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Special Project Supplement
Advanced boilers help Bouchain reach record-breaking efficiency.

Storage is finding its feet
Energy storage deployment continues to accelerate as costs continue to fall.
Page 13

Final Word
Junior Isles finds danger in the forest.
Page 16

News In Brief

Climate policy concern grows as Trump selects team
Concern over future US government energy policy and climate change is growing following key appointments in the incoming Trump administration.
Page 2

Keen interest in US offshore wind auction
The award of a lease to develop an offshore wind zone off the coast of New York state and the startup of the country's first offshore wind farm point toward a bright future for the US offshore wind sector.
Page 4

Australia calls for carbon policy certainty
In Australia's electricity industry has called for the state and federal governments to adopt consistent energy policies.
Page 6

New build CCGT loses out in latest GB auction
The results of Great Britain's latest capacity market auction have led to questions over whether the mechanism will drive construction of new generating capacity.
Page 7

Digitalization key to Enel business plan
Enel is to invest €4.7 billion to digitise its asset base as part of an enhanced strategic plan aimed at boosting growth, efficiency and protecting customer operations.
Page 9

Getting smart about network management
Intelligent networks have the power to transform how energy is distributed and consumed.
Page 14

Technology: Pioneering enzyme process improves waste recycling
DONG Energy is building the world's first commercial full-scale waste-to-energy bio plant, which uses enzyme treatment to convert household, municipal and some commercial waste into biogas.
Page 15

EU energy proposals could go further

Cañete: providing "a strong market pull for new technologies"

While the EU's latest package of clean energy proposals has been welcomed, some argue the measures do not go far enough. **Junior Isles**

The European Commission has received praise for its latest set of legislative measures related to the energy sector but some believe it can go further.

The overhaul of energy markets by the Commission will strengthen binding targets requiring EU member states to increase energy efficiency, step up the use of renewable energy and end fossil fuels subsidies for power generation in a five-year transition period.

The European Commission announced plans to cut energy usage by 30 per cent by 2030 to meet Europe's Paris Agreement commitments. Energy suppliers will now be required to save 1.5 per cent each year between 2021 and 2030. The package will also see new incentives for smart metering and innovative design, seek to boost renewables and give greater power to consumers to sell any electricity they produce.

The proposals will now need to be approved by member states and the European Parliament before going ahead.

Most notably, the package of measures contains the revised Renewable Energy Directive (RED), the Energy Efficiency Directive (EED) and Energy Performance of Buildings Directive (EPBD). Together, they constitute the legislative pillars underpinning the EU renewable energy sector.

Unveiling the measures, the EU Commissioner for Climate Action and Energy, Miguel Arias Cañete, said: "Our proposals provide a strong market pull for new technologies, set the right conditions for investors, empower consumers, make energy markets work better and help us meet our climate targets. I'm particularly proud of the binding 30 per cent energy efficiency target, as it will reduce our dependency on energy imports, create jobs and cut more emissions."

The European Environment Agency (EEA) commented that EU members "are collectively well on their way" to meeting 2020 targets on renewables, energy efficiency and greenhouse gas emissions.

The package was welcomed by the electricity industry. Eurelectric, the organisation representing Europe's electric utilities, said the proposals clearly underpin market integration and the removal of some regulatory interventions, which distort the functioning of the market.

"Market designs are not carved in stone and they are bound to evolve, but it is crucial that energy, flexibility and capacity are adequately valued to ensure cost-efficiency and security of supply," said Hans ten Berge, Eurelectric Secretary General.

Others, however, while welcoming the proposals, questioned its ambition. Brook Riley, from Friends of the

Continued on Page 2

Coal phase-outs continue

The phase-out of coal fired generation is gaining momentum, as several countries recently announced they would be closing all existing plants by 2030.

French President Francois Hollande announced during COP22 that all coal plants in France will close by 2023. The country sees the move as as the most cost-effective way of meeting its Paris Agreement commitment. The government says updating old coal plants is more expensive than developing facilities for renewable energy production, so keeping them open no longer makes financial sense.

According to the French President, the deal is "irreversible". The news follows similar announcements by the UK, Finland, Canada.

In mid-November, Finland announced its plans to phase out the use of coal for electricity generation by 2030. Finland's national climate target is to reduce greenhouse gas emissions by 80 per cent by 2050.

Olli Rehn, Finnish Minister of Economic Affairs said: "Finland is well positioned to be among the first countries in the world to enact a law to ban coal... This will be my proposal." He also said: "Giving up coal is the only way to reach international climate goals."

When the ban is put in place, Finnish utilities will be forbidden to produce energy from coal and the import of coal-based electricity will also be forbidden. The new plan will be presented to the Finnish Parliament in March for approval.

The news came as Canada said it will shutter its coal fired power plants by 2030 as part of its strategy to cut greenhouse gas (GHG) emission under the Paris climate accord.

The plants, located in four provinces, produce about 10 per cent of Canada's total CO_2 emissions, and closing them will remove the equivalent in emissions of 1.3 million cars from roads.

Reacting to the announcement, John Gorman, President and CEO of Canadian Solar Industries Association said: "Goals such as 90 per cent clean electricity by 2030 and an emissions reduction of 80 per cent by 2050 send a clear signal to investors that we are continuing to transition from fossil fuels to renewable electricity, as we must, to limit global warming to 1.5 degrees."

Canada has the cleanest, most renewable electricity generation system in the G7, and the fourth-largest renewable energy capacity in the world. Renewable energy sources such as sun, wind, and water currently meet 65 per cent of Canada's electricity needs.

In December, Canadian Prime Minister Justin Trudeau announced the country's first carbon tax at C$10 a tonne. The pricing will be introduced from 2018 and will rise by C$10 every year to reach C$50 in 2022. Under the agreement, the provinces can either implement a carbon tax or a cap-and-trade market.

Elsewhere, Ontario and Quebec, the country's most populous provinces, are installing a cap-and-trade system, and British Columbia already has a carbon tax.

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Continued from Page 1

Earth, said: "It is good to see this commitment from the EU. It is a real achievement and it will lift millions of people out of energy poverty and increase emissions cuts, but all of these elements are better with higher ambition. Why stop at 30 per cent? Why not go further and meet the EU's full potential?"

A joint statement released by the European Biomass Association (AEBIOM), European Geothermal Energy Council (EGEC), European Heat Pump Association (EHPA) and European Solar Thermal Industry Federation (ESTIF) said the "general lack of ambition of the package" is a missed opportunity to develop different renewable sources of energy, including those capable of decarbonising the heating and cooling sector, such as geothermal, solar thermal, biomass, and efficient heat pumps.

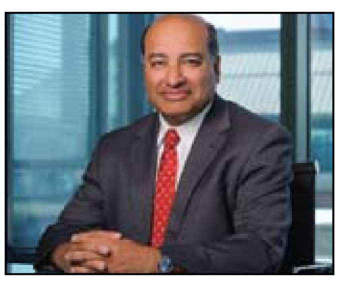
It pointed out that the Energy Efficiency Directive (EED) currently does not specify which sources and technologies are eligible to meet its energy efficiency targets. Further, the statement noted that the EU still supports fossil fuels for heating and cooling. Despite steps to increase the share of renewables in the heating sector, the Commission proposal does not remove the regulatory loopholes supporting new fossil fuel installations.

The lenient limiting of subsidies for fossil fuels is a bone of contention. Some argue imposing a limit of just 550 grams of carbon dioxide per hour will not rule out newer, more efficient coal plants.

This could slow the growth of generation from renewables. The EEA says preliminary figures for 2015 show that 16.4 per cent of total energy consumed came from renewables, up from 16.0 per cent in 2014. The goal is to have 20 per cent of the European Union's final energy consumption coming from renewable sources by 2020.

The proposals are designed to show that the clean energy transition is the growth sector of the future. In 2015, clean energies attracted global investment of over €300 billion. The EU is well placed to use its research, development and innovation policies to turn this transition into a concrete industrial opportunity. By mobilising up to €177 billion of public and private investment per year from 2021, the package can generate up to 1 per cent increase in GDP over the next decade and create 900 000 new jobs.

In December, the EU and the European Bank for Reconstruction and Development (EBRD) agreed to enhance energy cooperation in a number of areas, including renewable energy.



Energy cooperation: EBRD President Suma Chakrabarti

Under a new memorandum of understanding (MoU), signed by Cañete and EBRD President Suma Chakrabarti, the parties agreed to broaden the cooperation on scaling-up energy efficiency financing, increasing investment in renewable energy, developing smart grids, and enhancing resilience to climate change.

Climate policy concern grows as Trump selects team

Environmentalists see the appointment of climate change sceptics in key positions in the incoming US government administration as a threat to international efforts to tackle climate change.

Junior Isles

Concern over future US government energy policy and climate change is growing following key appointments in the incoming administration of US President-elect Donald Trump.

Trump has assembled a transition team in which at least nine senior members deny basic scientific understanding that the planet is warming due to the burning of carbon and other human activity.

Trump's selection of his one-time presidential rival Rick Perry to lead the energy department has triggered a backlash from environmental groups.

Commenting on the official appointment of Exxon CEO Rex Tillerson as the new US Secretary of State, Greenpeace UK's executive director John Sauven said: "So a real-life JR Ewing becomes America's chief diplomat as Donald Trump does away with the usual intermediaries and directly outsources foreign policy to the fossil fuel industry. We spent years warning that Exxon was too close to the US government. Now they are the government."

Not all green energy proponents, however, have reacted negatively. Some welcomed Governor Perry's background in recognising clean energy opportunities, which ultimately led the state of Texas to being the US leader in wind energy.

"He increased the ambition of the state's Renewable Energy Standard, directed state funds to innovative wind energy R&D initiatives, and created a 'Competitive Renewable Energy Zone' that helped expand transmission of renewables, bringing clean wind energy from rural communities to new state markets," said Tom Kiernan, CEO of the American Wind Energy Association (AWEA).

Meanwhile, Scott Pruitt, Oklahoma's Attorney-General, has been selected to head the US Environmental Protection Agency (EPA). Pruitt has claimed in the past that scientists "continue to disagree" about the causes and extent of global warming.

Commenting on the nomination, Richard Black, director of the Energy and Climate Intelligence Unit (ECIU), said: "In recent days Donald Trump has been signalling that he might moderate his campaign rhetoric on climate change, but his nomination of Scott Pruitt as EPA chief will re-ignite fears among groups such as scientists, business leaders, churches and the military that he does intend to follow through on promises to attack climate protection measures."

Yet many maintain that the climate change movement has gained too much momentum to be derailed by the new US government. President Barack Obama's environmental chief, says she is confident that progress in fighting climate change and creating clean-energy jobs will not be undone by the Trump administration.

Gina McCarthy, the head of the Environmental Protection Agency said she's confident that "the inevitability" of the clean energy future is "bigger than any one person or nation".

Trump has vowed to pursue an "America first" energy policy that will open up a new frontier in domestic coal, oil and gas extraction while undoing the effort to combat climate change, which he has previously called a "hoax ".

Utilities gain some clarity following nuclear decommissioning decision

The future of utilities owning nuclear power plants in Germany became a little clearer after the country's highest court ruled that the country's utilities should be compensated for the government's decision to shut down all of Germany's nuclear reactors in the wake of the Fukushima disaster.

The ruling by the Constitutional Court in Karlsruhe does not stipulate an amount that should be paid to the utilities but it will enable the likes of E.On SE, RWE and Vattenfall to pursue legal claims against the government or, alternatively, accept an out of court settlement.

The judgment is finally some good news for Germany's embattled utilities and came at the end of a pivotal year for the industry. Pressured by the rapid rise of renewable energy and the slump in wholesale power prices, they have been forced to write-off assets to the tune of billions of euros and radically alter business models by either splitting up or selling off conventional fossil fuel plants.

Shares in E.On and RWE rose more than 3 per cent on the news.

Germany has shut nine reactors since Fukushima, which triggered Merkel's U-turn on nuclear. Just months after extending the lives of reactors in 2010, she initiated an exit plan and closed some plants almost immediately. Germany's remaining eight reactors owned by RWE, E.On and Energie Baden-Wuerttemberg (EnBW)AG all have to close by 2022.

Under the ruling, the government will have to compensate utilities for about 80 TWh of lost output, roughly eight years of production from one reactor.

The court gave the government until June 2018 to amend a nuclear law to compensate utilities financially, or allow reactors to operate longer. This second option is complicated, as the two reactors operated by Vattenfall have already been decommissioned, while RWE units have to close before they can use up an allocated amount of electricity assigned under previous phase-out rules for nuclear plants.

Matthias Hartung, head of RWE Power, said the ruling brought "clarity in a legal question which is fundamental to our company and its assets". He said RWE would study the verdict in detail before deciding how to proceed. The company declined to say how much compensation it would claim.

E.On said it is "prepared to enter into constructive talks" with the German government on the implementation of the ruling. Noting that such talks "may take some time", the company said it is "not expecting any payments anytime soon".

However, the German environment ministry immediately ruled out the possibility of a big payday for the utilities. "Demands for billions are definitely not on the cards," said Jochen Flasbarth, Deputy Minister.

Lengthy negotiations between the utilities and the government are now expected. There is a chance that the utilities will waive their right to financial redress in light of ongoing negotiations with the government over how to divide the cost of nuclear decommissioning, cleanup and storage.

Andreas Kuebler, an environment ministry spokesman said: "We're really just at the start of trying to assess what the ruling means." And that this was just the "start of long, long negotiations. However, he stressed: "Our red line is that the nuclear phase-out will not be extended, nor will reactors run longer than has been set in legislation."

■ In a referendum at the end of November, Switzerland voted against plans to quickly phase-out nuclear power generation. A plan, backed by the Green Party, would have meant closing three of Switzerland's five nuclear plants in 2017, with the last shutting in 2029.

Power and utility megaprojects run over budget

A new report from EY, 'Spotlight on power and utility megaprojects – formulas for success, reveals power and utility megaprojects run 35 per cent ($2 billion) over budget and behind schedule by two years on average.

EY analysed 100 of the world's largest (by capital expenditure) power generation, transmission and distribution and water projects across all asset life cycle stages – from pre-financing through to decommissioning – and found that 64 per cent of these projects experienced delays and 57 per cent were over budget.

Safia Limousin, EY Global Power & Utilities, Capital & Infrastructure Leader, said: "Large and complex power and utility megaprojects are under massive pressure to come in on time and budget. And yet the majority of all megaprojects in the sector don't. This worldwide phenomenon often comes with a large price tag for overrunning costs that companies can't afford any longer."

The highest reported average delays occurred in North America (a little under three years), while South America reported the highest average cost overruns at nearly 60 per cent.

Almost three quarters (74 per cent) of hydropower, coal and nuclear infrastructure projects were over budget by 49 per cent on average, with hydropower and nuclear projects typically suffering the greatest cost overruns at $4. 6 billion and $4 billion, respectively. Offshore wind and gas-powered generation projects saw significantly less delays and cost overruns.

Limousin says: "Cost overruns and late delivery are symptoms of greater underlying problems in the power and utilities sector. Companies must address these issues head-on in the next wave of infrastructure investment or risk sacrificing the full economic and social benefits megaprojects offer. That means leveraging leading practices and innovations to enhance value."

The report outlines how harnessing digital innovation is an important step toward more effective control and enhanced project performance.

Embracing innovations in project fitness assessment, big data management and decision support management methods, for instance, can improve power and utilities companies' ability to formulate a holistic view of projects and accurately anticipate and address time and cost overruns to keep them on track.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Keen interest in US offshore wind auction

A competitive auction for a 1 GW zone off the US east coast has attracted some major industry heavyweights, indicating high levels of interest in the country's nascent offshore wind sector.

Siân Crampsie

The award of a lease to develop an offshore wind zone off the coast of New York state and the startup of the country's first offshore wind farm point toward a bright future for the US offshore wind sector.

In December Norwegian energy company Statoil emerged as the winning bidder in an auction to develop an offshore wind zone off the coast of New York state.

The company bid $42.5 million for the lease rights to a 32 000 hectare area located 30-60 km off the coast of Long Island in federal waters. The area has water depths of 20-40 m and could accommodate more than 1 GW of capacity, Statoil said.

Statoil will now explore the potential for developing the area by conducting studies to better understand the seabed conditions, the grid connection options and wind resources.

