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The perfect storm for M&A

The rise of renewables, aided by artificial intelligence and big data to improve forecasting, is creating a perfect storm for mergers and acquisitions. ***Page 13***

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Technology: Changing the diesel game
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World gets hotter as tempers flare at COP23

Global carbon emissions are once again on the rise as the international community rallies around the Paris climate accord. But in the face of growing resentment at climate change talks in Bonn, the US said it is sticking to its decision to exit the agreement. **Junior Isles**

US President Donald Trump's planned withdrawal from the Paris Agreement will push up global temperatures nearly half a degree Celsius by 2100, according to a report released at UN climate talks in Bonn.

Current data from research group Climate Action Tracker (CAT) predicts global temperature will be 3.2°C above pre-industrial levels – well above the target agreed in Paris – by the end of the century. The Paris pact, adopted in 2015, calls for capping the rise at "well below" 2°C, and even 1.5°C if possible, to avoid irreversible climate change.

CAT had previously calculated that if all countries – including the US – honour carbon-cutting pledges under the 196-nation treaty, the world would see 2.8°C of global warming.

Commenting on the revised figure, CAT said in a statement: "This is largely due to the fact that the United States is walking away from its 2030 target, and long-term 2050 goals."

In June, President Trump announced his administration's intention to withdraw from the Paris Agreement, throwing into doubt its role at UN climate talks and related bodies like the Green Climate Fund. The Bonn meeting was the first set of climate negotiations since the announcement.

Although the US is now the only UN member not part of the Paris accord, there was no sign that President Trump or his advisers were rethinking their demands that the agreement be changed significantly to prevent a Washington exit.

In a closing statement at the meeting, Judith Garber, an acting assistant secretary of state, told the forum that the administration remains open to rejoining the Paris agreement "under terms more favourable to the American people".

In a panel discussion held at the conference, White House climate adviser George David Banks extolled the virtues of coal fired power generation to ensure "universal access" to electricity and security of supply.

"We believe there is a rational way forward that does not force countries to choose between mitigation, development and energy security," Banks said during the event.

His remarks sparked a protest by over 100 climate activists, who interrupted the discussion before walking out.

"Promoting coal at a climate summit is like promoting tobacco at a cancer summit," said Michael Bloomberg, the former New York mayor.

Continued on Page 2

Reformed ETS demonstrates Paris commitment, says European Commission

The European Union's decision to overhaul Europe's carbon market after 2021, is being hailed as a key step toward meeting its pledges to cut greenhouse gases under the Paris climate agreement.

The deal between EU member states and the European Parliament includes measures to reduce the surplus of permits that has caused the EU's carbon price to fall by almost 70 per cent over the past nine years.

The EU Parliament also wanted to block aid to coal-fired power plants but this was resisted by Poland and other central European countries that still rely heavily on coal for electricity. A compromise was reached under which no funds would go to coal plants with the exception of district heating projects in countries with per capita gross domestic product more than 30 per cent below the EU average.

The deal still needs to be formally ratified by the EU parliament and member states but officials are confident this will happen.

The EU's Climate and Energy Commissioner, Miguel Arias Cañete, said in a statement that the "landmark deal demonstrates that the European Union is turning its Paris commitment and ambition into concrete action".

MEP Julie Girling, who led parliament in negotiations, said the agreement sent "an important signal" about the integrity of the trading scheme and gave "certainty" to stakeholders.

Eurelectric, the organisation representing Europe's electric utilities welcomed the agreement. "Investors across Europe have received the much needed legal clarity that will enable them to take better informed decisions on low-carbon investments," said Eurelectric Secretary General, Kristian Ruby.

The agreement to revise the ETS was followed weeks later by a positive vote by the European Parliament's industry and energy committee (ITRE) to increase efficiency and renewable energy targets.

MEPs supported a 40 per cent efficiency goal and national targets for 2030. Both targets will be legally binding.

The vote on the energy efficiency directive was preceded by a vote on the renewable energy directive, where MEPs supported increasing the Commission's proposed 27 per cent target to 35 per cent without imposing binding national targets.

In a separate development designed to further accelerate EU deployment of renewables, SolarPower Europe and WindEurope, RE100 and WBCSD established the RE-Source Platform. It is the first and only multi-stakeholder platform in Europe bringing together the interests of both renewable energy buyers and sellers. The RE-Source platform will pool resources and coordinate activities to promote a better policy framework for renewable energy sourcing, at EU and national level.

