must be assessed at regional level, assessing common solutions. To take into account the cross-border dimension of the internal market for electricity, regional adequacy assessments, complementing national assessments are necessary.

To be relevant, the methodology for regional adequacy assessments must be developed with the involvement of all relevant stakeholders, including market players. They should indeed consider the location of generation capacity within the region and the limited cross-border interconnection capacity. The economic viability of power plants must also be taken into account, as it cannot be expected that all existing assets remain online if they do not cover their fixed costs.

In many countries, part of the existing generation capacity is still necessary during the energy transition to provide firmness to the system and produce when intermittent renewables do not. Even though these plants are not required to deliver a large amount of energy, they are needed until the moment when storage, smart grids and increased demand response contribute more to security of supply.

If all these assets would close, they would have to be replaced with new thermal capacity during the transition, which would be very costly. In certain cases, a well-functioning capacity mechanism, remunerating the benefits that these plants bring to the power system, is therefore a viable solution.

Capacity markets should be well designed and have a regional perspective. The above-mentioned regional adequacy assessments should be taken into account when introducing changes in market design, such as, e.g., the introduction of market-based capacity mechanisms. Regions that do not consider such developments as needed should obviously not be forced to introduce them. On the other hand, the existing initiatives for well-designed capacity markets with cross-border participation should be considered as building blocks for an efficient regional and European approach.

To minimise the impact on the energy market, these mechanisms should be sufficiently harmonised in their basic design criteria: they should be technology neutral, open to cross-border participation, open to new and existing generation, storage and demand, and produce as outcome contracts with capacity suppliers which have a lead-time and a duration that is consistent with the needs of investment decisions. When such a mechanism is introduced, it becomes a valuable tool for future adequacy analysis, since it provides a market-based assessment of the need for new capacity.

Hans ten Berge is Secretary-General Eurelectric, the association representing Europe's electric utilities.



Gas on the rise?

Some argue that pressure on coal will open the door to gas. While this has been the case in the US where gas prices remain low, gas fired generators in Europe have struggled. But there is evidence this could be changing. A recent report by EnAppSys on the UK market could provide a glimpse of the shape of things to come.

A general shift to renewables, combined with slack power demand and climate change legislation has put unprecedented pressure on both coal and gas fired generation in Europe. Gas turbine demand has been particularly hard hit because it is cheaper to burn coal imported from the US following the shale revolution there.

In the pre-crisis years, Europe accounted for up to a 20 per cent of global demand for gas turbines. In 2015 that had slumped to a mere 0.5 per cent, according to McCoy Power Reports data.

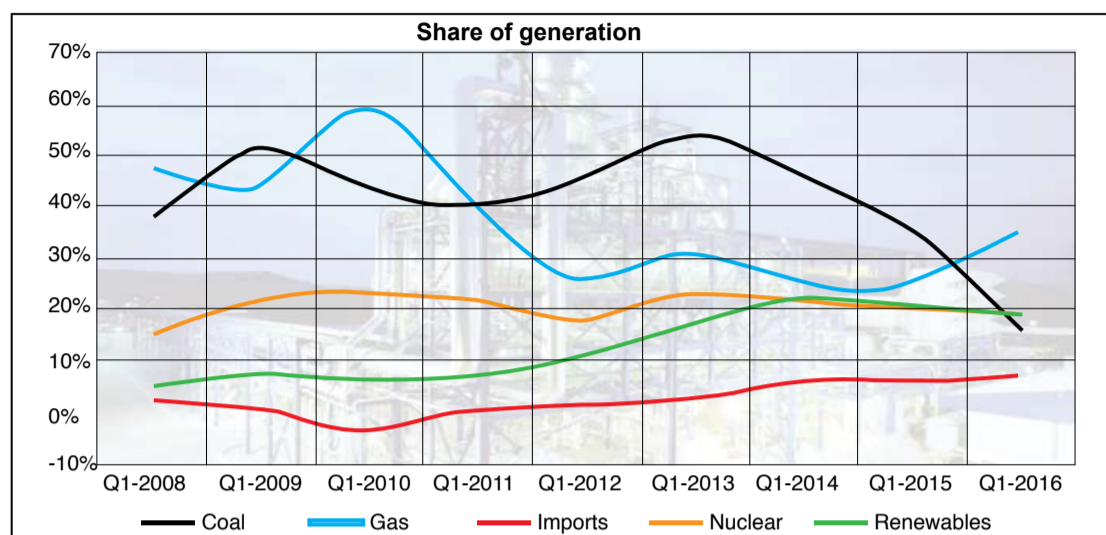
The situation has hit utilities and manufacturers alike. Utilities have mothballed gas plants in the UK and elsewhere. Meanwhile, Alstom has sold most of its power business to GE, which has now announced thousands of job cuts in its power and gas division, as has Siemens.