"The US is a key emerging market for offshore wind – both bottom-fixed and floating – with significant potential along both the east and west coasts," said Irene Rummelhoff, Statoil's Executive Vice President for New Energy Solutions. "Statoil is well positioned to take part in what could be a significant build-out of offshore wind in New York and other states over the next decade. This effort is in line with the company's strategy to gradually complement our oil and gas portfolio with viable renewable energy and other low-carbon solutions."

Offshore wind could play a key role in enabling US states to achieve renewable energy targets. The level of competition in the auction – which lasted for more than a day with 33 rounds – indicates that there is a "real appetite" for offshore wind in the US, the American Wind Energy Association (AWEA) said.

"Investment from such an established player in the offshore oil and gas industry illustrates how offshore wind is the next frontier in energy development," said Nancy Sopko, Manager, Advocacy and Federal Legislative Affairs, AWEA. "Over the past decade there has been consistent progress toward the realisation of offshore wind power's potential in America. The completion of [the] auction increases the strong momentum building to develop more of this ocean energy resource.

"Offshore wind is well suited to helping [New York] state meet its goal, because the turbines capture strong, consistent winds alongside America's largest population centers."

New York state has set a goal of generating 50 per cent of its energy from renewables by 2030.

Other bidders in the December auction, held by the US Department of the Interior's Bureau of Ocean Energy Management (BOEM), included Avangrid Renewables, Dong Energy Wind Power (U.S.) Inc., Innogy US Renewable Projects, New York State Energy Research and Development Authority, and wpd offshore Alpha.

The auction result was announced just as the US wind sector marked another milestone for its nascent offshore industry – the completion of the country's first offshore wind farm at Block Island.

Deepwater Wind announced in December that the testing phase of the five-turbine wind farm was complete and that commercial operations had started.

One turbine remains off-line, however, due to damage sustained to magnet modules during the construction phase.

"We've made history here in the Ocean State, but our work is far from over," said Deepwater Wind CEO Jeffrey Grybowski. "We're more confident than ever that this is just the start of a new US renewable energy industry that will put thousands of Americans to work and power communities up and down the East Coast for decades to come."

Aneel to re-launch bid for transmission lines

Brazil's power regulator Aneel is to re-launch a bidding process for two transmission line projects after the government cancelled concessions awarded to Spanish group Isolux Corsán for their construction.

Aneel says that the company has been stripped of two licenses, awarded in a 2015 auction, because of escalating concerns over project delays.

Isolux is undergoing debt restructuring in Spain and was reported to be in talks with rival Spanish firm Ferrovia over the sale of the Brazilian concessions.

Isolux has a right to appeal against the Brazilian government's decision. In October the company received court approval for a $2.2 billion debt restructuring plan, and it has also outlined a new, streamlined management structure.

The debt restructuring will enable the company to achieve a normal level of operations in the short term, and a return to profitability in the medium term, it said in October 2016. It may face a fine from Aneel for its failure to meet the conditions of the two concessions.

Aneel is expected to outline the new bidding process for the two projects in the next few weeks. The two lots include the construction of 686 km of high voltage power lines and seven substations in the northern Brazilian state of Pará and Rondônia.

The projects were due to be operational between 2018 and 2019.

Other transmission projects undertaken by Isolux are also reported to be behind schedule, including the Taubaté-Nova Iguaçu line in the southeast of Brazil.

Wind developers gear up for Chile

Wind power development companies are gearing up to participate in Chile's latest auction.

The country's government recently announced plans to auction over 7900 hectares of land for wind power projects in the Taltal area of Antofagasta. The land could host up to 400 MW of wind power capacity and companies have been invited to tender proposals for projects of up to 100 MW in size.

The plans show Chile's continued commitment to developing renewable energy to boost generating capacity and increase energy security.

The country has so far provided 220 concessions – equivalent to more than 51 000 hectares – for the construction of renewable energy projects. In November 2016, environmental authorities in the Biobío region approved an environmental impact assessment for the 139 MW Rihue wind farm, which will feed energy into the central SIC power grid.

Other key renewable energy projects in Chile's pipeline include the 96.7 MW Pirita solar and the 185 MW San Juan and 110.4 MW La Cabaña wind projects, being developed by Latin America Power.

Pacific Hydro is developing the 82 MW Punta Sierra wind farm in Coquimbo region, while Ibereolica and France's EDF Energies Nouvelles (EDF EN) are building the 115 MW Cabo Leones I wind project in north central Chile.

■ Transitioning to a fully renewable electricity system is possible for South America by 2030, according to a study by Lappeenranta University of Technology (LUT) and VTT Technical Research Centre of Finland. Favourable wind and solar resources, such as Patagonia and the Atacama desert, and the abundance of biomass make South America "one of the most favourable regions globally to shift to a 100 per cent renewable energy system", said Professor Christian Breyer.

Delayed Kemper inches toward full commercial operation

Mississippi Power has come a step closer to integrating all the systems at its Kemper clean coal facility with the start up of the plant's second gasifier.

The Kemper integrated gasification combined cycle (IGCC) plant achieved first electricity generated by syngas produced from coal in September 2016. The start-up of the second gasifier unit will lead to full commercial operation.

The Kemper facility has been criticised because of its cost overruns and delays. The project was originally due to start up in 2014 and cost $2.9 billion to build, but actual construction costs have been $6.9 billion.

There are also concerns about significant rises in predicted operation and maintenance costs.

In November 2016, Southern Company-owned Mississippi Power said it was completing maintenance on the first gasifier at the plant, which followed six weeks of successful syngas production. It expects the plant to enter full commercial operation in January 2017.

The remaining major milestones for the IGCC include successful carbon capture and integration of all systems necessary for both combustion turbines to simultaneously generate electricity with syngas.

Southern has admitted in regulatory filings that the operation and maintenance costs of Kemper could be much higher than originally envisaged.

The company estimated the operations and maintenance costs for Kemper at about $258 million over five years when it originally sought authorization in 2010 from the Mississippi Public Service Commission to build the plant. That figure rose to $515 million in a 2013 filing and could rise further as more is learned about the plant during operations.

Australia calls for carbon policy certainty

■ Urgent need for nationally integrated policy ■ Closure of coal fired stations must be orderly

Australia's electricity industry has called for the state and federal governments to adopt consistent policies that will deliver predictable energy prices and security of supply, while helping the country to meet its carbon abatement targets.

The Australian Energy Council and Energy Networks Australia said in a joint statement that there is an urgent need for "nationally integrated, predictable policy and regulation".

The organisations asked for "national, market-based measures for achieving carbon abatement, preferably an emissions intensity scheme for the electricity sector or an economy-wide price on carbon", to help companies move towards renewable energy sources.

Without such a change, they said customers face higher prices and an increasingly unstable electricity supply.

The call came after Australian Prime Minister Malcolm Turnbull ruled out introducing carbon pricing only days after his environment minister announced that the government would be exploring all options, including an emissions intensity scheme, as part of the planned 2017 review of climate policy.

Australia-based energy expert Anthony Arrow of law firm Pinsent Masons said this latest retraction is "a step in the wrong direction".

Arrow commented: "The combination of completely inconsistent policy frameworks across the various states and the federal government's recent backflip on policy direction is a dangerous cocktail for our electricity industry.

"It really is time for our federal government to allow an independent climate change expert to make recommendations on policy options without political persuasion or influence. Without looking at all of the options, it is difficult to see how we are able to make a completely informed decision in the best interest of the economy and the environment. Cutting off the options for a future tax on carbon or emissions intensity scheme is both unhelpful and short-sighted in the context of the Paris agreement and achieving our 2020 targets and beyond."

In late November a Senate report recommended that Australia should move completely away from coal fired generation within 10 years, citing economic factors as the primary drivers.

The report came about a month after the unplanned closure of the Hazelwood coal fired station, and before the unplanned closure of several others around the country.

With the backing of both the Labor and Green members of the committee, the report called for a comprehensive energy transition plan and the development of a mechanism that would ensure coal-fired power stations close in an orderly fashion and with plenty of warning.

Larissa Waters, the committee's chairwoman, said: "This report should be a wake-up call for the government. The electricity market is going through a dramatic transformation but it must be managed.

"Evidence to the committee showed that Australia's biggest power companies, unions, climate NGOs and affected communities like the Latrobe Valley are all pleading with the government for a national plan."

The interim report also called for a change to the national electricity objective, which governs the national electricity market but currently demands regulators focus only on price, quality, safety, reliability and security but not environmental factors. The report said it should include an objective that was "consistent with Australia's obligations under the Paris agreement".

The nation's major power companies have warned of the dangers of state-based renewable energy targets by Labor states, saying they will hamper investment and increase uncertainty.

The energy companies say the unstable policy environment caused by several state and territory governments establishing their own renewable energy targets will harm efforts to replace coal-fired power stations with renewable generation in an affordable and orderly manner.

■ RES has been granted planning approval for the Murra Warra Wind Farm in Australia. The project will see up to 116 state-of-the-art wind turbines constructed on farmland north of Horsham in the Wimmera district of Victoria. When completed the wind farm will have a capacity of 420 MW, one of the largest in the southern hemisphere.

South Korea outlines emission reduction plan

South Korea has set out mid- and long-term action plans to reduce greenhouse gas emissions in the country.

A pan-governmental comprehensive framework, approved by the cabinet, is aiming to achieve the country's goal of cutting carbon emissions by 37 per cent, or 315 million metric tonnes, as specified in the Paris Agreement.

According to the International Energy Agency, Korea is the world's seventh-largest polluter, with its carbon emissions reaching 572 million metric tonnes in 2013.

Under the new plan, the government aims to cut 219 million metric tonnes of CO_2, or nearly 70 per cent of the total reduction goal, from eight different areas including power production, industry and buildings.

To reach this goal, the government is hoping to raise the share of renewables to 7 per cent by 2020 by boosting incentives for renewable energy and cleaner power projects. At the same time, funding will be increased for the development of technologies such as solar, fuel cells and conversion of waste gas. Investment in clean energy research will be doubled to Won1.12 trillion ($957 million) by 2020.

The government said it also plans to introduce a cap-and-trade system to accelerate industry innovation and environmentally friendly investment.

On releasing the plans, the government said: "The action plans were formulated in a way that helps to shift the reduction-focused responses to climate change to a fresh paradigm centring on the market and technology... and strengthen the private sector's role and promote the acceptability of the policy."

■ K-Water, South Korea's state water resources company, has started raising funds worth about Won100 billion ($84 million) to build the world's largest floating power generating facilities. The energy company said it plans to sign deals with institutional investors by March to build and manage the 40 MW solar power facilities inside Hapcheon Dam in Hapcheon, about 350 km south of Seoul.

K-Water will build a 10 MW solar power facility by December 2017 and an additional 30 MW facility by December 2018, said company spokesman Kim Tai-kwang.

Thailand announces bids for 1000 MW of renewables

Thailand's Energy Regulatory Commission (ERC) has announced bids for the development and operation of renewable power in 2017 with a total generating capacity of 1000 MW.

This will result in the total investment budget in the renewable sector rising to as high as Baht60 billion ($1.67 billion) in 2017, up from Baht46 billion in 2016.

All types of renewable power sold to the government will be based on feed-in tariffs (FITs), which the ERC recently revised.

ERC commissioner Viraphol Jirapraditkul said bidding will open for solar, biomass, biogas and waste-to-power projects.

"It will be another year in which small investors can access business opportunities in this sector because it will take up to a decade before the ERC will open a new round of bidding for large companies to develop fossil-fired power plants or big independent power plants," said Viraphol.

The first bid, expected in the second half of 2017, will be for solar farms with capacity totalling 519 MW.

Energy policymakers have estimated the FIT for the solar segment will start at Baht4.19/kWh, slightly lower than the 2016 average of Baht5.60/kWh, due largely to falling construction and developing costs.

Bids for biomass projects with a total power generating capacity of 400 MW will also be opened in 2017. Bidding for the remaining 63 MW based on community waste-to-power projects is also set to open in 2017.

The ERC reported that renewable power in Thailand had a generating capacity of 9263 MW as of November 30, 2016. That accounted for 55 per cent of the goal set out in the Master Plan for renewable power development in Thailand, with 16 778 MW of renewable generating capacity targeted by 2036.

PPIB gives go-ahead for 330 MW Hubco project

Pakistan's Private Power and Infrastructure Board (PPIB) has given the green light to Hub Power Company Limited (Hubco) to go ahead with its plan to set up a 330 MW coal-fired power plant in Thar, Sindh.

In issuing a Letter of Support (LOS) to Thar Energy Limited (TEL), the PPIB said TEL would have to achieve financial close for the project within nine months.

Issuance of the LOS, which is part of regulatory approvals, would help the company find suitable financiers more easily. Project costs are estimated at $550 million.

The project, which is being developed by China Power Hub Generation Company (CPHGC), is expected to start commercial operation around three and a half years after financial close.

New build CCGT loses out in latest GB auction

The latest GB capacity market auction has raised questions as to whether it is the right policy intervention tool to secure new capacity.

Siân Crampsie

The results of Great Britain's latest capacity market auction have led to questions over whether the mechanism will fuel the construction of new generating capacity.

The December auction closed at £22.5/kW, with over 52 GW of capacity awarded 1-, 12- or 15-year capacity market contracts for delivery starting in 2020/21.

The clearing price will not be adequate to incentivise the construction of new large-scale CCGT plant, according to analysts.

There have also been questions over the role that energy storage units such as batteries can play in the capacity market, and the continued trend towards the construction of small, reciprocating engine-based 'car park' power plants.

"At £22.50/kW the market continues to see value in these smaller generation projects and this creates challenges for large new build CCGT plants whose value is weighted more towards trading revenues," said Rob Lalor, Senior Analyst at EnAppSys. "Some developers have, however, managed to get round this by developing on existing sites, and presumably achieving significant cost savings.

"This auction style where numerous projects are brought to market only to fail to progress as a result of a single auction will always drive the lowest possible prices whilst developers are still willing to participate in volume."

EnAppSys said that it had been anticipated that this round would bring higher prices than previous auctions with BEIS and Ofgem introducing a number of changes to address perceived market distortions, whilst also procuring more capacity. However, of the 52 GW of capacity awarded, almost 85 per cent is for existing generating units.

Storage units were also successful in the auction, with over 3.2 GW of capacity awarded, including 500 MW of new-build battery projects. Over 1.4 GW of demand side response capacity was also awarded, an eight-fold increase since the first capacity market auction in 2014.

"This auction saw large scale battery procurement for the first time and highlights the adaption of the market towards changing conditions evolving towards a green power system, with peakers and batteries backing up renewables, whilst incumbent CCGTs will continue to carry the main market load," EnAppSys said in a research note.

Prospect union said that the auction "has effectively deferred resolving where the bulk of the UK's future electricity will come from". The union's Mike Macdonald said: "The latest auction has secured a host of small-scale generation, but we are no nearer to solving the problem of where the bulk of the UK's electricity will come from after 2025 as existing nuclear and coal stations close.

"The eventual price range of £22.50/kW for 2020-21 is far below the £35-£45/kW needed to stimulate development of gas-fired power."

Centrica said that its success in the capacity market auction would enable it to build a 49 MW battery storage facility, two 50 MW distributed generation gas-fired power plants, and a 370 MW combined cycle gas turbine plant.

The CCGT will be located at the firm's Kings Lynn site and will use some of the existing infrastructure of the mothballed unit there.

InterGen also won a 15-year contract for its proposed Spalding gas unit, an expansion project that will add around 300 MW of open cycle capacity to an existing unit.

Some 10 GW of new CCGT capacity withdrew from the auction before clearing.

Plutus PowerGen won contracts for three 20 MW new build sites, but environmental groups said that they were pleased that fewer small-scale diesel plants had won contracts compared with the last auction.

"This… auction has illustrated the rapidly changing nature of the GB power market," KPMG said in a research note. It added: "In the future, we will be reliant on a much wider range of technologies, including storage, DSR and interconnection to keep the lights on, alongside existing large-scale power generation.

"Only time will tell if this more diverse and, as yet, unproven set of technologies proves to be reliable or not – and what the longer term role of new baseload plant, like a CCGT, will be – and thus the policy interventions needed to secure it."

Dutch look to subsidy-free offshore wind

- Energy Agenda sets long term goals
- €12 billion budget for renewables in 2017

Continuous cost reduction efforts in the offshore wind sector will enable the Dutch government to hold a subsidy-free tender in 2026, it has said.