■ Luxembourg and Lithuania have signed a statistical transfer agreement that will see the Baltic country transmit renewable electricity to Luxembourg so as to help it achieve its 2020 national renewable energy goal. The pact, the first of its kind between two EU member states, was officially announced by the EC.

Under its terms, Lithuania will transfer 700 GWh, or more if needed, of renewable energy generation to Luxembourg between 2018 and 2020 as the Baltic nation has already reached its 23 per cent target under the EU Renewable Energy Directive set for 2020. In 2015, the renewables share of its total energy consumption was 25.75 per cent.

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Bloomberg, now a UN special envoy for climate change said, however, the group of American cities, states, and businesses who remain committed to the Paris Agreement "represents a bigger economy than any nation outside the US and China".

"Together they are helping deliver on the promise of the agreement and ensuring the US remains a global leader in the fight against climate change", he added.

During the conference, America's Pledge presented the official report on US climate action, analysing how US states, cities, businesses, citizens, and universities can support the Paris Agreement even without federal action.

The report constitutes the first communication of the initiative to the international community addressing the scope and scale of non-federal climate action in the US following the "We Are Still In" declaration, with more than 2300 signatories to date.

The America's Pledge report said that backing the Paris Agreement meant rallying around a target set by former President Barack Obama to cut US emissions by between 26 and 28 per cent below 2005 levels by 2025.

It also said 20 US states, 110 US cities and more than 1400 businesses with US operations representing $25 trillion in market capitalisation had already set quantified targets to cut emissions. Together they accounted for 900 million tonnes of greenhouse gases per year, it said. And US net greenhouse gas emissions have dropped by 11.5 per cent in the past decade, while the economy grew by 15 per cent, it added.

The international community also rallied behind the Paris Agreement with the launch of the Powering Past Coal alliance.

The alliance launched by the UK and Canada to lead the rest of the world in committing to an end to the use of unabated coal power, also includes Angola, Austria, Belgium, Costa Rica, Denmark, El Salvador, Fiji, Finland, France, Italy, Luxembourg, the Marshall Islands, Mexico, the Netherlands, New Zealand, Niue, Portugal and Switzerland. The US states of Washington and Oregon, as well as five Canadian provinces have also signed up.

Notably, however, the alliance does not include Germany or Turkey. The European Climate Leadership Report 2017, Measuring the Metrics that Matter published at the COP23 shows that Germany, UK, Turkey and France together account for 50 per cent of all GHG emissions on the European continent.

Talks at COP23 took place as the latest data on global carbon emissions was published. After three years of flat growth, a series of reports from the Global Carbon Project, a group chaired by Stanford University scientist Rob Jackson, showed that global fossil fuel emissions are rising again. Atmospheric carbon dioxide concentration reached 403 parts per million in 2016, and is expected to increase by 2.5 parts per million in 2017.

Jackson revealed fossil fuel emissions are rising

Global energy system "being reshaped", says IEA

The International Energy Agency (IEA) has said four major forces will reshape the global energy system over the next two decades.

In its recently launched flagship publication, 'World Energy Outlook 2017' (*WEO 2017*), the Paris-based organisation finds: renewables are being deployed rapidly thanks to falling costs; the share of electricity in the energy mix is growing; and China's new economic strategy takes it on a cleaner growth mode, with implications for global energy markets; the United States is set to become the undisputed global oil and gas leader.

According to the IEA, solar PV is set to lead capacity additions, driven by deployment in China and India. In the European Union, wind becomes the leading source of electricity soon after 2030. The report states that, based on existing policies, renewables could make up two-fifths of power generation by 2040.

Dr Fatih Birol, the IEA's Executive Director commented: "Solar is forging ahead in global power markets as it becomes the cheapest source of electricity generation in many places, including China and India."

The report notes, however, that while carbon emissions have flattened in recent years, global energy-related CO_2 emissions increase slightly by 2040, but at a slower pace than in last year's projections. Still, this is far from enough to avoid severe impacts of climate change.

This year, *WEO 2017* includes a special focus on China, where ongoing economic and energy policy changes will have a profound impact on the country's energy mix, and continue to shape global trends. A new phase in China's development results in an economy that is less reliant on heavy industry and coal.

At the same time, a strong emphasis on cleaner energy technologies, in large part to address poor air quality, is catapulting China to a position as a world leader in wind, solar, nuclear and electric vehicles and the source of more than a quarter of projected growth in natural gas consumption. As demand growth in China slows, other countries continue to push overall global demand higher – with India accounting for almost one-third of the global growth to 2040, states the *Outlook*.