Yet the the global climate agreement reached at COP21 in Paris in December and the impact of the Large Combustion Plant Directive is driving further change in Europe's energy landscape.

A dramatic role reversal has seen gas fired power stations in the UK generate more than twice the electricity output of coal stations during the first three months of the year, according to the latest quarterly market report by energy specialists EnAppSys. While the UK is not necessarily representative of the whole of the EU, with its higher carbon prices, it may be an indicator of the shape of things to come in the rest of the continent.

According to the EnAppSys report, issued on April 11th, gas fired plants increased their power contribution by nearly a third from the end of 2015.

This was echoed in April's ICIS Power Index Q1 2016 analysis. The analysis said gas fired electricity reached its highest Q1 share of the UK's generation mix in five years, despite competing with demand for heating during Q1.



“UK gas demand was affected by a mild winter, but more gas fired generation helped to keep prices stable,” says Ben Wetherall, Head of Gas at ICIS. “Cheaper gas prices, the additional emissions costs for burning coal, and less wind generation than a year earlier all helped to boost demand.”

With gas prices falling and coal fired stations closing, generation from coal during the three-month period was also lower than both nuclear and renewable sources.

According to EnAppSys data, in the first quarter of 2016 combined cycle gas turbine (CCGT) power stations provided 35.4 per cent of the country's electricity at 29.68 TWh (13.7 GW). This was followed by renewables at 22.4 per cent which generated 18.78 TWh (8.7 GW), nuclear at 19 per cent and generating 15.98 TWh (7.5 GW), coal at 16.2 per cent generating 13.56 TWh (6.3 GW) and imports at 7.1 per cent providing 5.92 TWh (2.8 GW).

This position is a marked turnaround from one year ago, when there was almost 50 per cent more generation from coal than from gas. In Q1 2015, coal generated 28.7 TWh (13.3 GW),

against an output of 19.65 GW (9.1 GW) from CCGT plant.

The dramatic reversal reflects the poor economic conditions for coal generation, as demonstrated by the closures of Eggborough and Ferrybridge due to a combination of the UK's carbon price support mechanism, falling gas prices delivering tight margins and the investment needs of increased environmental requirements.

However, further anticipated coal closures were forestalled by the recent offer of supply contracts to both Drax and Fiddler's Ferry by National Grid as part of its efforts to maintain the country's generating margins for winter 2016/17.

Paul Verrill, a director of EnAppSys, explained: “The government has sent out the message that unabated coal will play no role in the market beyond 2025. With this message as a backdrop and with coal stations in the UK paying much higher carbon costs than stations on the continent, many coal stations have taken the decision to close earlier than anticipated.

“The government has previously declared an intention to get new CCGT

plants in place to offset the coal station closures, but obviously this is not going to be possible ahead of winter 2016/17. As a result, the ancillary service contracts recently awarded to Drax and Fiddler's Ferry will play a role in securing additional capacity for the next 12 months and this should reduce the risks of supply shortage.”

The growth rate of renewable generation slowed due to lower levels of wind generation but overall the sector continues to grow with an 82 per cent increase in solar and a 22 per cent growth in hydro generation against the last quarter. In the quarter, 46.1 per cent of renewable generation came from wind farms, 33.2 per cent from biomass plants, 13.5 per cent from hydro plants and 7.2 per cent from solar farms.

Overall, following a mild weather end to 2015, levels of power demand climbed by 18 per cent during the first quarter of 2016. Despite this increase, with power availability levels also growing, the supply margin was generally very comfortable, although when levels of wind generation did drop off the system saw high prices for stations able to provide additional power.