The government revealed the target as part of its Energy Agenda, a document outlining the country's trajectory to near-zero carbon emissions by 2050, published by the Ministry of Economic Affairs in December.

The country's medium-term goal calls for 14 per cent of total energy consumption to be from sustainable sources by 2020, rising to 16 per cent by 2023. By 2050, the Netherlands aims to be almost climate neutral.

Offshore wind energy will play a key role in these plans; the country has set a target of 4.5 GW of installed capacity by 2023. The government's long-term commitment to offshore wind and its new offshore wind tendering system have been central to recent cost reduction achievements, according to WindEurope.

Last month a consortium of Shell, Van Oord, Eneco and Mitsubishi/DGE won the concession to build the Borssele 3&4 offshore wind farm (740 MW). The winning bid came in at €54.5/MWh excluding the cost of grid connection, 25 per cent lower than that for Borssele 1&2 and II (€72.7/MWh) awarded to Dong Energy in July.

"This is yet another indication of the accelerated trend towards cost reduction in offshore wind," said WindEurope's Giles Dickson. "The winning bid reflects the industrialisation of the offshore wind supply chain. And it highlights the confidence of the industry in the Dutch offshore wind programme.

"The Dutch government gives the industry visibility on volumes to be tendered several years in advance. They minimise administrative burdens and ensure the grid connection.

"WindEurope welcomes the government's recently announced intention to tender out a further 1 GW offshore wind capacity per year from 2023. The Netherlands are a model for other Member States who want to capitalise on the development of a competitive, clean and job creating wind energy sector."

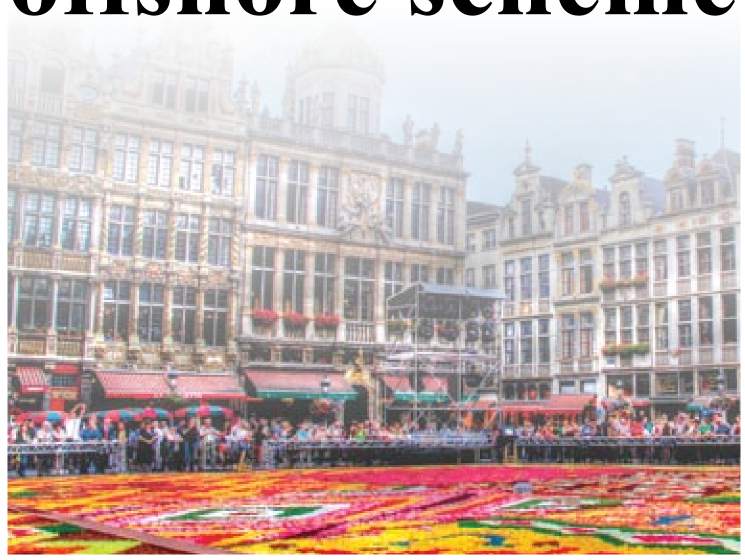
The Dutch government said in December that the Borssele 3&4 wind farm will be built and operated with a subsidy of just €0.3 billion, significantly less than the €5 billion originally anticipated. It also believes that with the current energy price outlook, Borssele 3&4 can be operated without subsidy after 7.5 years.

Earlier in December, Dutch Minister of Economic Affairs, Hank Kemp, said that the government had allocated €12 billion for renewable energy projects in 2017.

In a letter to parliament, Kemp announced plans to spend €12 billion on subsidies for renewable energy projects in 2017, including tidal energy projects, through two tendering processes set for spring and autumn next year as part of the SDE+ scheme.

■ Germany's Federal Network Agency (Bundesnetzagentur), which regulates the connection of wind farms in the North and Baltic Seas to the German transmission network, has confirmed a plan for offshore grid development by 2025. The plan will provide a reliable basis for future development of the offshore wind sector as well as a smooth transition towards competitive tendering of new projects.

Commission clears Belgian offshore scheme



The European Commission has given the all-clear to Belgium's plans to provide financial support for offshore renewable energy schemes.

The Commission said in December that the support scheme, financed by a surcharge paid by end consumers, meets EU state aid rules.

Under the proposed scheme, operators will receive certificates for offshore energy produced from renewable energy sources from the federal energy regulator (CREG). The operators can then sell these certificates to the transmission system operator Elia at a premium on top of the price they receive for electricity sold on the market.

To avoid discrimination against foreign renewable energy producers resulting from the financing mechanism, Belgium has committed to partially opening up the scheme from January 1, 2017, to foreign producers of electricity from renewable sources.

In December 2016 Norther NV, developer of the 370 Norther offshore wind farm in the Belgian North Sea, said that it had taken the final investment decision for the project.

Norther – a joint venture between Eneco, Elicio and Mitsubishi – also announced MHI Vestas as the turbine supplier for the project, and Van Oord as the balance of plant contractor.

The Norther wind farm will be Belgium's largest when it is commissioned in 2019. Construction will be supported with a €438 million loan from the European Investment Bank.

Investors launch clean energy fund

■ Innovation roadmap launched ■ Coalition to develop "ecosystem" of collaboration and finance

Siân Crampsie

Microsoft founder Bill Gates is leading a group of high-profile investors backing a new $1 billion clean energy fund.

The Breakthrough Energy Coalition (BEC) aims to fund the development, deployment and commercialisation of next-generation energy technologies through the Breakthrough Energy Ventures (BEV) fund. Other investors include Michael Bloomberg, Richard Branson and Mike Zuckerberg.

The investor-led fund will collaborate with other investors, governments, research institutions and corporate partners, to transform energy markets and attain a goal of reducing global greenhouse gas emissions to near zero.

BEC – launched just over a year ago – recently shared its 'Landscape of Innovation', outlining a roadmap of development for a range of technologies and pathways for accessing finance and markets.

"The world needs to be carbon neutral by 2050," said Richard Branson, founder of the Virgin Group. "This *can* and *has* to be achieved by governments, business and others coming together to create an energy revolution.

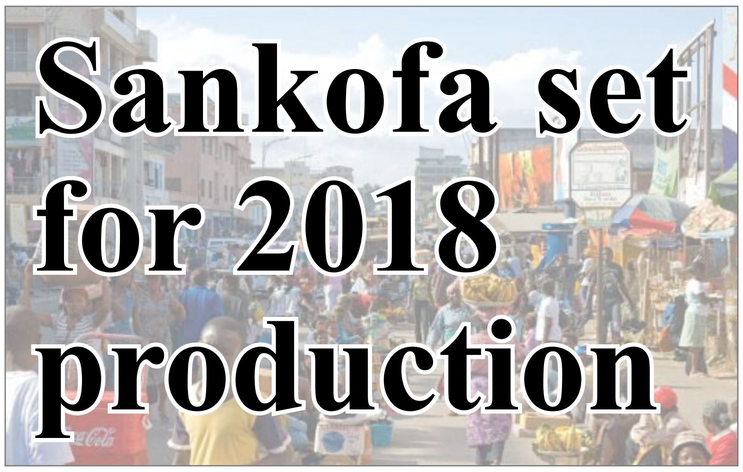
"The next decade presents a great opportunity to invest in businesses and technology aimed at tackling climate change. We must produce an abundance of clean, renewable energy and drive further innovation to make the next generation of energy more efficient. It will benefit the environment, our society and the economy."

One of the fund's key strengths will be its ability to bring to the table an investor-led fund with internal scientific expertise, a long-term horizon and a tolerance and understanding of the investment risks required to transform energy markets, BEC said.

"The mission, experience and global networks of BEV investors will allow it to attract the best scientists, entrepreneurs and private sector investors to guide the fund's trajectory," BEC said in a statement. "BEV is not confined to any segment of the investment pipeline – it will build companies, engage in traditional venture investment, and have the ability to invest for growth as innovations mature."

BEC will use the Landscape of Innovation document to help guide investment focus, and has called for other clean energy investors to do the same. "The scale of the challenge and the size of the opportunity presented by the global energy market will require investments far beyond the resources of the BEV," BEC said. "It will take the efforts of governments and investors from around the world."

BEC also said that one of its future aims is to explore ways in which it can develop an "ecosystem" of investment by engaging strategic corporate partners to coordinate expertise and capital to move technology development forward.



Sankofa set for 2018 production

■ 1000 MW generation capacity planned
■ Project enables switch to cleaner fuel

Plans to develop a "transformational" energy project in Ghana are taking shape with new financing commitments from the International Finance Corporation (IFC) and the Multilateral Investment Guarantee Agency (MIGA).

The $7.7 billion Sankofa gas project is an integrated offshore oil and natural gas project that will provide a domestic source of energy as well as 1000 MW of generating capacity to help Ghana meet growing energy needs.

IFC and MIGA, both members of the World Bank Group, have committed $517 million in debt and guarantees to support Sankofa, which will be developed by Eni, Vitol and Ghana's National Petroleum Corporation.

Their pledge brings the World Bank Group's financing for Sankofa to approximately $1.217 billion, building on a $700 million guarantee package from the World Bank in 2015 that will help Ghana's National Petroleum Corporation ensure timely payments for gas purchases and that has enabled the project to secure financing from its private sponsors.

IFC has committed a loan of $235 million to Vitol Ghana and arranged another $65 million in debt from the Managed Co-Lending Portfolio Program, a loan-syndications initiative that enables third-party investors to participate passively in IFC's senior loan portfolio. The IFC financing is part of a $1.35 billion loan facility provided by commercial banks, including HSBC, Société Générale, ING, Standard Chartered Bank and UKEF, among others.

MIGA has committed these commercial lenders with up to $217 million in political risk guarantees that will support Vitol's borrowing needs against risks of transfer restriction, breach of contract, expropriation and war and civil disturbance.

Sankofa will tap fossil fuel reserves located in deep waters 60 km off the coast of western Ghana. It will not only enable Ghana to reduce oil imports, but also reduce its reliance on diesel for power generation as well as CO_2 emissions.

"Developing Ghana's domestic natural gas resources will help the country reduce carbon emissions and provide a clean source of power for generations, said Philippe Le Houérou, IFC Executive Vice President and CEO. "Ghana will require significant power generation and infrastructure to meet the growing needs of its young and expanding population.

"This project demonstrates that private capital can be mobilized on a large scale to contribute to the country's energy security."

Gas production is set to start in early 2018. The project is expected to generate $2.3 billion per year for Ghana's government and provide a stable, long-term source of domestic gas that will solve chronic gas supply constraints.

Ian Taylor, CEO of Vitol Group, said, "This is a transformational project for Ghana at an important time. The World Bank Group's involvement, including financing from IFC and MIGA, is enabling Ghanaian gas to be used for the benefit of Ghana's economic development."

Chinese boost fuel cell development

China is increasingly influencing the development and growth of the fuel sector, a new report has revealed.

Sustainable energy consultancy E4Tech says that it has observed a shift in focus from the usually diffident Chinese government towards supporting fuel cell technology.

The move has helped to underpin continued growth in the global fuel cell market, with the total number of shipments in 2016 up by two-thirds on 2015.

In its latest 'Fuel Cell Industry Review', E4Tech says that in keeping with Paris commitments, air quality concerns and economic opportunities, the Chinese government has continued its fuel cell subsidies under a major government support scheme for new energy vehicles. The government also has plans to bring at least 300 fuel cell electric buses into service in 2017.

David Hart, E4tech director and fuel cell and hydrogen expert, said: "This year's report demonstrates the importance of a long-term outlook for governments that seek to support a growing industry.

"The sector remains fragile, but by supporting fuel cell-powered vehicles in tandem with funding for hydrogen infrastructure and projects developing roadmaps, monitoring and supply chain capabilities, the Chinese government is providing a real sense of direction for private sector firms to follow."

The transport sector is leading the growth in the fuel cell sector, but other key growth areas are domestic CHP systems in Japan, where the government has set targets of 1.4 million installations of fuel cell systems by 2020 and 5.3 million by 2030.

"This is an important period in the development of fuel cells internationally," added Hart. "The sector is yet to fully mature and new players are entering the market all the time.

"This increased competition could lead to dramatic improvements in the energy solutions available. Savvy businesses should monitor the situation to make the most of breakthroughs as soon as they arrive."

Landmark Hassyan plant closes finance

Development of a major clean coal power plant in Dubai is moving forward following the closing of finance for the $3.2 billion project.

The Hassyan power plant will be the first power plant in the region to use ultra-supercritical technology and will play a key role in the UAE's commitment to diversifying its energy mix.

The Dubai Electricity and Water Authority (DEWA) said last month that it had closed financing on the first phase of the 2400 MW project. The financing package is divided between a senior secured loan and secured mezzanine financing.

Lenders to the project include Industrial and Commercial Bank of China, Bank of China, First Gulf Bank and Standard Chartered.

Phase one of the coal plant is to be operational in March 2020, with all four 600 MW stages that make up the scheme to be completed by March 2023. A consortium led by ACWA Power is developing the plant.

Dubai's Clean Energy Strategy 2050 includes a target of generating around seven per cent of electricity needs from coal by 2030, as well as 25 per cent from solar, seven per cent from nuclear power and 61 per cent from gas.

Bouchain is on the boil

The demands placed on the heat recovery steam generators used in the current crop of advanced combined cycle power plants is calling for innovations in boiler technology. **Junior Isles**

Record-breaking performance: the Bouchain combined cycle power plant in France

Since breaking the 60 per cent combined cycle electrical efficiency barrier at the Irsching 4 power plant (later renamed Kraftwerk Ulrich Hartmann) in Germany in 2011, the major gas turbine manufacturers have been pushing the performance envelope of their large machines, with the latest milestone being 62.22 per cent power plant efficiency achieved in June 2016 at the 605 MW Bouchain power plant located in north Calais, northeast France.

While much of the increase in plant efficiency can be attributed to the move to H-class and J-class gas turbine technology, developments have also been required in the boiler or heat recovery steam generator (HRSG) that sits behind the turbine. Not only do these boilers have to handle the higher gas turbine exhaust temperatures and flows, they also have to be flexible – working in tandem with the gas turbine to cycle and ramp quickly to meet the demands of today's power markets.

Bouchain comprises a GE 9HA.01 gas turbine with a power output of 400 MW. Exhaust gas from the turbine at a temperature of 650°C is fed to an HRSG designed and supplied by CMI, based in Belgium and the US. The HRSG is a triple-pressure, drum-type boiler, designed to deliver superheated high pressure steam at 585°C and 158 bar[a].

Following the award of the contract in March 2012, CMI had to come up with several innovative features to enable the HRSG to exploit the technical abilities of the GE 9HA.01 gas turbine at the heart of the facility. Among the key innovations were the use of materials in the superheater and reheater sections that allow the HRSG to potentially handle steam temperatures in excess of 600°C and pressures approaching 200 bar.

The Bouchain combined cycle plant is the first commercial reference of the GE 9HA.01 (an upgraded version of the 9FB.05). It represents a huge investment that saw GE tie-up with the French utility EDF for the development and commercialisation of the turbine. GE also worked with CMI on developing the boiler to utilise the exhaust heat from the turbine.

Development of the new HRSG began in 2013, around the time when GE was in the process of changing the design of its H-class gas turbine.

Pascal Fontaine, Vice President Marketing & Licence Manager, CMI Energy said: "We were just finishing two projects in France that were based on the GE Frame 9FB.03. GE wanted to change the design of this gas turbine and developed the 9FB.05. This was quite a different machine, with two additional rows in the turbine section. We worked with GE to develop the boiler behind this new generation of gas turbines to take advantage of their ability to enable higher steam temperature and pressure in the boiler.There was a lot of discussion on the maximum steam temperature and pressure, and GE fixed the steam cycle at 585°C in the superheater and reheater."

Such high steam temperature prompted significant debate over the most suitable materials needed in the superheater and reheater.

The decision was taken to use austenitic stainless steel (Super304H) tubes in the superheater/reheater sections instead of the ferritic alloy (carbon) steel (SA335 P91) that is more commonly used.

Fontaine noted: "Even though we are at the limit for P91 and have a few years experience of using austenitic stainless steel at such a temperature (585°C), the market is still questioning its use."

ASME codes authorise carbon steel P91 up to 650°C at design conditions. It has been on the market for many years and is used extensively worldwide. However there is a concern about steam oxidation above about 605°C.