Meanwhile, the shale oil and gas revolution in the US continues, thanks to the ability of producers to unlock new resources in a cost-effective way. By the mid-2020s, the nation is projected to become the world's largest LNG exporter and a net oil exporter by the end of that decade.

These themes – as well as the future role of oil and gas in the energy mix, how clean energy technologies are being deployed, and the need for more investment in carbon capture utilisation and storage (CCUS) – were among the key topics discussed by the world's energy leaders at the IEA's 2017 Ministerial Meeting in Paris in early November.

The theme of the two-day meeting was 'Bolstering energy security for sustainable energy growth'. It provided an opportunity for governments and industry to discuss major energy issues, including how to create the right conditions for energy investments and building a framework for 21st-century energy markets, stimulating energy and technology innovation, and examining the transformative potential of digital technologies on energy systems.

The IEA also hosted a high-level CCUS Summit, co-chaired by Rick Perry, the US Secretary of Energy, and Dr Birol. The event brought together energy ministers, government officials and chief executives of major energy companies to support a renewed push for investment in CCUS, a critical technology to tackle greenhouse gas emissions and meet global climate targets.

Digitalisation set to become $64 billion market by 2025

■ Smart meters biggest driver ■ IoT increases cyber threat

Junior Isles

The global market for digitalisation in the energy sector is set to grow to $64 billion by 2025, as new energy innovations focus on digital technologies and the strategic use of data, according to new research published by Bloomberg New Energy Finance (BNEF).

The 'Digitalization of Energy Systems' report predicts significant shifts in the intelligence of digital technologies used in energy from today to 2025, and a big change in the sectors of the energy system that most benefit from these technologies.

Currently, the biggest use of digital technologies like sensors, data collection and analytics in the energy sector is to improve the bottom line of fossil fuel generators. Revenue for digital services for fossil fuel operation and maintenance, or O&M, are estimated to be $24 billion in 2017 – some 44 per cent of the total market size for digitalisation measured by BNEF.

But as natural gas and coal plants come offline, and those that remain become digitalised, the opportunities for new revenues from the fossil fuel sector will shrink. Home energy management technologies will therefore see the most significant change in digital revenues, rising from $1 billion in 2017 to $11 billion in 2025.

"The largest driver for digital technology revenues in 2025 will be smart meters, growing 44 per cent between now and 2025, to $26 billion. This revenue increase matches the fall in digital revenues from fossil fuel O&M – 46 per cent over that time period," said Claire Curry, head of emerging technology analysis at BNEF.

BNEF said the US will be a major market, having long been a leader in digital technologies and early-stage fundraising while Australia, although ranking lower today, will move near the top of the group in 2025 due to high forecast levels of decentralised energy production. In emerging markets, countries that have beneficial government policies, foster innovative start-ups and are rolling-out network infrastructure are likely to digitalise soonest – for example Chile, Indonesia and Nigeria.

The report was issued as the IEA launched its first report on the interplay between digitalisation and energy.

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

The IEA also noted that while the growth of the "Internet of Things" (IoT) could herald significant benefits in terms of energy efficiency to households and industries, it also increases the range of energy targets for cyber-attacks.

Cyber security is a serious issue for the sector, costing the power industry hundreds, if not billions, of dollars each year. Nils Ahlrich, head of strategy and portfolio management for security at Nokia Networks noted: "Although it has been ongoing for more than 10 years, the number of incidents and impact is clearly rising.

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

EDF under scrutiny in transition from nuclear to renewables

The French government is considering changing the governance of state utility EDF in an effort to reduce the country's reliance on nuclear and embrace the transition to renewables.

Energy and Environment Minister Nicolas Hulot, said in November that the country's largest electricity producer needed to embrace a transition towards environmentally friendly energy rather than "resist" it. He said the process may require revisiting the structure of the company, in addition to a plan to close up to 25 of the 58 nuclear reactors it operates across France within the next 15 years.

Hulot, a former environmental activist and critic of nuclear power told the *Financial Times*: "It's complicated when the operator, EDF, doesn't supply its own scenario to achieve these goals. Now the big difference is that I asked EDF for a precise plan.

"Everything is on the table, we are in a phase of discussion, including over governance. EDF has two priorities: manage nuclear power on the one hand and renewables on the other. Is the architecture of EDF the right one to address the challenges of the 21st century? A reflection is under way."