Verrill said: “It has been an interesting start to 2016. However, while the system has generally been well supplied, with wholesale power prices dropping 15 per cent from Q1 2015, there have been some occasions of interesting market activity.

“For example, the decline in coal's share of generation is seeing the market relying more and more on intermittent sources of power, increasing the role of ancillary services and storage. At times this has seen National Grid pay millions of pounds on tight days to ensure that there is sufficient short-term margin within the system. This has surprisingly come from the coal plants, which had planned to close.

“One of the biggest issues facing the market into 2016/17 is the cost incurred to maintain margin until the capacity mechanism comes into full force in October 2018, and how National Grid and the government achieve this without distortion to market operation that can risk jeopardising investment in new build.”

EnAppSys is an independent energy specialist company that provides electricity and energy market data, systems and consultancy services to parties with an interest in the UK energy market. For the full report, visit the EnAppSys website: http://www.enappsys.com/news_and_rep/Q1_2016_Market_Summary.pdf

Q1 2016 – key statistics

	9	8	7	6	5	4	3	2	1
*GB only (Excludes Northern Ireland)	Q1-2014	Q2-2014	Q3-2014	Q4-2014	Q1-2015	Q2-2015	Q3-2015	Q4-2015	Q1-2016
Total generation by fuel (TWh)									
Coal	32.61	21.11	15.87	27.07	28.70	16.60	12.63	16.53	13.56
Gas	18.06	20.67	25.81	22.18	19.65	19.63	22.57	22.50	29.68
Imports	4.56	4.79	5.27	4.86	4.69	5.48	5.98	4.60	5.92
Nuclear	15.40	16.30	14.70	13.34	16.90	15.81	15.51	17.45	15.98
Renewables	15.93	10.87	10.95	16.00	17.05	15.15	14.31	18.83	18.78
TOTAL	86.55	73.74	72.60	83.44	86.99	72.67	71.01	79.91	83.93
Share of generation (%)									
Coal	37.7	28.6	21.9	32.4	33.0	22.8	17.8	20.7	16.2
Gas	20.9	28.0	35.5	26.6	22.6	27.0	31.8	28.2	35.4
Imports	5.3	6.5	7.3	5.8	5.4	7.5	8.4	5.8	7.1
Nuclear	17.8	22.1	20.2	16.0	19.4	21.8	21.8	21.8	19.0
Renewables	18.4	14.7	15.1	19.2	19.6	20.9	20.2	23.6	22.4
*GB only (Excludes Northern Ireland)	Q1-2008	Q1-2009	Q1-2010	Q1-2011	Q1-2012	Q1-2013	Q1-2014	Q1-2015	Q1-2016
Total generation by fuel (TWh)									
Coal	32.89	38.06	31.41	33.68	40.33	39.26	32.61	28.70	13.56
Gas	41.45	32.67	43.35	33.08	22.57	22.75	18.06	19.65	29.68
Imports	2.10	0.24	-2.27	0.37	1.49	2.36	4.56	4.69	5.92
Nuclear	13.54	16.07	17.05	18.24	16.03	17.04	15.40	16.90	15.98
Renewables	4.45	5.55	5.09	6.69	9.43	12.14	15.93	17.05	18.78
TOTAL	94.42	92.58	94.63	92.07	89.84	93.57	86.55	86.99	83.93
Share of generation (%)									
Coal	38.0	51.6	43.3	40.4	46.4	54.0	45.9	35.9	16.2
Gas	47.9	44.3	59.7	39.6	25.9	31.3	25.4	24.6	35.4
Imports	2.4	0.3	-3.1	0.4	1.7	3.3	6.4	5.9	7.1
Nuclear	15.6	21.8	23.5	21.9	18.4	23.5	21.7	21.2	19.0
Renewables	5.1	7.5	7.0	8.0	10.8	16.7	22.4	21.3	22.4

Power and water in a container

A standalone system that can combine several renewable energy sources with energy storage and water purification can provide affordable access to power and drinking water in developing countries, or commercial installations that are looking for off-grid solutions.