Fontaine said: "We have to be very careful with the heat treatment and welding procedures – a lot of problems can occur, especially with small piping. There has been a lot of debate, and even today ASME is considering the maximum allowable stress for this material." He notes that there is similar discussion around P92, another high-pressure steel alloy that is used more widely in coal fired boilers.

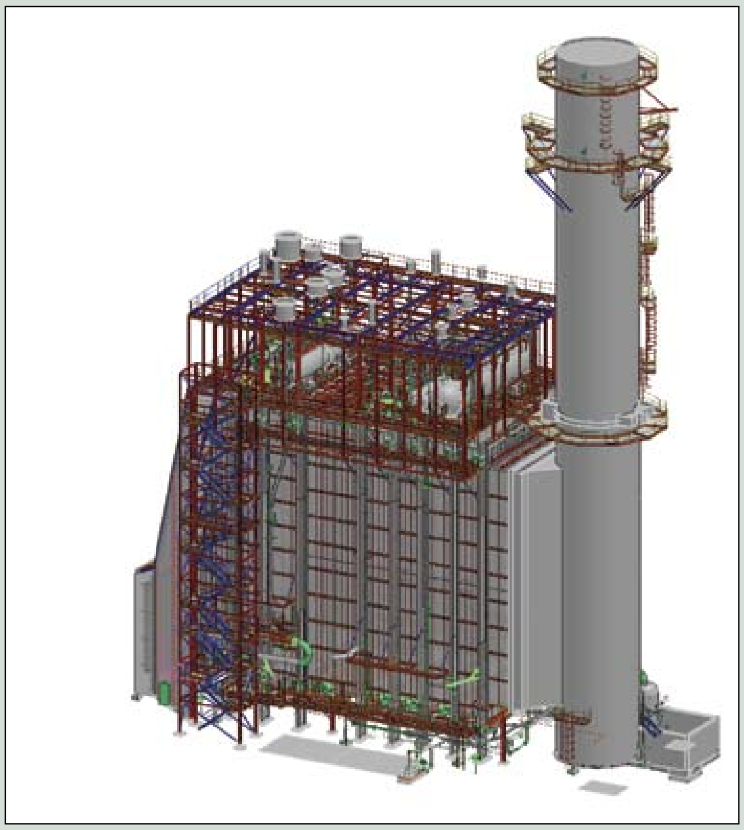
Values for parameters such as creep and fatigue and the maximum stress remaining after 200 000 hours of operation are known up to 650°C design conditions. But even though the material is potentially still useable above this temperature, Fontaine says the 'Maximum Allowable Stress' is reduced and thus component thickness increases, which has an impact on cycling ability.

In anticipation of going to higher steam conditions following the upgrade of the 9FB.05 to the 9HA.01, it was decided that Super304H would be the best choice of material for the superheater and reheater tubes.

"The designation of the gas turbine was changed around the time of project execution," said Fontaine. "The turbine had been operated at higher gas flow, while keeping the steam temperature at 585°C but GE saw the potential for even higher steam temperature. So when we designed the boiler, we had in mind the upgrade of the 9FB to the 9HA.

"Other projects using Mitsubishi 701J and Siemens 8000H machines already have steam cycles at 600°C. For example, the Hamitabat project we are building in Turkey also has an operating steam temperature of 600°C for both high pressure superheater and reheater."

Super304H, which is specified



CAD drawing of the Bouchain boiler. The HRSG is a triple-pressure, drum-type design

under the ASME Codes and meets Europe's Pressure Equipment Directive (PED), has been used in supercritical boilers for some time.

"Super304H is available on the market and accepted by ASME Codes. It has a long history in coal fired boilers," said Fontaine. "But considering it for combined cycle boilers is quite a new development. We are using it in the HRSG at Hamitabat, which will use the Siemens H gas turbine and at the Norte project in Mexico, which will use the MHPS J class machine."

According to Fontaine the decision to change the material in the superheater/reheater sections for the first time at Bouchain was a big step for this and future projects. While the use of a new material may sound straightforward, it called for a lot of developments.

"Ferritic steels are basically from the same family, so there is no problem in welding them to each other, as they have almost the same thermal expansion," said Fontaine. "But where you have to weld the stainless steel tube to carbon steel tube, like at Bouchain, it is a challenge. We are talking about [welding] two different families – ferritic to austenitic."

One of the biggest challenges is welding dissimilar materials when connecting austenitic steel and carbon steel components. The difference in coefficient of thermal expansion of the different materials means that the joints between the materials are subject to greater stress, which can be a particular challenge for plants in cycling operation.

At Bouchain Super304H is used in the first rows of the superheater/reheater – the hottest part of the boiler. Conventional carbon steel is used in areas of the boiler where temperatures are lower. Special attention has to be paid in welding the two materials in order to reduce shearing stress, especially when cycling.

"It is like mixing water and fire. Because one material expands more than the other, we have to make a deal between the two," noted Fontaine.

Dealing with the challenges posed by dissimilar welds in HRSGs of the Bouchain type was one of the reasons CMI established a welding expertise centre at its Seraing site in Belgium.

There are options on where to locate these dissimilar welds – they can be in the connections between the steam manifold and the header of the superheater (6-inch diameter tubes)/reheater tubes (diameter tubes of 31/38 mm) or alternatively downstream in the superheater/reheater piping (diameter > 650 mm).

"We had some discussions with GE on where they should be but finally decided to have them on the connectors between the header and the manifold," said Fontaine. The dissimilar welds are essentially located within the connections where Incoloy transition sections are placed between the P91 connectors and 347H connectors.

Explaining the arrangement, Fontaine said: "Incoloy has a thermal expansion just in between carbon steel and stainless steel. The transition pieces are 150 mm long to make the connection between stainless steel and ferritic steel. So there are two critical welds – one for stainless steel to Incoloy and one from Incoloy to carbon steel."

Notably, there will be access to these welds so they can be monitored over the lifetime of the plant to see how they hold up under the heavy cycling that is expected.

"The welds will expand and shrink daily over time, so good accessibility has been provided so we can perform some specific inspection procedures that have been established. We can do non-destructive testing over time," said Fontaine.

While this is the solution for Bouchain, he noted one benefit of locating the dissimilar welds in the tubes themselves. "The tubes [in the superheater/reheater] have smaller diameter, so the thermal expansion is potentially much smaller. This means the stress on the welding will be much less," he said.

Here, specific procedures are followed to weld ferritic steel alloy to austenitic steel and there will be no need to use Incoloy transitions. Extensive studies have been carried out in-house in the laboratory, as well as with tube boiler suppliers such as Sumitomo, using Finite Element Analysis to measure parameters such as accelerated stress fatigue.

"Each solution has its advantages but the preferred solution of CMI is to have the dissimilar welds in the tubes," Fontaine commented.

In terms of general design, the HRSG at Bouchain is a traditional bundle-type boiler, with 18 pre-fabricated bundles arranged in modules. Each boiler is three modules wide by six rows. There is no duct firing as this has a negative impact on efficiency. There is also no selective catalytic reduction, although a 6 m cavity is provided for potential future installation if needed to meet any tightening in emission regulation.

The boiler has to handle gas flowing from the turbine at a rate of 750 kg/s and a temperature of around 650°C. This led CMI to design a boiler with a heating surface of 405 428 m^2, provided by 14 142 tubes, each measuring 21.7 m in length. Fontaine explained the current market trend to this long tube length.

"Going to more than three modules wide in order to handle greater gas flow is a big step in price; it's a killer. So as gas flow is increased, we have to increase the cross-section by increasing the tube length. This allows us to keep to three modules, even if the size and weight of the modules is greater."

It is notable that it is a drum-type boiler, since the trend is towards once-through design at such high pressure.

Fontaine explained: "Drum type boilers have been proven in the industry up to [steam outlet] pressures of around 170-180 bar. But the reason for the limitation is quite simple – as the pressure increases the steam becomes denser. It becomes closer to water as you approach the supercritical point."

Construction of CMI's HRSG at Hamitabat: the boiler uses stainless steel tubes for an operating steam temperature of 600°C for both high pressure superheater and reheater

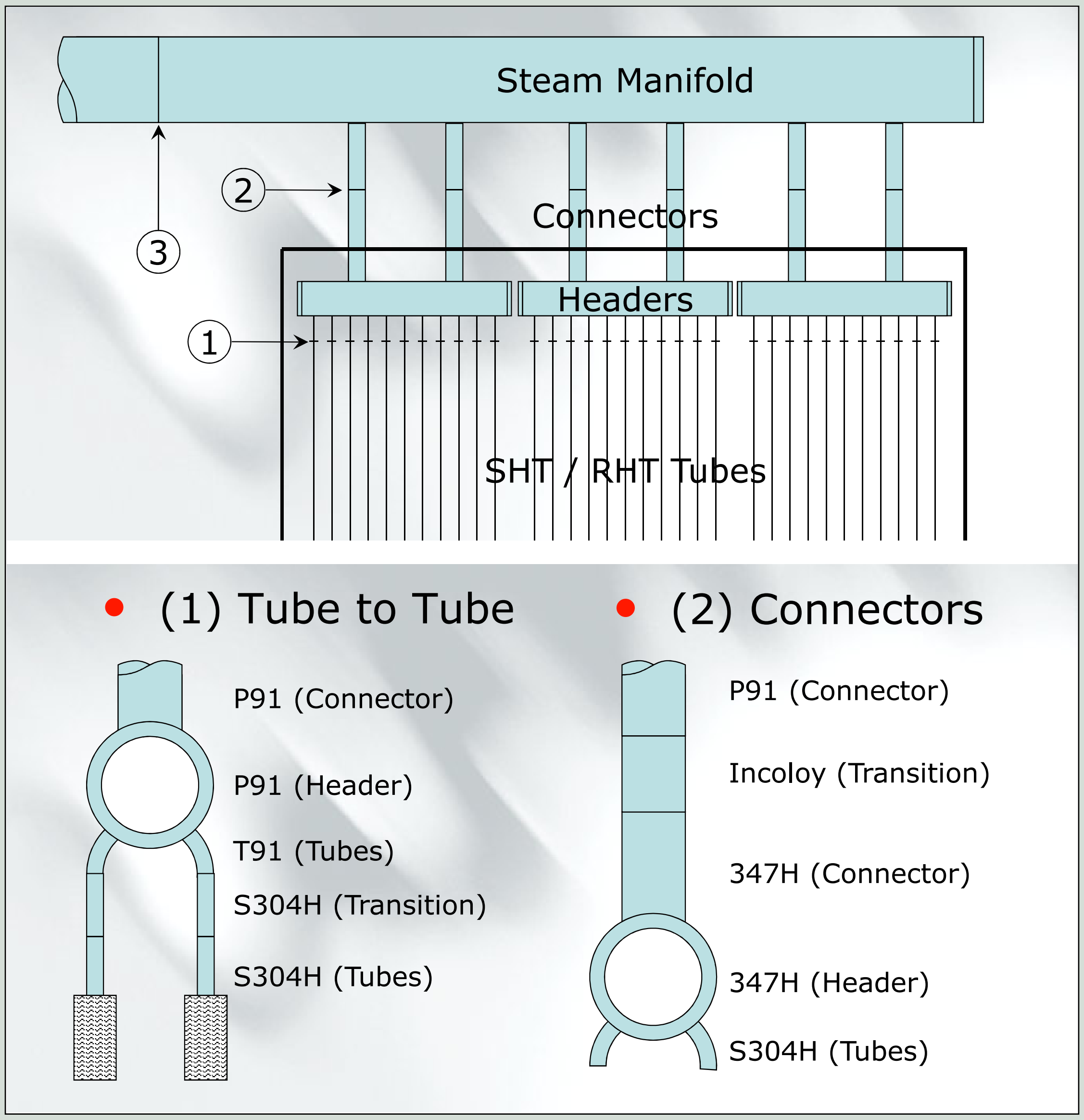
This means it becomes more difficult to effectively separate steam and water in the drum because one of the purposes of the drum is to have dry steam going into the superheater. Fontaine noted: "This task becomes more difficult as the pressure increases; so 180 bar at the outlet is considered as the limit."

While the pressure at the steam outlet is usually slightly lower than that inside the drum, the pressure inside the drum at Bouchain is still 160 bar, which is close to the considered limit. In order to increase the pressure and therefore efficiency, once-through technology is considered.

In the once-through design, water enters at one end and exits as superheated steam. The circulation ratio is one and there is no need for circulation pumps. Since the phase change takes place in the heat exchanger in a once-through boiler, there is no need for either steam drum or blow-down tank. In this scenario, there would be a steam separator instead of a drum to separate water from steam and to accommodate the swelling effect during start-up.

Yet while once-through design has many advantages, an important feature of the drum-type boiler is the flow stability in the heat exchanger.

Stainless steel superheater tubes. The shiny surface indicates that it is not carbon steel



Possible locations for dissimilar welds: The configuration adopted for Bouchain is shown in (2) on the right of the lower diagram (dissimilar welds located within connectors)

This is explained by thermodynamic principles that dictate how water changes phase according to pressure and temperature.

Fontaine explained: "As steam goes to the superheater, we have to go through an S-curve [in a typical phase diagram]. This means there is potentially a problem with flow stability because there could be several points of operation since some tubes will circulate more than others in a large heat exchanger. This could result in significant flow instability.

This is even more critical for combined cycle power plants, as you go through a range of gas turbine loads during operation and pressure sliding. Flow stability is solved naturally in a drum-type boiler because we remain on the increasing part of the S-curve under biphasic conditions."

Solving this flow stability issue, while minimising the flow pressure drop, is one development that CMI has worked on. Regarding the once-through steam generator, he points out that these developments are on vertical type boilers, as opposed to horizontal type boilers.

"The horizontal design is valid for a range up to about 180 bar – whether it's once through or drum type – there is the same limit in pressure for the horizontal once-through under the Benson patent," explained Fontaine. "Indeed, we have to rely on gravity and pressure to perform the separation [of steam and water] in the vertical tubes"

"This is why we noticed a shift in the market to vertical-type once-through boilers. There's no limit; we can do 200 bar or even up to the supercritical point if we wish but I don't think this will happen as it would present other challenges. It would require thicker headers, thicker tubes, which would reduce operational flexibility."

Reduced operational plant flexibility is sometimes argued as a drawback of drum-type boiler versus the once-through design but Fontaine does not see this as being the case at Bouchain.

"The plant potentially will be shifting everyday, as is required of many combined cycle plants today. It will start in the morning, stop in the evening and we will keep the boiler warm overnight.

"Under hot conditions Bouchain can make a straight start-up without limitations on the gas turbine. The limitation generally does not come from the HRSG; it's more from the steam turbine side where we have to heat up the large components of the machine."

Notably, GE's trademarked 'Rapid Start' is also implemented here. GE says the plant is capable of reaching maximum combined cycle power output in less than 30 minutes from a hot standstill.

This fast start capability is made possible by features such as a double intermediate and final attemperator, which according to Fontaine is not so common for GE.

"Bouchain is a breakthrough for GE. In the past they have preferred an intermediate attemperator-superheater only. Siemens has used a double attemperator – both intermediate and final – for some time.

"A final attemperator located between the boiler and the steam cycle is used for fine-tuning of the steam temperature control during rapid load changes such as start-up. It is a way of fine-tuning at the outlet of the boiler, even though the gas turbine is loading. Most of the control is done with the intermediate attemperator and the fine-tuning is performed by the final attemperator."

Another feature of the boiler at Bouchain that also allows rapid start, is what Fontaine describes as 'purge credit'. This means the HRSG is purged when the gas turbine is stopped instead of during start up, so the boiler is ready to start during the next loading cycle.

When Bouchain started in June 2016, it set a new world record for combined cycle plant efficiency under ISO conditions. Commenting on the achievement, Fontaine said: "It is an achievement we are proud of because it's a CMI boiler, which we have developed with GE, behind the 9HA.01 gas turbine."

Since then, however, GE's purchase of Alstom's power business and Doosan's HRSG segment may mean there will be fewer opportunities for CMI to undertake projects with GE.

"The market trend is to keep the complete power train, including the boiler – within the group. So, the market for us, as an independent boiler supplier, of these big sized projects is a bit more complicated," said Fontaine.

Nevertheless, he remains optimistic, noting that Bouchain is a flagship project for both CMI and the industry. "It is the first new generation of HRSGs in commercial operation for the advanced H-class and J-class machines."