The news came as Hulot announced that France is unlikely to meet its target of reducing nuclear power to 50 per cent of its electricity supply by 2025, as required by an environment law passed in 2015. France currently generates some 77 per cent of its electricity from nuclear power.

After the government discussed an annual report from electricity networks firm RTE, he said: "Yes, it will be difficult to meet this timetable of 2025 without restarting electricity production from fossil fuels."

Hulot said that a new timetable would have to be considered that would "also enable our first priority, which is of course not to hamper the dynamic and progress of our exit from fossil fuels."

Hulot says a detailed plan, setting out which reactors should be closed, would now be drawn up within a year.

Some experts argue that the decision to abandon the current timetable for nuclear closures is the best decision for the industrial sector in France.

Alexandre Grillat, an official at management union CGE, said the 2025 target meant "gambling on the fact that renewable energy is going to develop in a tremendous way over the next 10 to 15 years".

Chile auction sees prices tumble

The Chilean government says it expects energy prices to fall following the country's latest renewable energy auction.

The country's National Energy Commission (CNE) has secured 2.2 TWh/year from solar and wind energy projects starting in 2024. The auction set a new record low for solar photovoltaics (PV) in Chile, with one bid secured at $21.48/MWh.

The average price secured in the auction was $32.50/MWh, CNE said.

The auction will result in the construction of 600 MW of new renewable energy capacity. Although 2200 GWh of capacity was contracted in the auction, the submitted bids reached a volume that was nine times higher, for a total of 20 700 GWh.

The prices secured in Chile's latest auction are a significant drop compared to prices secured in earlier rounds held in 2015 and 2016. Consumer prices will fall by around 50 per cent as a result, the Chilean government said.

Andrés Romero, the executive secretary of the National Energy Commission, said households currently pay around $90/MWh. "Now, with this tender, we expect that these new contracts will gradually go down at prices in around $50, which will go directly to the benefit of households."

The average price in the 2016 auction was $47.6/MWh, with 12 430 GWh contracted per year. In the 2015 tender, which was the first of its kind in Chile, the average price was $79.3/MWh, with 1200 GWh/year contracted.

"The goal set by President Bachelet was to lower energy prices by 25 per cent. Today we can say with great calm, transparency and joy, we have managed to lower the price of energy by 75 per cent in the last three years," said Minister of Energy Andrés Rebolledo.

Enel won the lion's share of contracts in the auction, securing 54 per cent of the 2.2 TWh/year offered. The Italian firm said it would build 116 MWp of solar and 33 MW of geothermal capacity in the Antofagasta region, and 93 MW of wind energy in the Araucanía region in southern Chile.

"We are extremely pleased about this new important award for the supply of electricity to Chilean customers," said Enel CEO and General Manager Francesco Starace. "The combination of different renewable technologies and some thermal generation has proven once again the winning approach."

■ Acciona Energia has officially opened its 246 MWp El Romero solar PV plant in Chile's Atacama region. The facility was connected to the grid a year ago. It started supplying power to Google in January this year and from the start of 2018 will be providing electricity under contracts awarded in a Chilean tender.

Branson calls for green "Marshall" plan

■ Distributed grids more resilient, says Branson

■ Long term solutions required

British entrepreneur Sir Richard Branson has called for Caribbean islands to wean themselves off "their irresponsible and costly" dependency on fossil fuels to make their critical infrastructure more resilient.

Branson has been in talks with the World Bank, the IMF and the Inter-American Development Bank (IADB) over efforts to create a "Marshall" plan for the Caribbean to boost recovery efforts following the devastating effects of hurricanes in 2017.

The name of the plan refers to the multi-billion dollar US-led programme that helped rebuild Western Europe after the devastation of World War Two.

Branson says diversified energy supplies would also have a positive economic effect

South African business magnate Elon Musk has also been helping relief efforts in Puerto Rico using Tesla battery packs to restore power supplies, according to reports.

Branson believes that the islands of the Caribbean would be more resilient to hurricanes if their electricity infrastructure was based on distributed and renewable power grids that don't break down so easily and can be repaired quickly. "As an investor and entrepreneur, I've never seen a more compelling business case than the one presented by more energy-efficient systems that make use of the abundance of the region's natural resources, like solar or wind," Branson said in a blog.