Junior Isles reports

According to institutions such as the World Bank, IMF and the African Development Bank, there are around 1.5 billion people with no access to electricity, another 1 billion with just limited access to electricity and about 1.2 billion without potable water.

While there are ongoing efforts to solve the problem, there is still a need for more cost-effective solutions. German-based firm SAEnergy Systems believes it has the answer with what it calls its Power & Life Container.

The idea behind the Power & Life Container came about following discussions between SAEnergy and scientists in Germany's Economic Development Board, who were looking at alternative use cases for renewables.

Following technical and market due diligence and after obtaining support from the Ministry of Economics, SAEnergy came up with a strategy to combine renewables with energy storage and possibly water desalination in "off-grid scenarios".

Klaus Naderer, Managing Director, SAEnergy explained: "We were looking to move away from the conventional solution, where a few solar modules are placed on a rooftop or empty plot of land. We discussed combining several renewable energy resources with energy storage and desalination to build small scale power plants that could be deployed at virtually any place on the planet to provide power and potable water."

According to SAEnergy, when it first started looking at the issue, there were no solutions similar to what it was proposing to address the issue.

Naderer noted: "At the time it was considered extremely ambitious to put solar modules next to a diesel genset to help reduce fuel consumption. Today, there are some solutions that use regular shipping containers but most of them use a single energy resource. Also, we are the only ones that have taken a structured approach to developing a hybrid solution that is scalable."

SAEnergy is adopting two strategies to deliver its systems. In the first, it is using existing renewable technologies from suppliers. In the second, it will use its own proprietary technologies.

"At this point, we are buying solar modules and wind turbines, used shipping containers and energy storage technologies – typically lead gel batteries, which are 100 per cent service and maintenance-free," said Naderer. "We can also incorporate other technologies. We will use a diesel genset as a backup or to cater for peak demand; we can also incorporate small-scale waste-to-energy."

Power & Life Containers using solar modules will start off at 6 kW peak and grow in increments of 6 kWp up to 240 kWp. A large system, however, would require a number of floor-mounted solar panels. Wind turbine installations start at 4 kW and can be expanded incrementally to 50 kW. Beyond this it would then be expanded in blocks of 50 kW.

There are two systems to produce potable water – one for simple water

purification and the other for desalination. The purification system is a German technology that has been around for about six years.

It is a filtration system, which according to SAEnergy, can be applied in about 80 per cent of cases. SAEnergy says it is a highly automated system that is expandable to provide from 5 m³/h of potable water up to 50 m³/h. Depending on the amount of energy that has to be stored, the purification system is housed either in the same container or separately from the batteries.

The desalination unit is of the small-scale type typically used in ships. As it is more complex and larger, it is usually housed in its own container. Further the desalination process produces heat, which is not conducive to the battery.

In terms of proprietary technology, SAEnergy drafted a technology master plan for how to set up the unit. Naderer noted: "If you have a decent electrical engineer, it's not that difficult to have wind and solar working together but when you have a system that comprises three or four energy producing technologies, along with storage and water purification, then it becomes a bit more difficult to manage and have a high level of efficiency."

According to Naderer, the technology master plan allows SAEnergy's proprietary technology to deliver the maximum efficiency in any scenario. SAEnergy has developed its own control and guidance software, as it says there was no software available that allows the control of all these technologies simultaneously.

"Our software allows us to manage up to eight energy sources, the energy storage system, water desalination and all the consumers," said Naderer. "It's not only control in the classical sense, it's also active management software. The system also includes a communications facility that not only allows monitoring but enables us to switch the system on and off, re-boot individual components and have a great deal of analysis that allows us to operate at average efficiencies of around 99.6 per cent."

SAEnergy has also developed its own wind turbine, which it says is about 20 per cent more efficient than other small and medium sized turbines. It says these machines also operate with noise levels that are low enough for them to be placed in residential areas. These machines are rated at 4-50 kW.

The company is working with two universities to develop an energy storage system based on compressed air. "We want to move away from batteries, which do not last long enough, are not efficient and are definitely not green," said Naderer.

The storage system will utilise used welding gas bottles, approximately 1.6 m in height, to store compressed air. The capacity of these small-scale storage systems depends on the set-up, says Naderer, but a standard version would provide up to 300 kWh of storage from a 40 ft (12 m) container.