In the meantime, CMI says it will continue developing its HRSGs to accommodate bigger sizes of gas turbines for steam cycles with higher temperatures and pressures. In particular, further developments in the vertical once-through steam generator can be expected.

"At the end of the day it will be up to the designer, who is establishing the heat balance. The heat balance is the key. Even behind a big gas turbine, it is the developer's decision as to whether to go for a conventional steam cycle or not. But the trend, in order to increase efficiency, is take advantage of the potential to increase steam temperature and pressure," said Fontaine.

He notes that if power output increases in future gas turbine models, it is possible we may see steam pressure of 200 bar and will have to go to once-through. "We developed such cycles with GE for the 9HA.02. The Bouchain unit is rated at 400 MW, providing 605 MW in combined cycle. The 9HA.02 would be a much bigger machine and the steam cycle behind it could be up to 200 bar."

Having already developed and tested this advanced boiler design at its test facility, CMI believes it is ready, whichever way the market goes.

Fontaine concluded: "We already have a new design to propose to the market; the large vertical once-through HRSG is already there. For CMI, it will be the next big step."

Boiler technical parameters and guaranteed performance

Type	**Three-pressure, drum-type**
Superheated steam	
Flow (kg/s)	90.2
Temperature (°C)	584.3
Pressure (bar)	158.4
Reheated steam	
Flow (kg/s)	104.4
Temperature (°C)	582.5
Pressure (bar)	27.8
LP steam	
Flow (kg/s)	15.5
Temperature (°C)	315.1
Pressure (bar)	4.7

The Hamitabat combined cycle plant featuring two Siemens GT 8000H gas turbines and CMI boiler is due for completion in 2017

Shell flies high in wind sector

■ Record low bid for Borssele 3&4 ■ Shell back kite power

Siân Crampsie

Oil giant Shell has made further strides in the renewable energy sector with key investments in wind energy.

A consortium led by the Dutch firm has won the bidding to build a 740 MW wind farm in the Borssele zone of the Dutch North Sea, while Shell's venture capital arm has given its backing to an innovative wind energy technology based on kites.

Shell and its partners – Van Oord, Eneco and Mitsubishi/DGE – will build and operate the Borssele 3&4 wind farm after winning the Dutch government's tender with a strike price of €54.50/MWh excluding transmission costs. It will equip the wind farm with MHI Vestas wind turbines, it said.

Borssele 3&4 will play a key role in the Netherlands' target of 4.5 GW of offshore wind capacity by 2023 and will be built and operated with a subsidy of just €0.3 billion, significantly less than the €5 billion originally anticipated by the Dutch government.

The recent tender indicates that the offshore wind industry is successfully attaining its ambition of reducing the costs of the technology.

In July Dong successfully bid a winning price of €72.7/MWh for the 700 MW Borssele 1&2 project. The Dutch government's long-term commitment to offshore wind development is an important element of the cost trajectory, WindEurope says.

Shell and its partners will invest around €300 million in the wind farm. The investment will add to Shell's onshore wind business in the USA and other green investments, such as its Brazilian biofuels business.

The firm is coming under increasing pressure from shareholders to assess its climate exposure and invest in renewable energy. Shell CEO Ben van Beurden told *Reuters* in late November that the company plans to play an active role in the green energy market.

UK-based Kite Power Systems (KPS) last month announced that Shell Technology Ventures, Schlumberger and E.On had committed a combined £5 million to support technical and commercial development of its technology.

KPS' solution uses tethered kites that are able to fly as high as 450 m and achieve flight speeds of up to 45 m/s in 9 m/s winds. The technology has the potential to disrupt conventional wind solutions as it is cheaper to manufacture and install, KPS says.

Paul Jones, Chief Financial Officer of KPS said: "The new investment from three major international businesses is an endorsement of the R&D work that the KPS team has carried out and demonstrates support for our technology and our business. The backing of these companies will accelerate KPS's commercial development plans towards deploying lower cost, deep-water offshore wind energy on a global scale."

KPS is planning to deploy a 500 kW onshore power system in Scotland next year. It is eventually planning to develop a 3 MW onshore system in Scotland followed by deployment of a similar sized power system in offshore waters.

So far the firm has invested £3 million in technology development, with financial support from the UK government, Shell's GameChanger programme and private investors.

Steag, Macquarie target SE Asia

Steag and Macquarie have formalised their working partnership in the power sector by creating a joint venture targeting power plant development opportunities in South East Asia.

The two companies have founded a joint development and investment platform to design, construct and operate energy projects in key markets such as Indonesia, the Philippines, Malaysia and Thailand. They will jointly invest around $500 million in equity and are in talks with finance partners, according to a statement.

"In the South East Asian region there are many emerging countries with a large or growing demand for energy infrastructure and reliable power supplies," said Joachim Rumstadt, Chairman of the Board of Management of Steag GmbH. "Steag is familiar with power plant projects in upwardly striving countries like these. A joint platform with a partner like Macquarie, which has the know-how in collecting investment capital, is therefore an excellent constellation for us, leading to successful projects in the region."

The joint venture firm – Asia Power Development Platform Joint Venture Pte. Ltd. (APDP-JV) – will target projects at the development phase of the infrastructure lifecycle. It aims to develop a diversified portfolio including thermal, wind, solar, hydro and waste to energy projects in the mid-scale segment (50-300 MW).

Areva continues non-core sell-off

French company, Areva, has continued its strategy to focus on the nuclear sector with the sale of subsidiary ELTA to the ECA Group, a subsidiary of Groupe Gorgé.

ELTA specialises in the development, marketing and in-service support of electronic equipment and systems for severe environments. It was jointly held by Areva TA and Areva SA.

Last month Areva received a firm offer for a ten per cent stake in a new nuclear fuel company that will be split from its parent company as the French nuclear sector restructures.

Areva said that an unnamed company had offered €500 million for the stake in NewCo, which will encompass Areva's nuclear fuel and mining activities.

The deal would be a major step forward in the recapitalisation of Areva, which was brought to the brink of financial collapse under the weight of its own debt.

In November Areva reached a deal with EDF for the sale of Areva NP, its reactor business. The deal paves the way for Areva to access government capital. EDF is also seeking new partners for the reactor business.

Digitalisation key to Enel business plan

Starace: Enel is more focused

Enel is to invest €4.7 billion to digitise its asset base as part of an enhanced strategic plan aimed at boosting growth, efficiency and protecting customer operations.

The Italian firm said that the enhanced plan for 2017-19 would add new elements to a strategic plan unveiled last year. It said that it had delivered ahead of schedule on the four key pillars of the last plan and was in a position to take its strategy "to the next level a year early".

"Since we first presented our transformational strategic plan at the beginning of 2015, we followed up with an accelerated update this time last year," said Enel CEO Francesco Starace. "Enel is a more focused, efficient and profitable organisation, as the sustainable business model we built is bearing fruit with increasing momentum."

Enel is aiming to digitise its assets base, operations and processes, spending €3.9 billion on extending smart meters across 75 per cent of its networks' end-users, and digitalising 70 per cent of its generation capacity. The move will protect Enel's customer base and reduce operating expenditure.

The firm will also achieve growth by adding 6.7 GW of renewable energy generating capacity to its portfolio over the next three years, it said. Some of this will be achieved through a lower-risk, build-sell-operate business model.

Enel is also aiming to introduce a more streamlined corporate structure, and take a more active portfolio management position with a three-year rolling asset rotation target of eight per cent. Some €3 billion of assets will be sold in the next three years, Enel said, enabling it to reinvest while maintaining financial flexibility.

Credit ratings firm Moody's said that the plan was positive for business risk overall as it would diversify Enel's business away from merchant risks as well as extend it geographically.

Eni, GE seal renewables pact

Eni and GE say they will use a diverse range of renewable energy technologies in a new pact aimed at developing large-scale power generation projects.

The two firms recently announced plans to build a portfolio of renewable energy projects. Eni said that the agreement was part of its strategy to leverage the industrial and commercial synergies of its traditional activities in the clean energy sector.

The Italian oil firm has been operating in the renewable energy sector since 1980. Its existing relationship with GE in the oil and gas sectors will provide the basis of the partnership, it said, while it would also be able to draw on GE's portfolio of technology and experience in the renewable energy sector.

Americas

Trents expand Bayonne Energy Centre

Macquarie Infrastructure Corporation (MIC) has placed an order with Siemens for the supply of Trent 60 aeroderivative gas turbines to expand the Bayonne Energy Centre in New Jersey, USA.

Bayonne supplies energy via a dedicated 10 km-long underwater transmission cable to Consolidated Edison's New York customers, and can reach full power from a standing start in less than 10 minutes.

Siemens will deliver two Industrial Trent 60 Wet Low Emission (WLE) gas turbines and two generators to the Bayonne plant, adding to the eight Trent units already operating there. The expansion will bring the plant's output to 640 MW.

Wärtsilä secures Bahia Blanca deal

Wärtsilä has won a contract to build a 101 MW power plant in Central Piedra Buena, Bahia Blanca, Argentina, for Pampa Energia.

Under the contract, Wärtsilä will deliver a turnkey solution, including 50DF multi-fuel engines.

The power plant will start operating in December 2017.

Palo Verde signs up Areva NP

Areva NP has signed a multi-million dollar contract to supply and replace 12 low-pressure feedwater heaters at the Palo Verde nuclear generating station in Tonopah, Arizona, USA.

Areva NP will lead a team that includes SPX and Barnhart to design, manufacture, prepare and install the feedwater heaters. Pre-outage work for the replacements begins in spring 2018, with the maintenance outages occurring between 2019 and 2025.

In 2016, Areva NP delivered 54 in-core detector assemblies to Palo Verde as part of another initiative to increase the facility's efficiency. In-core detector assemblies provide operators with the ability to enhance reactor operation through continuous, real-time monitoring of core conditions. Two additional deliveries, each of 53 in-core detector assemblies, are scheduled for 2017 and 2018.

Nordex to supply 228 MW at Bruenning's Breeze

E.On has placed an order with Nordex for a 228 MW wind power project in the USA.

Nordex will install 76 AW125/3000 turbines at the Bruenning's Breeze wind farm in Texas. The IEC-2b turbine with its rotor diameter of 125 m is designed for medium wind speed conditions like those found in the area near Bruenning's Breeze, and will enable E.On to realise a project with a low cost of energy. The manufacturer will be installing the turbines on 87.5 m tubular steel towers.

E.On plans to commission the turbines at the end of next year.

Gamesa secures 115 MW Chile order

Gamesa says it has reinforced its position in the Chilean market with the signing of a contract with EDF EN Chile and Spain's Ibereólica for the supply of 115 MW.

Under the terms of the agreement, Gamesa will supply, install and commission 55 of its G114-2.1 MW turbines at phase one of the Cabo Leones I wind complex located in Comuna de Freirina, in the second region of Atacama.

The turbines will be delivered by the end of the first semester of 2017. The company will also provide operations and maintenance (O&M) services at the complex for the next 20 years.

Asia-Pacific

Direct drive turbines for Uljin onshore wind farm

Siemens Wind Power has received an order to supply 17 direct drive wind turbines for the Uljin onshore wind power plant in Gyeongsangbuk province on the east coast of South Korea.

The scope of supply for the customer, SK D&D, includes the delivery and technical field assistance for the installation of 16 wind turbines of the new type SWT-3.6-130 on different towers ranging from 85-115 m hub heights and one SWT-3.0-108 on a 71 m tower. Siemens was also contracted for full service and maintenance over a period of 10 years.

The Uljin wind farm project is Siemens' second project for SK D&D and also its second order in South Korea.

Vestas chosen for Sapphire

SWF Nominees Pty Ltd has placed an order with Vestas for the supply of turbines for the Sapphire wind farm project in New South Wales, Australia.

The Sapphire wind farm will comprise 75 Vestas V126-3.45 MW turbines. Vestas will build the facility under an engineering, procurement and construction (EPC) contract. The order also includes a minimum 10-year Active Output Management 4000 (AOM4000) service contract, in which Vestas guarantees a defined level of availability and performance as well as a SCADA VestasOnline Business system for data-driven monitoring and preventive maintenance.

Suzlon bags India order

Wind turbine firm Suzlon has won an order for a 50 MW wind farm in Anantapur, Andhra Pradesh, India.

The project will comprise 24 of its S95 90 m tubular tower turbines with a rated capacity of 2.1 MW. Suzlon will also carry out operation and maintenance of the wind farm for 20 years. It is scheduled for completion in March 2017.

Europe

JDR to deploy 66 kV inter-array cables

VBMS has awarded JDR a contract for the supply of 66 kW inter-array and export cables for Vattenfall's European Offshore Wind Deployment Centre (EOWDC).

JDR will supply more than 20 km of inter-array and export cables, including the first deployment of its 66 kV technology, as well as associated accessories.

Located in Aberdeen Bay, the 92.4 MW, 11-turbine development is Scotland's largest offshore wind test and demonstration facility. First power generation is planned for 2018 with the scheme operating for 20 years.

Centrica battery storage for Roosecote

Centrica has selected Younicos to design one of the world's largest and most sophisticated battery-based energy storage systems. The battery plant will be built at the site of the former Roosecote coal and gas-fired power stations in Barrow-in-Furness, Cumbria, UK, and will be based on lithium ion battery technology.

Supported with a capacity market contract with National Grid, the Roosecote facility will help to guarantee electricity supplies in the UK market.

The Roosecote battery facility will be able to respond to fluctuations in demand in less than one second. Construction will start in 2017.

Nexans subsea cable for Hornsea Project One

Danish company Dong Energy Wind Power A/S has contracted Nexans to supply and terminate a total of 139 km of three-phase subsea cable for the first of three construction phases of the Hornsea Project One wind farm, off the UK's Yorkshire coast.

Nexans will provide 34 kV cables of the latest generation that will be used for inter-linking a total of 58 wind turbines and connecting them to the offshore transformer station. This first stage of the wind farm, on which construction began in January, is expected to be operational within approximately three years and to produce 406 MW.

When the project's three phases are complete, it will be the largest wind farm in the world. It will be located 120 km from the UK coast, in water depths of 20-40 m.

Statcom supports Nemo connection

National Grid has placed an order with GE to supply its latest Utility Statcom technology at UK substations to support the development of the UK-Belgium network interconnection project, known as Nemo.

GE will install its Utility Statcom solution on a turnkey basis at the Bolney, Ninfield and Richborough substations. This Statcom solution will support National Grid's alternating current (AC) network and the operational reliability of the HVDC connection between the UK and Belgium, which will deliver more than 1 GW of bi-directional power between the two countries.

Amprion and Elia award ALEGrO contract

Amprion and Elia have signed a contract with Siemens for the delivery of two high-voltage direct-current (HVDC) converter stations for the first electricity interconnector between Germany and Belgium.

The Aachen Liège Electricity Grid Overlay (ALEGrO) interconnector will use 90 km-long underground cables to connect the Belgian and German high-voltage electricity systems.

Siemens will be responsible for the system design and the supply, installation and commissioning of all components for both converter stations using HVDC Plus technology, which is highly controllable and brings operational benefits to both transmission systems.

ALEGrO is scheduled to commence commercial operation in 2020. The European Commission has designated the ALEGrO project as one of its projects of common interest.

GE future-proofs UK power plants

Uniper UK Ltd. has selected GE's Power Services to provide plant equipment upgrades and advanced digital solutions to boost the performance of its Enfield and Grain combined cycle power plants in the high-demand regions of greater London and the southeast of England.

The upgrades are part of GE's new Fleet360 services platform of total power plant solutions and include a full suite of digital, plant and gas turbine solutions. The contract also includes the first order for GE's Operations Optimization software on a GT26 gas turbine.

International

Wärtsilä wins Tanzania contract

Wärtsilä has won a contract to supply a 40 MW Smart Power Generation plant to Geita Gold Mining Limited in Tanzania.

Under an engineering, procurement and construction (EPC) contract, the Finnish firm will provide four of its 32TS engines, which will run on heavy or light fuel oil.

The plant will start operating in the first quarter of 2016, providing the off-grid mining operation with a reliable source of energy.

Green Watts orders Gamesa turbines

Gamesa and Elecnor have been awarded a turnkey contract to build an 86 MW wind power plant in the region of Maan, Jordan.

The two Spanish firms will install 41 Gamesa G114-2.1 MW wind turbines at the Al Rajef wind farm for Green Watts Renewable Energy Company LLC, a subsidiary of Alcazar Energy. Gamesa and Elecnor will also carry out operations and maintenance of the facility for 20 years.