Hurricanes Maria and Irma left tens of thousands homeless and without water and other essential services in September. Branson said that the extent of the devastation "across the entire community" was "heart-breaking", and caused him to question the resilience of energy and other services in the Caribbean.

"In the British Virgin Islands, every single island has been hit and battered; more than 90 per cent of all residential buildings have become uninhabitable, and all local infrastructure – power, telecommunications, water and sanitation – has either been destroyed or seriously damaged," Branson wrote.

"But we have to start thinking beyond emergency relief and turn our attention to the islands' long-term recovery and reconstruction," he continued, adding that diversified energy supplies would also have a positive economic effect.

Mexico auction boosts renewables

■ Enel to invest $700 million ■ Solar dominates auction

Siân Crampsie

Mexico's government is expecting investments of around $2.4 billion in its energy sector following the successful completion of its latest renewable energy auction.

The country's third long-term auction for renewables secured around 2000 MW of wind and solar photovoltaic projects at an average price of $20.57/MWh, with 593 MW of wind capacity awarded to Enel, 688 MW of wind and solar to Engie, and 367 MW of solar PV awarded to Canadian Solar.

"We are thrilled about yet another great success in Mexico, a core market for us, and we are proud to confirm our leadership in the country's renewables arena," said, Head of Enel's Global Renewable Energies Division Enel Green Power, Antonio Cammisecra. "Through this important win, we will significantly contribute to the country's demand for electricity from renewable sources."

Enel said it would invest around $700 million in the construction of the wind farms, which are due to enter commercial operation in the first half of 2020.

Three plants, Amistad II and Amistad III with a total installed capacity of 100 MW each, and Amistad IV with an installed capacity of 149 MW, will be built in Acuña, in the northern State of Coahuila.

The 244 MW Dolores facility will be built in Chino, a municipality in the northeastern State of Nuevo León, Enel said.

Engie said it would build one wind farm in Tamaulipas state, and three solar farms in Chihuahua, Sonora and Tiaxcala states.

Other winners were Japan's Mitsui, France's Neonen and Spanish company X-Elio.

Solar energy dominated the electricity auction, making up 55 per cent of the awarded capacity, with wind energy taking the remainder.

The average price of $20.57/MWh was 39 per cent lower than the $33.47/MWh secured in the previous auction in September 2016. Enel submitted a record low bid of $17.70/MWh for one of its wind farms, according to reports.

The lowest solar bid submitted was for an 80 MW project proposed by Mitsui and Trina at $19.70/MWh.

NY Green Bank expands

New York state's government says it will double efforts to invest in clean energy and fight climate change, as the Trump administration continues attempts to dismantle Obama-era climate commitments.

New York Governor Andrew M. Cuomo says that the NY Green Bank will raise an additional $1 billion in private sector funds to expand financing availability for clean energy projects, and is also hoping to work with other states to replicate its business model in other parts of the country.

The NY Green Bank is a state-sponsored, specialised financial institution targeting investments in New York's clean energy markets alongside private sector partners. NY Green Bank has made approximately $440 million in investments in clean energy projects across New York and helped to drive a total of $1.4 billion of clean energy investment in the state.

Governor Cuomo said that the additional funds would be raised from third party investors and would help the bank to deliver more clean energy investment in New York as well as collaborate with other states to establish green banks outside New York state.

"As the federal government turns its back on solutions to climate change while denying reality, New York is doubling down on our efforts to act on the clean energy future," said Governor Cuomo. "This expansion of the New York Green Bank will combat climate change while creating good-paying clean energy jobs across the state, helping to secure a cleaner and greener tomorrow for all New Yorkers."

South Korea backs super grid plan

Plans for a northeast Asian super grid are taking shape as the region looks to improve energy security and ease political tension. **Syed Ali**

A plan for a northeast Asian energy super grid received a boost in November after winning the support of the head of South Korea's state-run energy group, Korea Power Electric Corp. (Kepco).

The company's Chief Executive Cho Hwan-eik claimed the project goes "beyond economics", saying it has the potential to ease the region's political tensions. "We have carried out a preliminary feasibility study on the project and concluded that it is feasible economically and technically," he said.

The plan, floated by Japanese billionaire Masayoshi Son, aims to connect the electricity networks of South Korea, China, Japan, Mongolia and Russia. Son, Chief Executive of Japanese technology group SoftBank, first proposed the plan for the super grid following the 2011 Fukushima nuclear disaster.

Cho met with Alexander Galushka, Minister for Development of the Russian Far East, in Seoul in early November to discuss ways to connect the two nations' electricity network via a direct current electricity cable along the seabed.