Its proprietary solar technology will use a solar heat concentrator to heat a



The Power & Life Container can be deployed virtually anywhere to provide power and potable water

fluid medium up to around 750°C. Naderer points out that solar thermal is typically three times more efficient than conventional solar. This type of concentrator, often seen on the roof of commercial buildings in Asia and in particular Thailand, is basically a half-pipe, shaped to reflect the sun's energy. A small tube at the other end of this half-pipe has a small tube containing the fluid medium.

This all sits on the rooftop of the container and produces steam to drive a sterling engine that compresses air to drive a generator. Generator outputs currently offered are 12, 24, 48, 110, 230 and 400 V.

Further down the line, SAEnergy will also develop a small scale waste-to-energy (WTE) power plant for some parts of the world. "In India, for example, we know there is a huge market for solutions like this," said Naderer. These, he says, will be "real WTE plants" that can accept, organic, material, plastics or whatever is available.

He noted: "It will be a small-scale plant that allows you to get rid of the logistical issues and infrastructure you would have in putting up, say, a biomass plant."

The electrical output for the first version will be in the region of 500 kW, while thermal output will be around 1200-1300 kW. Like the other units, it will be a containerised pre-assembled unit essentially housing a large oven to burn waste at a pre-defined heat.

While the Power & Life Container can be deployed almost anywhere, SAEnergy sees a particular market for radio tower owners such as mobile network operators. Radio towers in rural off-grid areas are typically powered by diesel gensets, which can be expensive to run.

"A study by a German government-owned firm of 500 radio towers in Africa, which looked at the fully loaded cost of operation, found that the cheapest cost of operation was \$1.30/kWh. And the most expensive was \$3.30," said Naderer. "At that

\$3.30 site, we can provide energy at 49 cents and maybe below."

While the Power & Life Container has built-in communications, in these applications the radio tower can also provide the communication needed to control and manage the unit. Naderer sees such installations as a "win-win".

Certainly the system looks good value for money. An entry-level Power & Life Container (solar, plus storage plus small diesel engine) manufactured in Germany comes in at around €30 000 for the smallest unit. This can range up to €150 000 for a large system with water purification.

Since the start of commercial sales during the first quarter of 2015, SAEnergy has made installations of systems that use existing supplier technologies in Europe and Asia and is about to sign contracts in Africa and North America.

"Several hundred systems have been either installed or ordered," said Naderer. "We are currently negotiating a contract in Africa with a radio tower company, where the initial order would be 2000 units."

The next step for SAEnergy is the roll-out of Power & Life Container systems that incorporate the company's own technology. Manufacturing of proof-of-concept units of its small wind turbines has just started, and manufacturing of commercial units for India is expected to start in June.

Manufacturing of its patented solar concentrator, along with the compressed air energy storage systems, is scheduled to start towards the end of this year or early next year. This will be followed by the WTE module around the middle of 2017.

While the market has been more cautious than expected in adopting the systems, the availability of the full range of technologies combined with the growing number of orders can only help boost the prospects for a system that can be of immense value to rural communities or indeed anyone looking for a totally off-grid solution.



Junior Isles

Orchestral manoeuvres in the dark

Whether they like it or not, change is coming their way. Tough market conditions, policies aimed at adjusting the energy mix to tackle climate change and legislation to drive new technologies such as smart meters are all conspiring to scupper business as usual for utilities across Europe. It's all too easy to say utilities must "adapt or die" but as we all know, things are usually easier said than done.

The poor operating figures and rating downgrades of a number of European utilities have been widely reported in recent months. In late March, for example, Fitch downgraded RWE's credit rating to BBB from BBB+, after a "further deterioration" of the

German utility company's "operating environment".

Explaining the reasons for the downgrade, Fitch cited the problems in the UK, which began in 2011 with the installation of a new IT system and led to more than 500 000 bills being issued late between September 2013 and December 2014.

"Problems with delivering the bills and the lack of adequate operations controls led to a write down in expected revenues, higher bad debt provisions but also increased IT costs, which make the UK Supply division unprofitable in the medium term," said Fitch.