Delivery of the wind turbines will start in autumn 2017 and the facility is scheduled to be commissioned in September 2018 and fully operational by October 2018.

The contract is the second in Jordan for Gamesa.

Nordex turbines head for Turkey

Bakir Enerji and Marmarares Elektrik have ordered a total of 19 Nordex wind turbines with a combined capacity of 68.4 MW for the "Esenköy" and "Kürekdagi" projects in Turkey.

The Esenköy wind farm, located in the Marmara region of northwest Turkey, will comprise nine N117/3600s turbines, while Kürekdagi, also in Marmara, will comprise ten of the same turbine model. The turbines will be set on 106 m towers.

The N117/3600, currently the most powerful turbine for medium winds in the Nordex portfolio, is well suited to such IEC-2 regions.

Construction of the two wind farms is due to start in the late summer of 2017 meaning that they can be handed over to the customer at the beginning of fiscal 2018.

Nordex will service all 19 turbines on the basis of a Premium Service agreement for a period of five years.

Doosan wins Egypt contract

Doosan Heavy Industries & Construction has won a 160 billion won ($137 million) contract to supply turbines and generators in Egypt.

The Korean firm will supply, install and test one unit of 650 MW-class turbine generator at the Assiut thermal power plant and one unit at the Cairo West thermal power plant. The plants are owned by UEEPC (Upper Egypt Electricity Production Co.) and CEPC (Cairo Electricity Production Co.), respectively.

The work is scheduled for completion by April 2020.

Electricity demand by region and scenario (TWh)

				New Policies Scenario						Current Policies		450 Scenario	
	2000	2014	CAAGR 2000-2014	2020	2025	2030	2035	2040	CAAGR 2014-2040	2040	CAAGR 2014-2040	2040	CAAGR 2014-2040
OECD	8 600	9 561	0.8%	10 040	10 372	10 707	11 048	11 388	0.7%	12 412	1.0%	10 647	0.4%
Americas	4 298	4 729	0.7%	4 948	5 100	5 279	5 471	5 697	0.7%	6 212	1.1%	5 421	0.5%
United States	3 590	3 880	0.6%	4 027	4 109	4 211	4 317	4 452	0.5%	4 907	0.9%	4 388	0.5%
Europe	2 819	3 113	0.7%	3 316	3 424	3 510	3 605	3 673	0.6%	4 069	1.0%	3 516	0.5%
Asia Oceania	1 482	1 720	1.1%	1 776	1 848	1 918	1 973	2 018	0.6%	2 131	0.8%	1 709	0.0%
Japan	1 005	955	-0.4%	929	944	965	982	999	0.2%	1 045	0.3%	805	-0.7%
Non-OECD	4 599	10 996	6.4%	13 147	15 383	17 905	20 472	22 862	2.9%	24 625	3.1%	19 728	2.3%
E. Europe/Eurasia	1 104	1 404	1.7%	1 474	1 571	1 684	1 801	1 912	1.2%	2 014	1.4%	1 648	0.6%
Russia	677	864	1.8%	882	935	999	1 060	1 116	1.0%	1 171	1.2%	972	0.5%
Asia	2 129	7 115	9.0%	8 834	10 500	12 291	14 036	15 563	3.1%	17 073	3.4%	13 490	2.5%
China	1 174	4 982	10.9%	5 999	6 925	7 832	8 604	9 116	2.4%	10 254	2.8%	8 108	1.9%
India	376	954	6.9%	1 336	1 759	2 265	2 820	3 383	5.0%	3 579	5.2%	2 823	4.3%
Southeast Asia	322	756	6.3%	996	1 206	1 453	1 724	2 014	3.8%	2 129	4.1%	1 694	3.2%
Middle East	359	828	6.1%	984	1 153	1 390	1 631	1 844	3.1%	1 972	3.4%	1 509	2.3%
Africa	385	643	3.7%	762	921	1 142	1 428	1 783	4.0%	1 670	3.7%	1 511	3.3%
Latin America	622	1 006	3.5%	1 094	1 238	1 398	1 575	1 758	2.2%	1 895	2.5%	1 571	1.7%
Brazil	327	516	3.3%	555	620	694	778	864	2.0%	936	2.3%	797	1.7%
World	13 199	20 557	3.2%	23 186	25 755	28 612	31 521	34 250	2.0%	37 037	2.3%	30 374	1.5%
European Union	2 605	2 774	0.5%	2 929	2 997	3 038	3 087	3 112	0.4%	3 461	0.9%	3 023	0.3%

Notes: CAAGR = compound average annual growth rate. Electricity demand is defined as the total gross volume of electricity generated, less own use in the production of electricity, plus net trade (imports less exports), less transmission and distribution losses.

World Energy Outlook 2016, © IEA/OECD, Table 6.1, page 246

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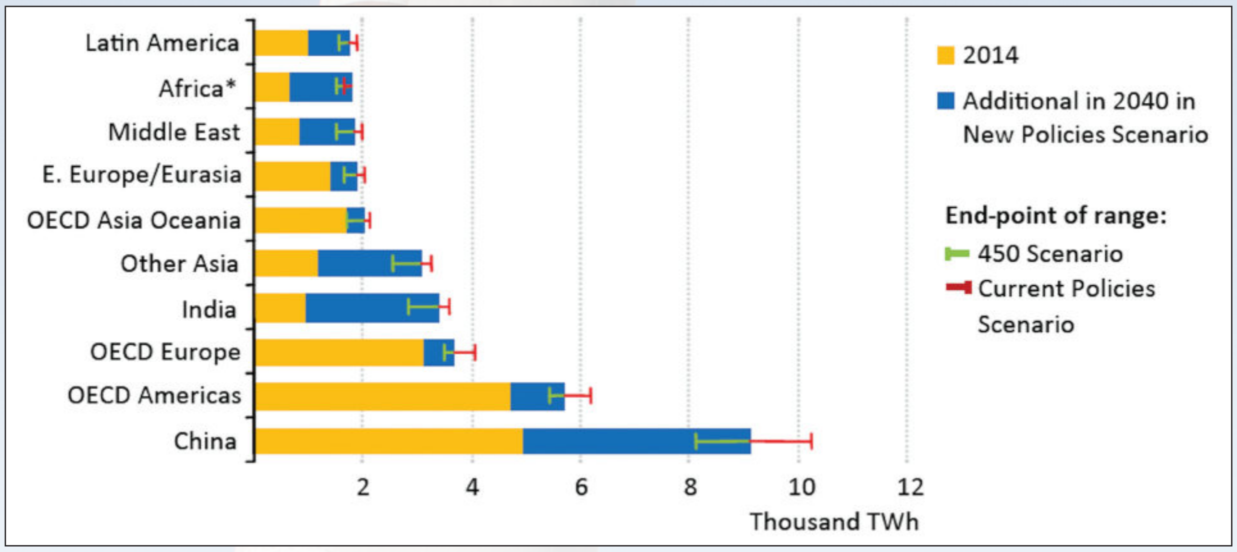
Global electricity generation by fuel and scenario



World Energy Outlook 2016, © IEA/OECD, Figure 6.3 , page 248

World electricity generation by source and scenario (TWh)

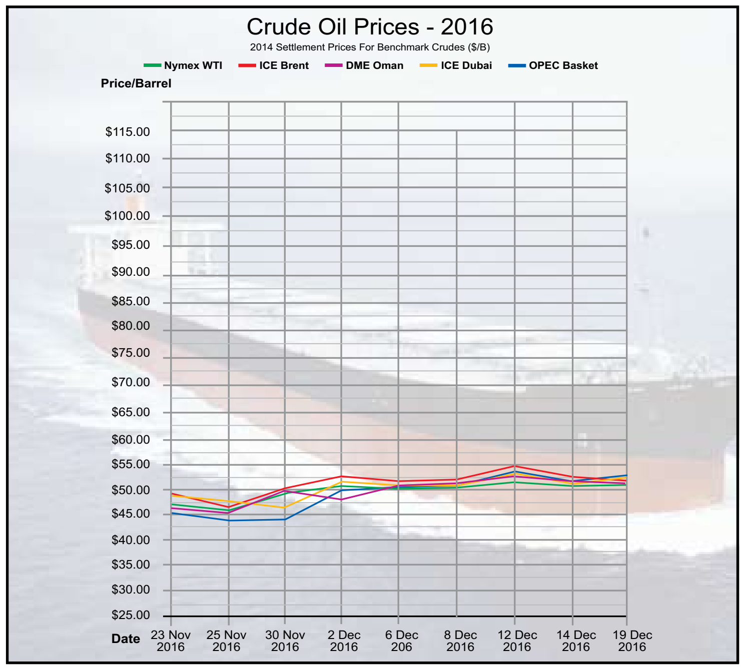
			New Policies		Current Policies		450 Scenario	
	2000	2014	2025	2040	2025	2040	2025	2040
Total	15 476	23 809	29 540	39 047	30 886	42 511	27 688	34 092
Fossil fuels	10 017	15 890	17 175	20 243	19 183	26 246	14 113	8 108
Coal	6 005	9 707	9 934	10 787	11 479	15 305	7 062	2 518
Gas	2 753	5 148	6 514	8 910	6 957	10 361	6 466	5 389
Oil	1 259	1 035	727	547	746	580	585	200
Nuclear	2 591	2 535	3 405	4 532	3 319	3 960	3 685	6 101
Hydro	2 619	3 894	4 887	6 230	4 817	5 984	4 994	6 891
Other renewables	250	1 489	4 074	8 041	3 567	6 320	4 896	12 992
Fossil fuels	65%	67%	58%	52%	62%	62%	51%	24%
Coal	39%	41%	34%	28%	37%	36%	26%	7%
Gas	18%	22%	22%	23%	23%	24%	23%	16%
Oil	8%	4%	2%	1%	2%	1%	2%	1%
Nuclear	17%	11%	12%	12%	11%	9%	13%	18%
Hydro	17%	16%	17%	16%	16%	14%	18%	20%
Other renewables	2%	6%	14%	21%	12%	15%	18%	38%

World Energy Outlook 2016, © IEA/OECD, Table 6.2, page 249

Source: World Energy Outlook 2016

Oil

Compliance issues linger despite Opec agreement



- Production cuts lift prices above $50/b mark
- Members may edge production up as prices increase

David Gregory

Opec's agreement at the end of November to cut production by 1.2 million b/d beginning on January 1 and aim for a total average production of 32.5 million b/d for the first six months of 2017 was reinforced in early December with an agreement by non-Opec producers to cut their output by some 600 000 b/d.

These announcements lifted prices over the $50/b mark, about half of what the price of oil was in mid-2014 when this – some might say fruitless – battle for market share began. By mid-December, Brent crude was sticking close to $55/b and market analysts were expecting the price to edge higher but most were questioning whether the Opec and non-Opec deal would last.

"Opec's agreement to cut production impressed the futures markets, which duly took flight, pushing the February 2017 Brent contract to $55/b," Leo Drollas, oil market analyst and former head of London's Centre for Global Energy Studies (now closed), told *TEI Times*. "The price bulls were also encouraged by the pledges of 11 non-Opec countries to reduce output by a further 558 000 b/d, led by Russia with a cut of 300 000 b/d."

"As usual with such Opec promises – and more so regarding the assurances of the non-Opec contingent – there is 'many a slip between cup and lip'," Drollas said. "Already Russia is talking about delivering cuts of 200 000 b/d by the end of the first quarter and Iraq does not appear to have got the Kurdish Regional Government (KRG) on board," he added.

Crude will have to see a sustained price of $55/b in 2017 in order for the oil industry to see a positive cash flow during the year, Angus Roger, Director of research for upstream oil and gas at Edinburgh-based Wood Mackenzie told *CNBC TV* in an interview.

"If we stay [at $55/b], the world's biggest oil companies start to make money again," Roger said. "If we go back down to $50/b [or lower] in 2017, then those companies are in the negative territory and they go back into survival mode where they have been in the last two years."

Roger said he expects Opec and non-Opec to comply with their planned removal of 1.8 million b/d from the market, but allowed some margin of error, adding that if compliance is 75 per cent, then oil should average a price of $57/b throughout 2017.

Compliance will be the question throughout this entire exercise. This is the first time since 2008 that Opec members have agreed to cut production, and even during the days of the quota system, there were always those members that would edge production up as prices got higher. Something to consider is Libya and Nigeria, two Opec members that were excluded from the agreement.

Developments in war-torn Libya have enabled it to boost output from 200 000 b/d to 600 000 b/d and its National Oil Corporation (NOC) hopes to push this to 900 000 b/d in the coming weeks. Nigeria is keen to push current output from 1.9 million b/d back to 2.2 million b/d as soon as possible. The 600 000 b/d that Libya and Nigeria would bring back on the market would erase Saudi Arabia's 486 000 b/d cutback.

There is an even bigger question around US shale oil, which some might say is the instigator of this mess. The higher the price of oil, the more likely US 'frackers' are to come back into production. US oil men have learned how to keep working during times of low prices.

"Costs in the shale plays have been cut by at least 30 per cent in the last few years and well break-even prices are now below $40/b in the Permian [West Texas], the Niobara [northeast Colorado, Nebraska and Wyoming] and the Eagle Ford [southcentral Texas] formations, and just above $30/b in North Dakota's Bakken," Drollas said, referencing Rystad Energy.

"The surge in futures prices has allowed the shale producers to lock in prices about $55/b from April 2017 onwards, enabling them to organise the necessary finance to boost drilling next year," he said.

"The emergence of shale oil was a game-changer," Drollas said, drawing upon years of studying the oil market. "It allowed the US to boost its crude oil production by 82 per cent within a decade and challenge the Saudis to a tug-of-war for market share. By letting go of the rope in Vienna, Saudi Arabia is yielding the initiative to shale oil, thereby encouraging its producers to undertake new bouts of investment. A few years hence – perhaps even sooner – Opec will be back in the same old bind, competing for demand barrels with a resurgent shale oil industry."

Gas

Several LNG hubs could ring Africa by 2020s

Gas from the Zohr field could see Egypt be an exporter by 2020, while exploration of the Tortue gas field will help East Africa LNG fulfill its promise of being an exporter by the mid-2020s.

Mark Goetz

Egyptian media reported in mid-December that the government will allow Eni to direct gas from the giant Zohr gas field to the idle LNG plant of Damietta on the Nile Delta coast. While there was little in the report regarding the details, just having that news in the public domain causes one to imagine that so much talk about Egypt establishing itself as an East Mediterranean gas hub may be more than just talk.

Until now it was understood that all of the 30 trillion cubic feet of natural gas discovered in the deep water Zohr field had been allocated to Egypt's domestic market, where demand is growing and will continue to do so. And Cairo has pressed Italy's Eni, which discovered the Mediterranean's largest gas field in August 2015, to deliver the gas as soon as it can. Eni now plans to bring 1 billion cubic feet per day (bcf/d) on-stream by the end of 2017, and to complete full development with production at 2.7 bcf/d by the end of 2019.

Egypt is genuinely working to get its energy act together. It is cutting subsidies that have crippled its economy, agreed to pay operators reasonable prices for the natural gas they deliver, and is looking to introduce renewables on a large scale. There are a number of gas exploration and development projects under way and the country stands a chance of meeting its own gas demands by 2020, as it plans to do.

Since 2015, Egypt has been importing LNG, by 2020, if the reports in Egyptian media are correct, Egypt could get back to being a gas exporter in the early 2020s.

Eni is a 50-50 partner in Union Fenosa Gas (UFG) with Spain's Gas Natural, and UFG holds 80 per cent of SEGAS, the company that owns and operates the 5 million tons/year LNG plant at Damietta. The plant shipped its first cargo in 2005 but has been idle since 2012 because Egypt was unable to supply gas to the facility due to it being re-directed for domestic demand.

The report mentioned 750 mcf/d allocated for Damietta, but it did not say when, yet it can be presumed that this will be after the full 2.7 bcf/d comes on-stream later this decade. There are also reports that talks continue to sell gas from Israel's Tamar gas field to Damietta. If these two deals connect, then Egypt would be back in the export business.