"South Korea and Russia will have to form a joint working group and road map to expand cooperation in the energy sector," Cho said in a release.

The state power provider has already been working on a project to link an electricity grid with China's State Grid Corporation of China (SGCC), Japan's SoftBank and Mongolia's energy development company Newcom.

The demonstration project is aimed at building a 2 GW complex that can produce solar and wind power in Mongolia and a seabed power grid connecting the three nations. The scope of the project was expanded to include Russia during an economic forum held in Vladivostok in September.

Although essentially aimed at strengthening the region's energy security, the super grid is also seen by South Korea President Moon Jae-in as a foundation for deeper regional economic and security integration.

President Moon believes the initiative could bring nations together in a region on edge over North Korea's nuclear provocations.

However, some analysts have questioned the project's viability. "It is not technically impossible and could boost energy security," said Kang Seung-kyung, an analyst at Korea Investment & Securities. "[But] it will take a long time to reach a political agreement and actually establish the energy network."

Solar helps Japan cut emissions but prices still high

- Solar prices eight times higher than some parts of the world
- Project launched to cut carbon footprint of households

Japan's first auction for contracts to provide solar electricity have pushed solar prices down by nearly a quarter from a previous system, but the cheapest bid was still more than eight times higher than a record-low achieved recently in overseas markets, government data shows.

The lowest accepted price for solar projects was Yen17 200 ($153.20) per MWh, according to documents from the Ministry of Economy, Trade and Industry (METI), which handled the auction in November. This was down from Yen24 000/MWh in the year through March 2017 for projects approved under METI's feed-in-tariff programme set up in 2012 to encourage a switch to renewables after the Fukushima nuclear disaster.

The price, however, is still far higher than those seen in a recent solar power auction in Mexico, which delivered bids as low as $19.70/MWh.

"It is encouraging to see prices in Japan coming down. However, it is worrying that prices are falling faster in other parts of the world," said Tomas Kaberger, energy and environment professor at Chalmers University of Technology in Sweden and chairman of the Renewable Energy Institute in Tokyo.

Government incentives have enabled Japan's solar power production to soar to more than 40 000 GWh from virtually zero before 2012.

Solar is a key part of the country's plans to reduce CO_2 emissions by generating 24 per cent of its power from renewables by 2030, up from 14.6 per cent in 2015. Japan has committed to reducing greenhouse gas emissions by 26 per cent by fiscal year 2030 (compared to fiscal 2013 levels).

As part of those plans, last month Oracle Utilities announced that it is working with the Ministry of Environment and five major power utilities in the country as part of the Ministry's effort to promote a Japanese model of information-based CO_2-reducing behavioural changes in the residential sector.

With nearly 70 per cent of the average Japanese household's carbon footprint stemming from energy use, Japan's Ministry of Environment (MOE) commissioned a nationwide study to measure the potential of residential behavioural energy efficiency programmes as a means of reaching Japan's fiscal year 2030 CO_2 emissions reduction goals – of which a 40 per cent reduction is required in residential sector emissions alone.

As part of this effort, Oracle Utilities will work with five major Japanese utilities, including Hokkaido Gas, Ltd., Tohoku Electric Power Co., Inc., Hokuriku Electric Power Co., Inc., Kansai Electric Power Co., Inc., and Okinawa Electric Power, Co., Inc., to deliver Home Energy Reports (personalised energy consumption communications) to residents across each utility territory using the Opower Energy Efficiency Cloud Service platform.

Bangladesh bets big on gas

Bangladesh is set to significantly boost its gas fired generating capacity following agreements to build two major projects.

Germany-based Siemens recently signed a Memorandum of Understanding (MoU) for setting up a 3600 MW combined cycle power plant based on liquefied natural gas (LNG) by 2021 at Dhankhali in Patuakhali district.

State Minister for Power, Energy and Mineral Resources Nasrul Hamid said this represents the single largest investment from Germany, noting: "The estimated cost is $2.8 billion including debt of $2.4 billion and equity $400 million."

The project details will be implemented in three phases. It is expected that the first 1200 MW unit of the plant will go into operation in June 2020, while the second with the same generating capacity will startup in December 2020 and the third in December 2021.

Meanwhile, a joint venture of the state-run Coal Power Generation Company Bangladesh Limited and Japan's Mitsui and Company Limited is set to install a 500-600 MW imported LNG-based power plant involving an investment of approximately $600 million at the under-construction Matarbari power station, Cox's Bazar.