Indeed the whole IT issue and the transition to smart grids along with the

mandatory roll-out of smart meters presents a huge challenge – one that some argue will require a fundamental re-think of the traditional approach to IT outsourcing.

Alsbridge Inc. is a global sourcing, benchmarking and transformation advisory firm. Elesh Khakhar, Managing Director of its UK practice said: "Whether the pace of smart meter roll-outs and smart grid development means we have the Internet of Things (IoT) by 2020 is almost crystal ball territory. But the reality is that utilities will have millions of intelligent devices that they will have to monitor, manage and deal with in order to do business differently and leverage devices and the data that goes with it.

"This vast increase in digitalisation will mean there will be much greater integration of operational processes and technology processes, which blurs the difference between operations technology (OT) and information technology (IT). The future world won't be as comfortable as it is today where IT organisations source IT services and business units source their [respective] business services. Sitting back and hoping that we can continue to keep that demarcation may not be the best approach."

It is a world that IT organisations have to adapt to, and if they do it now they will have more time to evolve, as opposed to having to do it suddenly in response to a sudden change in the market.

According to Alsbridge, IT organisations have to get on top of three key things.

Firstly, they need to recognise that they are moving away from a world where they control, implement and operate every bit of technology – much like an 80s pop group with a lead singer and three or four band members, who controlled everything. Today IT has to be more like an orchestra conductor.

"As a conductor you have whole sections of an orchestra that may have rehearsed completely separately and may be introduced at various times. Your job is to make it all work in harmony. So you're abdicating your responsibilities but recognise that you can no longer control every bit. As an orchestra leader, you have to define enough so that they practice the same pieces in the same way although they won't come together until quite a late stage, and then your job is to make them all work together."

The second aspect IT business units have to handle is the constant "waves" of change they will face. "You know you will have to face quite a lot of change," said Khakhar. "It will come at you regularly; it's not going to be a tsunami every four years, it will be a steady stream. As business units want to respond to the market changing, they will have to be able to implement that change quite quickly."

He says organisations have to find their "Fitbit", as they will need a level of maturity and fitness to be able to respond to that change. The IT business has to create the environment

that supports that. It has to identify the things it has to control as well as those it has to facilitate and enable, so that business can implement change regularly.

The third element, which is particularly important to utility companies, surrounds what Khakhar defines as a "safe enterprise." Trying to implement rapid change in a critical national infrastructure presents the problem of how to maintain safe and secure operations.

Like the security services in developed countries, Khakhar says utilities have to carry out smart monitoring, and gather intelligence and knowledge about what is happening in their environment. "This will allow them to spot where the potential trouble spots are likely to be and find a way of getting them dealt with," he said.

In a nutshell, utilities have to decide how they will use all of the new things brought by the digital world – IoT, robotics, autonomics etc. – to get IT to handle these three elements more effectively than they can with just human beings.

Alsbridge argues that it would make sense for IT to start leveraging their sourcing arrangements and relationships today. Khakhar explained: "They could implement the same tools and techniques they might need for managing the millions of electronic devices [in the future] for their in-house devices [today]. If you can leverage the capability and technology used to manage your in-house devices, you can evolve from there. It helps you to prepare."

"This in turn drives a different conversation with your service providers on the outsourcing side. Outsourcing deals fundamentally haven't changed in the last 20 years but utilities need to think differently."

Most utility companies have mature outsourcing arrangements and tend to look at them when they are due for renewal. IT organisations within utilities need to see how they can use the experience, innovations and capabilities of their sourcing suppliers to help them respond and accelerate the pace at which they can be ready for the new faster moving world.

At the same time sourcing providers will have to get used to different players, as the traditional technology product companies such as ABB, Siemens Landis & Gyr and Schneider become a more critical part of the service solution.

Sourcing providers can help utilities make the transition from pop group band-leader to orchestra conductor but IT businesses within those utilities have to be open to the idea.

Stepping into the future can be daunting. It is a leap in the dark but being open-minded and creative can produce some interesting outcomes in any industry. Pop group *Orchestral Manoeuvres In the Dark* was renowned for its experimental recordings. They were among the pioneers in electronic music. Their music may not be my cup of tea but they did sell 40 million records.