Separately, BP announced in mid-December that it had entered a deal with Dallas-based Kosmos Energy covering exploration and development of the Tortue gas field offshore Mauritania and Senegal. Discovered by Kosmos in April 2015, Tortue could hold up to 50 tcf of natural gas, and with a resource that size, a LNG project would be warranted. The 33 00 km^2 area could also contain more than 1 billion barrels of oil, BP said.

BP, which purchased 10 per cent of Egypt's Zohr field in late November, said it had acquired 62 per cent and operatorship of Kosmos' exploration blocks offshore Mauritania and 32.49 per cent of its block offshore Senegal. BP said it would invest nearly $1 billion towards exploration and development. The partners will process and transport gas from Tortue at a near-shore LNG facility.

Another African LNG hub in the making is East Africa, where gas discoveries offshore Tanzania and Mozambique will require billions of dollars of investment for partnered LNG plants in both countries. The region promises to be a major LNG exporter by the mid-2020s if local obstacles are overcome and gas markets improve.

Development of a two-train 10 million ton/year LNG plant is on the drawing board in Tanzania, but progress has been slow due to the lack of a legal framework for a hydrocarbon industry and acquisition of some 2000 ha of land for the facility. Statoil, Shell, ExxonMobil, Ophir Energy and Pavillion Energy will combine their investments for the $30 billion project to process the 50 tcf discovered in Tanzania's Indian Ocean blocks.

The gas discoveries offshore Mozambique are huge – up to 160 tcf – but the LNG projects planned for that country are being severely complicated by government debt stemming from financial mismanagement. Some progress was registered in early December when the government approved changes in the original contracts that will allow Anadarko and Eni to sell the government's share of LNG.

Anadarko and Eni have made huge gas discoveries in their respective Area 1 and Area 4 concessions in the Rovuma Basin. Eni is expected to soon make a final investment decision (FID) on an initial floating LNG project while Anadarko will make its FID on a land-based LNG plant some time next year.

Storage finds its feet

Energy storage technologies are finding their feet as costs continue to fall, but clarity over policy and regulation is required for the market to reach its potential. **Siân Crampsie**

In early 2016 energy firm AES commissioned two new utility-scale battery energy storage facilities in Europe. The two 10 MW arrays – at Vlissingen, Netherlands, and Kilroot, Northern Ireland – now provide valuable ancillary services to grid operators and are evidence of the value energy storage technologies can provide.

TenneT – the transmission system operator (TSO) in the Netherlands said that the Vlissingen array would be an "excellent alternative" to conventional power plants in providing balancing services. It competes weekly with traditional generators to provide balancing services to the Netherlands, Germany, Switzerland and Austria via the TenneT system.

The battery arrays in Vlissingen and Kilroot are based on AES' Advancion technology incorporating lithium ion batteries and provide the equivalent of 20 MW of flexible resource to the grid. They are a "smart, modern and low-cost solution to today's grid challenges", according to AES, while the UK's government has hailed the technology as "game-changing".

Energy storage capacity is increasingly being deployed on electricity grids – particularly in North America and Europe – because of a growing need for flexibility in the electricity generation system. Storage can provide back-up generation for renewables, enable arbitrage, as well as ancillary grid services such as grid congestion relief and frequency control. It will also become an integral part of smart grids. Growing levels of renewable generation on electricity grids, along with projected growth in electric vehicles, indicate that demand for energy storage will rise.

According to DNV GL, Germany now has 39 energy storage projects (excluding pumped hydro), 20 of which are lithium ion battery installations. Spain has 40, Italy 19 and the UK 18. There are some 360 energy storage projects in the USA, 132 of which are lithium ion battery projects.

McKinsey says that both 2014 and 2015 were record years for the installation of energy storage capacity in the USA. Around 220 MW of storage capacity was installed in the US in 2015, and the Energy Storage Association predicts the US energy storage market will reach 1.7 GW and be worth $2.5 billion by 2020.

According to Bloomberg, there is around 1 GW of energy storage operating globally, and its analysts expect 25 GW of storage to have been deployed over the next 12 years. As the rate of deployment increases, the cost of storage technologies will drop, further driving demand in key markets where policies enable deployment.

Research by McKinsey indicates that the costs of stationary energy storage are falling and could be $200/kWh in 2020, half today's price, and $160/kWh or less in 2025. Lithium ion battery storage technology has made the most progress in terms of development, deployment, and cost reduction, and accounted for more than 95 per cent of new energy storage deployments in 2015. Used widely in a range of power and energy applications – including electric vehicles – further rapid development of lithium ion technology is expected, and the technology is widely expected to become central to the energy storage market.

In markets that do provide regulatory support for energy storage, such as the PJM and California markets in the United States, uptake of storage capacity has been strong. However, most markets do not yet regulate specifically for energy storage capacity and there is a lack of clarity around issues such as grid access and network charges. Utilities, network companies and storage technology companies can therefore face considerable risk when deploying units.

Some governments are now starting to look at ways of supporting energy storage and other flexibility mechanisms. The European Commission is currently drawing up a roadmap for the development of energy storage, addressing regulatory issues as well as technical and economic barriers facing the energy market.

In the UK, regulator Ofgem, together with the government, recently launched a consultation on electricity system flexibility.

The consultation – due to end in January – aims to examine ways in which the electricity system can be made smarter and more flexible, and how new, innovative technologies can be deployed. It will focus on removing barriers to the deployment of energy storage and other demand response technologies, encouraging innovation, and assessing changes to roles and responsibilities in the energy system.

The document includes a call to network companies to streamline the process for connecting storage to the grid. This includes ensuring it can connect in areas where it can ease network congestion and benefit other connecting customers.

Research by McKinsey indicates that the costs of stationary energy storage are falling and could be $200/kWh in 2020, half today's price

It also hopes to promote closer collaboration between local grid operators and National Grid to work out the best solutions for managing a system with increasing amounts of low carbon generation.

"New demands on our energy system – for instance from electric vehicles and the need to manage renewable energy sources – mean that these enhanced capabilities aren't just advantageous, but essential," said Greg Clark, Secretary of State for Business, Energy and Industrial Strategy. "And, as well as meeting new challenges, we must seize the opportunities enabled by a smart system – including active demand-side response to price incentives, and the use of advanced energy storage technology.

"The age of exclusive control by big energy companies and central government is over; we must maximise the ability of consumers to play an active role in managing their energy needs."

The UK's consultation follows on from a tender held by National Grid in mid-2016 calling for 200 MW of enhanced frequency response (EFR) capacity.

In the tender, National Grid received bids from 37 providers, and just eight winners were selected. The majority of the bids were for battery assets, and four-year contracts were awarded to firms including E.On, Belectric, RES, Element Power and Low Carbon, among others.

Cordi O'Hara, director of UK System Operator, National Grid said: "We are constantly looking to the future to understand how we can make the most of the energy available to us. This project is at the very core of our Power Responsive work, to balance the grid by the most efficient means possible, saving money and energy.

"These awards show that we can work with industry to bring forward new technology and I believe storage has much to contribute to the flexible energy system of tomorrow. This is the beginning of an exciting new chapter for the industry."

The EFR tender was developed to bring forward new technologies to provide sub-second response solutions to system volatility, improving on the previous fastest frequency response which could be delivered in under ten seconds.

This enhanced ability to control variations in frequency is expected to result in reduced costs of approximately £200 million, according to National Grid.

And battery technologies also won in the UK's most recent capacity market auction, in which more than 52 GW of capacity was awarded contracts for securing electricity supplies in the 2020/21 period.

In the December 2016 auction, energy storage projects secured a total of 3.2 GW of contracts. Some 500 MW of this was for new-build battery projects, including four projects that also secured contracts under the EFR tender, and a number of projects that were unsuccessful in the EFR tender.

Key projects moving forward under these contracts include Centrica's 48 MW Roosecote proposal, Low Carbon's 10 MW Cleator and 40 MW Glassenbury plants, EDF Energy Renewables' 49 MW West Burton site and E.On's 10 MW Blackburn Meadows project.

These recent developments in the UK make it one of the most promising markets for energy storage, according to Vinci Energies.

"Energy storage offers a multitude of opportunities for the UK, provided the challenges can be worked out," said Chris Hutchinson, Director, VINCI Energies and Managing Director, Actemium UK. "The key to all of this will be visionary leadership that creates the right frameworks. This in turn will enable businesses to deliver innovative solutions, as part of a strategic transformation, in electricity, heat and industry grids."

According to Vinci, the economic value of energy storage is dictated by the location of instability in the grid. In the UK, and other markets, that currently tends to lie centrally at the transmission levels, where energy storage can provide ancillary services such as frequency control, as well as help with renewable energy integration.

In the longer term, however, the market for these services is limited, says Vinci Energies' Director Simon Innis. "Our view is that the future of storage in the UK lies not in its capacity value, but in its energy value, where it can help the market to manage the costs of producing and delivering energy," said Innis. Key applications will include those behind the meter at industrial and commercial installations, where storage can enhance energy efficiency and support micro-grids and small-scale PV or CHP installations.

According to Innis, one of the key characteristics of the UK's market is volatility, a factor that will help drive demand for energy storage as self-generators will be able to use storage to arbitrage against price swings. "The UK is in a prime position to take advantage of this because of the characteristics of the market," said Innis. "However we need more certainty around policy and regulation."

AES' Advancion technology uses lithium ion batteries

The ADMS provides a visual of the distribution network and automates fault location

Getting smart about network management

The challenges posed by distributed generation, load growth and an aging grid are immense but intelligent networks have the power to transform how energy is distributed and consumed.

Junior Isles

According to a recent report by Zion Research, the smart grid market was valued at approximately $40 billion in 2014 and is expected to reach around $120 billion in 2020.

One of the key drivers behind such strong growth is the drive towards higher reliability, efficiency and safety of transmission and distribution networks, with distribution automation being one of the largest technological segments, accounting for a significant share of the total revenue generated.

The report titled 'Smart Grid (Advanced Metering Infrastructure, Distribution Automation, Software & Hardware, Communication Technologies, Transmission Upgrades and Cyber Security) Market: Global Industry Perspective, Comprehensive Analysis, and Forecast, 2014-2020' notes that in 2014 Asia Pacific dominated the smart grid market. The region accounted for around a 30 per cent share of the total revenue generated, followed by North America. Europe, Latin America, and the Middle East & Africa are noted as other important regional markets and are expected to exhibit significant growth in the years to come.

In Europe, the rapid rise of wind and solar has been a key driver and the UK has been among the frontrunners in modernising its networks. Like most countries in Europe, a smarter grid is vital to putting the UK on track to meet the European objective of becoming a low-carbon economy by 2050, as well as allowing distribution network operators (DNOs) to meet the goals outlined by UK regulator, Ofgem, in its new eight year Price Control Period (RIIO-ED1).

With an increasing amount of distributed generation of energy, the growth of renewables, an upward trajectory in peak demand and an aging grid, the UK requires a revolution in energy infrastructure.

As more distributed energy sources (such as solar, wind, combined heat and power and electric vehicles) are introduced to the grid, and as the load becomes more dynamic and difficult to predict, the DNOs need high levels of asset automation to drive operational efficiency and resilience.

Already there are a handful of projects under way in the UK that will help DNOs address the challenge.

Barrie Cressey, Smart Grid Director at Schneider Electric said: "The challenges posed by distributed generation, load growth and an aging grid are immense, but intelligent networks have the power to transform energy throughout the country."

In June 2015, Schneider Electric won a contract to deliver a new Distribution Management System (DMS) for Electricity North West (ENW) that will help create a more efficient, more intelligent energy network in the northwest. ENW operates and maintains the North West's electricity distribution network, connecting 2.4 million properties, and more than 5 million people in the region, to the National Grid.

DNOs like ENW have a large number of assets distributed over a wide geographical area. Managing those assets and knowing what is happening in real-time is quite a task. Predicting what will happen as conditions change through the day is a huge benefit to DNOs. While DNOs already have systems to support network management, the changing energy landscape, largely driven by the injection of renewables and other distributed generating sources is driving the need for more sophisticated tools.

Cressey noted: "Today power flows can be in two directions. Networks are much more dynamic and the complexity of a distribution network over a large geographic area makes it really complicated to understand what's going on at any point in time. So you need computer systems to look after it for you."

A key driver for all operators is performance. In the UK, DNOs are measured by Ofgem according to customer satisfaction and by the number of hours lost and frequency of faults on the network. "They are penalised or rewarded, depending on where they are in the league table of operators," noted Cressey.

The DMS for ENW is a suite of applications designed to monitor and control the entire network. It will control energy distribution, intelligently identify and self-heal outages, as well as gather and integrate grid and external data to improve efficiency of the network. The software sits on servers, which are located in ENW data centres in multiple locations for resilience.

The system will support decisions made by control room and field personnel as well as use algorithms to automate system management and respond to changes in the network. For example, following network incidents such as storm damage or asset maintenance, the system will be able to reconfigure around faults to ensure as many customers as possible remain connected to the grid.

Schneider's Advanced Distribution Management System (ADMS) has a layer within it that communicates with the field devices such as sensors attached to equipment like transformers and switchgear. Data gathered from these devices is stored in a database and the ADMS uses the data to calculate what is happening on the network in real-time.

This allows the DNO to manage voltage levels around the network in the most effective and optimised way. Also, if there is a fault, it will show them where it is using fault location, isolation and service restoration.

This is especially useful in the UK where there is very little monitoring on the low-voltage (240 V to 11 kV) distribution network. Quite often, the first time a DNO is aware of a problem is when a customer calls in.

Cressey commented: "One of the difficulties that operators have had in the past is actually knowing where the fault is. They may get calls from people saying 'my lights have gone out' but finding what had caused it was a very manual process. Using modelling, the new system can work out where the fault is very quickly and automatically reconfigure the network to get as many people back as soon as possible or advise the operator of the actions they might want to take."

The system, in fact, looks for faults before they occur by monitoring certain network parameters. It can reroute electricity around what it deems to be stressed points, while alerting operators of the potential failure.

ENW's three-year project is now at the end of its second year. Following its conclusion at the end of 2017, there will be a six-year support programme. The medium voltage network (33 kV to 132 kV) has already been implemented and the low voltage) network data is being migrated on to it during this final year.

The fact that similar systems have been implemented in the US, Asia, the Middle East and other countries in Europe demonstrates that, as DNOs recognise the benefits, there is a growing call for such technology.

For example, Schneider has implemented a large system in Italy for Enel. With 32 million customers and 40 per cent of renewables on the network, the ADMS allows Enel to integrate green energy sources into the system and have better visibility of its electrical network.

Enel used the ADMS to provide a visual, mathematical model of its distribution network, including detailed models for voltage management, distributed generation, frequency control, demand response, and other smart grid management data. According to Enel it has helped reduce energy losses to about 144 GWh/year, while CO_2 emissions have been cut by 75 000t/y.

Such impressive results will no doubt ensure that networks will continue to become more intelligent and the market for related products will continue to grow strongly in the coming years.

Cressey says there is a growing need for computers to manage distribution networks as they become more complex

Pioneering enzyme process improves waste recycling

Artist's impression of the Northwich plant

DONG Energy's patented technology REnescience is a ground-breaking way to generate value from waste

DONG Energy is building the world's first commercial full-scale waste-to-energy bio plant in Northwich, UK. The plant will use enzyme treatment to convert household, municipal and some commercial waste into biogas, as well as recyclable plastics and metals.

Thomas Dalsgaard

Although recycling performance has improved in recent years, tens of thousands of tonnes of waste are still sent to landfills every year. There is a pressing need for effective and efficient waste treatment facilities that can recover valuable materials and energy from waste. To reduce the costs for local authorities at a time when budgets are under pressure, there is a need to manage waste efficiently.

While many recognise DONG Energy's leading role in the British offshore wind sector, supplying increasing amounts of renewable energy to the UK while simultaneously bringing down the overall cost of offshore wind technology, waste management technology is also now a key focus.

Last year witnessed a significant landmark as DONG Energy took the first steps towards entering the UK's waste and resources market. It is an important milestone for the business, but it also occurs at an exciting time for the sector as new recycling and resource recovery technologies emerge with the potential to revolutionise the UK's waste landscape and putting it on a greener footing.

DONG Energy is taking its place in this movement towards better, cleaner waste management by building the world's first commercial full-scale bio plant in Northwich. The plant secured planning approval from Cheshire West and Chester Council's planning committee in February 2016 and construction is now well under way.

The facility will accept household, municipal and some commercial waste from surrounding areas in the North West and North Midlands, which – through enzyme treatment – will be converted into biogas, as well as recyclable plastics and metals.