The Coal Power Generation Company managing director told local press reporters that the LNG-based power plant was expected to be commissioned by 2021.

Philippines says renewables fast becoming "a better alternative"

The head of Philippines Trade Undersecretary and Board of Investments (BOI), Ceferino Rodolfo, said the production of renewable power is becoming cheaper and it is fast becoming a better alternative towards addressing power-sufficiency and cost-effectiveness in the economic development of the country.

The statement came as the BOI approved the application of nine renewable energy projects valued at Peso26.7 billion ($530 million) with a total capacity of nearly 333 MW. Based on the Department of Energy's renewable energy roadmap 2017-2040, the country expects to have at least 20 000 MW of renewable energy installed by 2040.

"In other parts of the world, renewables like solar are already cheaper than fossil-fuel based power and these countries are already transitioning to a 100 per cent renewable electricity," Rodolfo said.

"Sooner or later, we have to face this inevitability with the expectation it will bring down power costs while ensuring enough power supply for the country," he added.

The Philippines also recently signed an amended memorandum of agreement (MOA) with New Zealand Ministry of Foreign Affairs on Trade on cooperation related to geothermal power resources.

According to Alfonso Cusi, head of the Department of Energy, the geothermal energy cooperation between Philippines and New Zealand "expired in October of this year and will be renewed for another three years".

Geothermal is just one area of expertise that New Zealand can share with the Philippines. New Zealand plans to generate all electricity from renewable sources by 2035 – a target that some experts believe is possible. Last winter, up to 93 per cent of generation came from renewables at times, and the former government aimed to have 90 per cent of electricity from renewables across an entire year by 2025.

John Kidd of Woodward Partners said: "I do think the 100 per cent renewable target is materially achievable. I add the rider 'materially' because there are likely to be site-specific pockets of demand where renewable options may simply not be feasible, but these might eventually be few.

"The key enabler to this is energy storage – in New Zealand's case more so than generation itself. Battery and fuel cell technologies are advancing rapidly and will become increasingly mainstream as their economics improve."

- Businessman Salvador "Buddy" Zamora II has unveiled a plan to build a 1.1 GW gas fired plant, together with a Chinese partner, in Zambales. It will be the first LNG plant in the Philippines and is targeted to be operational within the next three years.

Helm review highlights UK market complexities

Helm: government should radically simplify interventions

- UK energy prices should be falling
- Government should simplify interventions

Siân Crampsie

A major review of energy policies in the UK has concluded that energy prices are too high because of the country's multiple and complex market interventions and legacy of renewable energy support mechanisms.

The review, conducted by Oxford academic Professor Dieter Helm on behalf of the government, says that energy prices are "higher than necessary" to meet the UK's climate obligations, and notes that consumers have not been able to benefit from falling costs of gas and coal, the rapidly falling costs of renewables, or from the efficiency gains to network and supply costs which come from smart technologies.

"Prices should be falling, and they should go on falling into the medium and longer terms," the report reads.

The report came amid an ongoing debate in the UK over rising energy prices and the continued dominance of the "big six" utility firms in the domestic energy market.

In November Centrica said that it had lost over 800 000 customers since June 2017 because of a price rise. Meanwhile SSE and npower have announced plans for a merger of their supply businesses – a move designed in part to stave off competition from a growing number of suppliers active in the market.

Prime Minister Theresa May has pledged to enforce a price cap to prevent energy companies over-charging consumers, a policy that many of the large suppliers have opposed.

In his review, Prof. Helm said that "tinkering with policies and regulations is unlikely to reduce costs". He added: "Each successive intervention layers on new costs and unintended consequences. It should be a central aim of government to radically simplify the interventions, and to get government back out of many of its current detailed roles."

He also proposed placing legacy costs of the Renewables Obligation, Feed-in Tariffs and Contracts for difference (CFDs) into a 'legacy bank', with charges explicitly made clear on consumer bills.

The report also recommends phasing out current government subsidy schemes and replacing them with a single auction in which all technologies, from offshore wind to gas, would compete, as well as the creation of a universal carbon price across the whole economy.

Jeremy Chang, energy expert at international law firm Pinsent Masons, said that the report proposed some "pretty radical" solutions.

"The review notes that the government strategy of 'picking winners' to essentially choose what technology becomes successful is not a good approach for the long-term," said Chang. "Investors are currently unable to make their investment decisions based on wholesale cost alone and instead have to navigate labyrinthine measures, incentives and regulations, which means increased costs in the long term."