DONG Energy will finance, construct and operate the plant, which is due to be operational in 2017. Around 150 workers will be engaged during the peak phase of construction, with an average of 75 at any given time. The plant will also require around 24 full-time local employees to operate it once finished.

The pioneering new technology that will be used at the plant is called REnescience. It is safe and reliable, and has been proven since 2009 at a demonstration plant in Copenhagen. Significantly, it does not involve incineration, pyrolysis, gasification or advanced thermal treatment.

The REnescience process takes place at a low temperature, at ambient pressure (meaning that the processing vessels are not pressurised) and is safe and gentle. Anaerobic digestion is also a well-proven technology operating at hundreds of sites in England, from farms to food processing facilities as well as other waste treatment facilities.

When compared to most traditional waste treatment processes, REnescience is capable of a higher capture rate of organic materials and can help to achieve higher recycling rates.

REnescience also increases recycling rates from the remaining solid materials, reducing the overall need for other treatment and disposal methods. Most importantly, depending on the composition of the waste (which can vary over the year), it almost completely eliminates the amount of waste that eventually goes to landfill.

The new facility will be able to receive 120 000 tonnes of waste every year, roughly equivalent to the waste produced by 110 000 UK households. Waste will be supplied by FCC Environment, which already collects household rubbish in the region.

While there are various local and central government initiatives to encourage more recycling, there is still an immediate medium-term problem that needs to be addressed as household recycling rates in England are currently at just under 45 per cent, with tens of thousands of tonnes of waste still being sent to landfills annually. There is a pressing need for effective, efficient and green waste treatment facilities that can recover valuable materials and generate clean energy.

At first, when the residual waste is brought to the Northwich plant it is treated with enzymes and warm water so that a greater volume of the recyclable material and other resources can be extracted. This process occurs without any up-front waste shredding or crushing, because the enzymatic process targets the organic material effectively, even in mixed, unsorted waste. This helps to avoid most of the dust, odour, noise and pollution issues that can occur when waste is shredded.

The process sees enzymes mixed together with warm water and waste inside a sealed vessel, where they are able to interact with and break down all of the organic matter. This allows for the organic or biodegradable material (food, paper, card, etc.) to be efficiently extracted from the other waste, concentrating it into a bioliquid. This means that no separate shredding or incinerating is required at the plant.

Through this process, cleaned metals and some other solid plastics are recovered separately for recycling, together with another stream of clean, solid recovered fuel for onward use elsewhere. In addition to these items, inert materials such as sand, gravel and glass, are recovered for reuse as aggregates. These processes are all carried out inside the one building.

Once this separation process is complete, the separated organic material is recovered as a thin bio-liquid, which is digested by bacteria within a sealed anaerobic digestion vessel to produce biogas. The biogas, which is captured, can then be used to fuel gas engines on site, generating renewable energy and heat.

Between 5 and 6 MW of electricity will be produced by these gas engines via their individual electrical generators. Ensuring that the facility is as sustainable as possible, a small amount of this energy will be used to power the operations itself. This will leave around 5 MW, enough to power around 9500 households, to flow into the national electricity grid for use by consumers and industrial users.

Producing the same amount of electricity in a modern gas-fired power station, for example, would release 15 000 tonnes of carbon dioxide equivalent (CO_2e) per year, a statistic which demonstrates the project's importance in the UK's shift to a low-carbon economy.

Heat from the gas engines will also be utilised on-site to maintain the required temperature for the REnescience bioreactors and to heat the buildings when needed. This makes the facility more energy efficient.

The refuse derived fuel (RDF) from the Northwich plant will have a high calorific value, making it suitable for use elsewhere in energy recovery plants or cement kilns, which need high temperatures to operate. Meanwhile, the digestate, a compost-like output left over after the anaerobic digestion phase, can be used for land restoration.

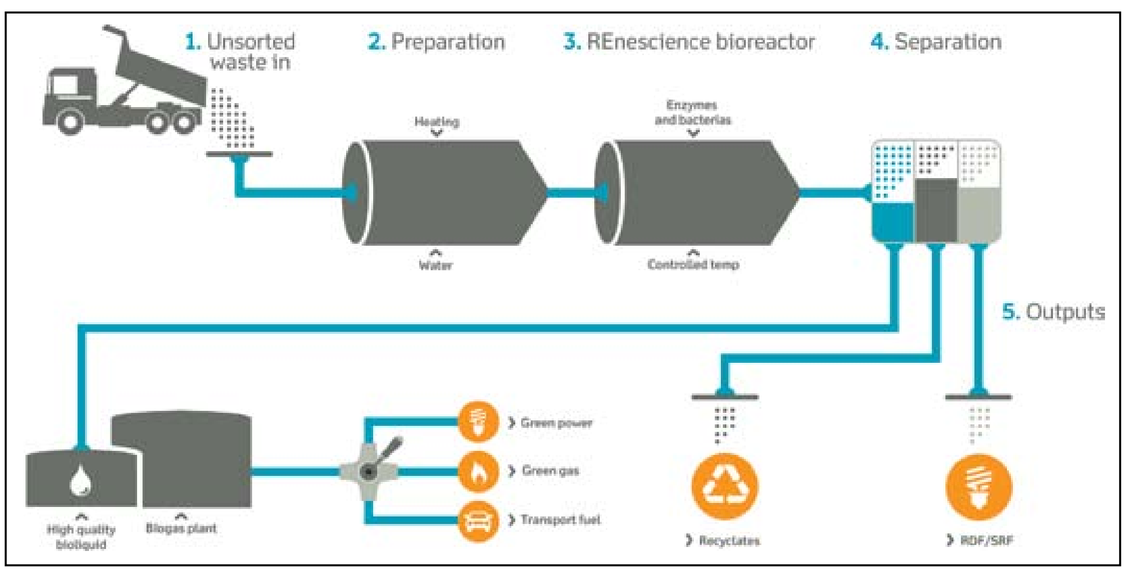
The facility is carefully designed to control any odours. Waste will be delivered in enclosed vehicles, unloading into a waste bunker that is fully enclosed inside the building. Since the REnescience process removes the biodegradable material, which is the component that can make waste smell, the final output has a low potential for odour.

However, the air in the waste treatment building will be extracted so that fresh air from outside is continuously and gently sucked into the building, ensuring that potentially odorous air will be cleaned through an odour control system before being released.

REnescience breaks with today's practice of waste disposal and collection by centralising the sorting of the waste and doing so in a more environmentally friendly way. This project is yet another example of complex, high-tech, green engineering at its best, once again the UK's firm commitment to renewable energy.

Thomas Dalsgaard is Executive Vice President, DONG Energy.

REnescience process diagram



Junior Isles

Can't see the forest for the trees

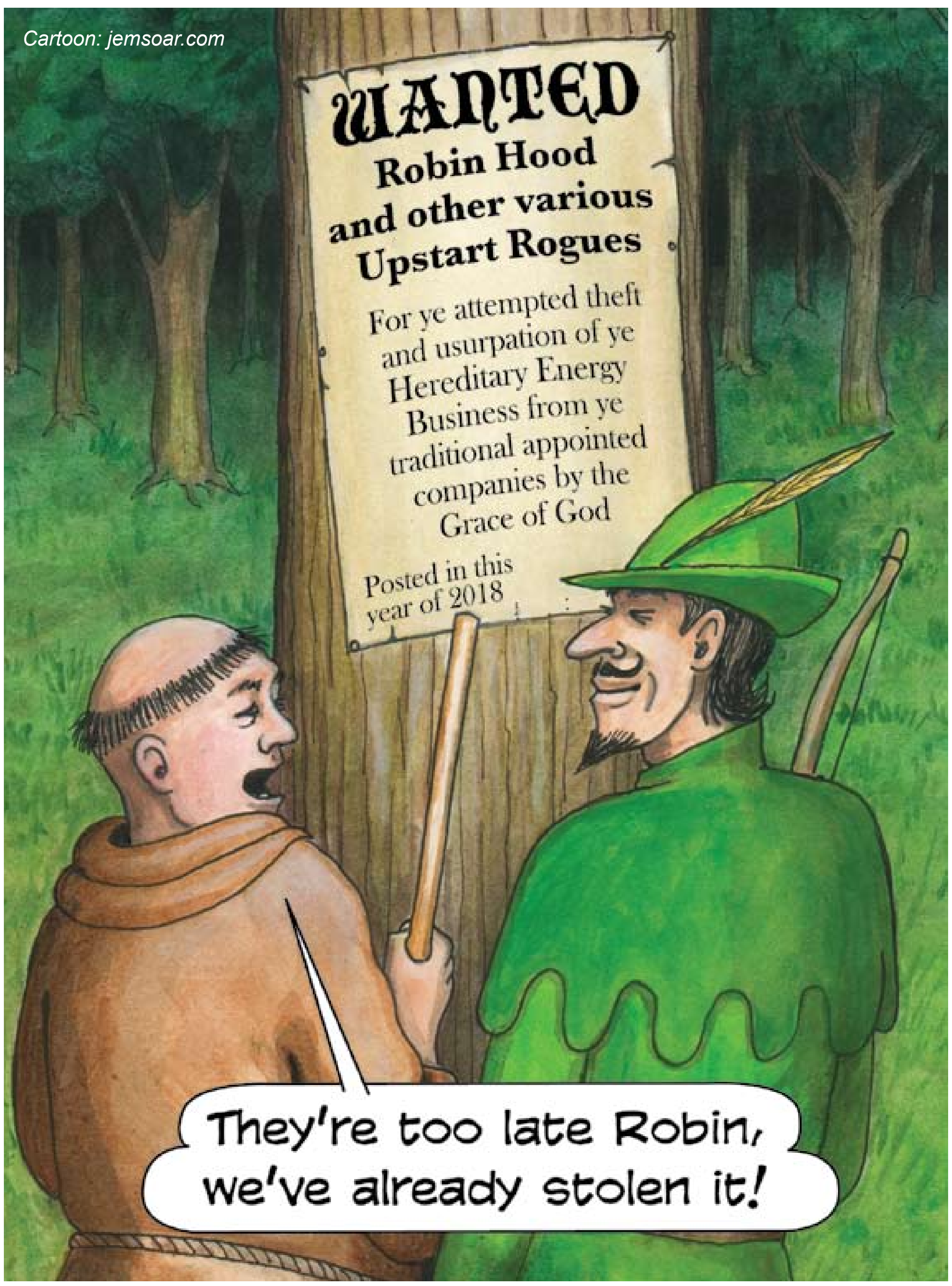
Few will forget 2016. The world of pop music lost David Bowie and Prince (to name but two) and the outpouring of grief following the death of the sporting legend that was Muhammad Ali was felt around the globe. It was also the year of political shocks. The British public voted to leave the EU and to top it all, billionaire businessman Donald Trump won the US presidential election.

It was indeed a year of endings, one that for many marked an unnerving departure from the world of business as usual. In the energy industry, the sun is setting on the days when all a power company did was build power stations, deliver electricity to your home and send the bill. One colleague once described the utility business as "a licence to print money". Those days seem to be long gone, or are at least fast becoming a distant memory.

Faced with exponential growth in renewables and the subsequent birth of new business models such as community energy schemes, energy companies worldwide will need to transform. Europe will be first, where utilities are struggling to turn a profit in the face of a changing energy landscape and slowing demand. Following a turbulent 2016, the pressure is on to accelerate that transformation in 2017.

Assessing the potential big news for the coming year, Perry Stoneman, Global Head of Sectors & Utilities Global Sector Leader at Capgemini said: "I think we could see the failure of a large utility because of the changing market dynamics – something that was never foreseen, even [just] three or four years ago – which will have ripple effects across the entire industry."

While no one hopes this will happen, it would certainly be a message for change – one that board members and directors ignore at their peril.



Cartoon: jemsoar.com

Until recent years, energy companies have either been simply complacent or perhaps too short-sighted to see the forest for the trees. Unseen competitors have been emerging from the woodwork to blindside traditional energy companies by utilising disruptive, innovative business models that take advantage of a market in transition.

The legend of Robin Hood is well known. With the help of his band of 'Merry Men' of Sherwood Forest, the heroic outlaw robbed from the rich and gave to the poor. Based in Nottingham, England, and inspired by his ideals, in September 2015 Nottingham City Council launched Robin Hood Energy (RHE) in an effort to help alleviate energy poverty. As a not-for-profit electricity supplier, RHE says it is able to offer the best possible tariff for electricity at all times, with transparent pricing.

Stoneman commented: "The fact they say they are not-for-profit builds trust." Trust has been a big issue for the UK's 'Big Six' energy companies. Stoneman added: "If you sign up for Robin Hood Energy, it's probably because you want transparency, trust and a lower price. It will probably be very difficult for the Big Six or Big Eight in the UK to come in and take this customer back."

This move by local communities and individuals to literally take power back into their own hands is not limited to the UK.

In November 2015 Sonnen, a German solar-energy-storage maker, created the SonnenCommunity, which allows peer-to-peer selling of electricity. Members pay Sonnen a monthly subscription charge (membership fee) to use a sonnenBatterie and solar PV to meet their own energy needs and feed into a 'virtual energy pool' that serves other members. This disruptive community, which bypasses the traditional utility, is thriving.

"In one year, they offered up over 14.7 million kWh, more than half of which was purchased. That says this is a successful business model in my books and it creates a stickiness around people that buy into this technology. Not only do they feel good about being able use solar electricity, but also about being part of a community that allows them to monetize their excess capacity," said Stoneman.

A different model is also seeing success in New Zealand. Although not a community energy scheme, Flick Energy has a similar goal to RHE, except it is for profit. According to Stoneman, Flick Energy is putting forward "honest prices" by offering customers with smart meters access to the wholesale price of electricity direct from the spot market. This, it believes, will make the retail prices it offers cheaper than the average.

Although slow to react, some utilities have been looking to defend their customer base by trying to move into the businesses that have disrupted them.

Dutch utility Eneco has developed a smart home solution called Toon to create a daily customer interaction, which it hopes will result in increased customer satisfaction and therefore better customer retention.

In April last year E.On, which has also been looking at how to take costs out of its operations, launched Aura for its German residential electricity customers. This is an "all-in-one" system comprised of solar, energy storage, energy management app and a tailored electricity tariff.

The approach is similar to the telecoms industry. "Even if they lost that customer to their traditional business model, they haven't lost that customer to their business," noted Stoneman.

French multi-national utility Engie, meanwhile, has taken a different approach by acquiring a company that has developed a disruptive business model. It has taken an 80 per cent stake in Green Charge Networks, which installs batteries and software to help industrial and commercial sites reduce their peak energy demand.

While the traditional energy companies are taking steps into these new models, a Capgemini survey found that 80 per cent of the companies implementing these models are start-ups. Stoneman commented that this shows "the utility industry probably needs to move a heck of a lot quicker… and embrace technology breakthroughs and disruptive business models".

Even if the traditional energy companies are as yet undecided as to which way to go, there are things they should be doing anyway.

They should maximise the use of analytics on existing operations as networks become smarter. Stan March, Senior Vice President of Corporate Communications at Landis+Gyr commented: "Utilities are exploring different options to respond to the demands placed on them. These [options] include implementing more built-in intelligence into their grids and introducing new network and grid distribution management capabilities, meter functionalities and data and analytics tools... The technology to collect, analyse and use data with unprecedented results is real. Advanced systems can now deliver remarkable control, with greater efficiency, better insights and a more conscious use of resources."

This was echoed by Stoneman, who added that the incumbents should also be exploiting digital channels to communicate with customers. "This can be a two-way type of weapon," he said. "You can push offers and direct customers to new services. Whereas a call operation tends to be one-way, a digital conversation encourages people to explore and wander a bit more."

But Stoneman was certain of one thing. He stressed: "100 per cent of the incumbents need to introduce new services and new offerings. We just haven't seen evidence of that happening yet. What they need to do is decide what they want to do – step out quickly and announce what their offering will be.

"... They need to make these announcements in 2017 – pick the one you want to attack because it's your biggest threat, and get out there and announce it. They know they have to do something and my advice to them is to do it fast."

Acknowledging the need and making changes can be a daunting challenge but fortune favours the brave. The route through the forest might not be clear but the threat is real. Lying asleep like a slumbering giant while the Robin Hoods of the energy forest creep up on you is not an option.