Dr Jonathan Marshall, energy analyst at ECIU said that the review overlooks what is happening in the energy market today. "He misses an open goal by claiming that renewables may not be subsidy-free by 2020, when some, like onshore wind, are there already," said Dr. Marshall. "Increasing deployment of these renewables would bring down consumers' bills, yet such a recommendation is strangely absent from the review.

"On a wider point, the review doesn't reflect the many good things that UK energy policy has achieved, nor that far fewer people are concerned about energy bills now than they were five years ago. In the face of many obstacles, the UK is effectively decarbonising the power sector while keeping bills down and the supply highly secure – and that success should be acknowledged."

Rome lays out new energy roadmap

Italy has called for a phase-out of its coal fired power stations by 2025 in a renewed effort to clean up its power sector.

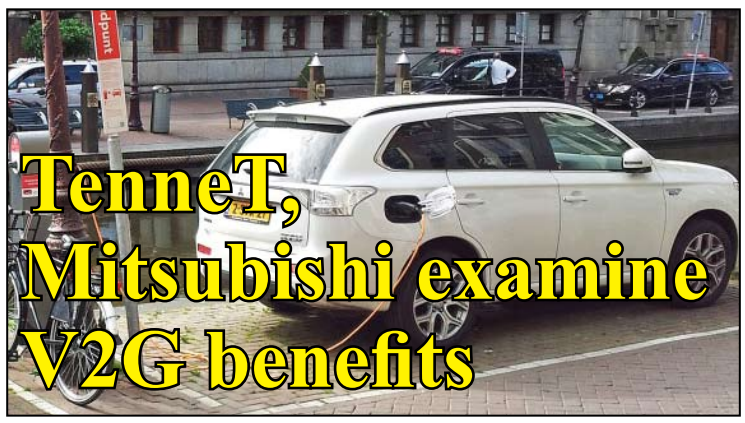
The country's government has published details of a new energy roadmap, in which it calls for an increased role for renewable energy and a boost in the number of electric and hybrid vehicles on the road.

Rome wants renewable energy to account for 28 per cent of overall energy consumption by 2030, up from 17.5 per cent in 2015, and for renewables to account for 21 per cent of energy consumption in the transport sector, up from 6.4 per cent in 2015.

Italian industry minister Carlo Calenda said that natural gas would continue to play a key role in Italy's power system, however, largely to ensure energy security in a country that imports around 75 per cent of its energy needs.

Calenda said the government would promote new gas import pipelines to diversify supply, including the TAP pipeline to Azerbaijan and the East-Med pipeline that will import gas from the Mediterranean.

Enel's CEO said that the roadmap did not go far enough to wean Italy off fossil fuels. Francesco Starace told *Reuters*: "The strategy looks tilted towards gas rather than renewables. It's probably a lack of vision or a conservative idea that a country should have at least one fossil fuel alternative for the future."



TenneT, Mitsubishi examine V2G benefits

Motor companies and power network operators are already joining forces to investigate the possibilities of vehicle to grid (V2G) technologies in the wake of plans by some European countries to phase out petrol and diesel vehicles.

Mitsubishi Motors Corporation (MMC) recently announced a demonstration project with Dutch grid operator TenneT to pilot V2G technology using its Outlander PHEV cars in Amsterdam.

V2G technology enables the grid to use the electrical energy stored in electric vehicles' batteries to provide balancing services. Not only does it provide firms like TenneT with a new source of reserves to use at times of peak electricity demand, it also introduces a new earnings model for drivers of EVs.

In the MMC demonstration, which also includes NewMotion, one of Europe's largest providers of smart charging solutions for electric driving and Nuvve, a worldwide leader in V2G technology and grid service deployments, MMC will provide services for capacity reserve and balancing services. The project will enable it to verify the V2G technology and better understand the opportunities for businesses and vehicle owners.

Other similar demonstrations are also underway in Europe.

Last year Enel and Nissan launched a V2G demonstration in the UK, while Cenex and Climate KIC are leading V2G demonstrations in the UK, Germany and Spain.

Earlier this year, the UK and France announced plans to ban the sale of fossil fuel vehicles from 2040. Germany, India and Norway have also implemented similar policies.

Spain looks to renewables growth

The share of renewable energy in Spain's power generation is set to rise following the country's decision to once again allow investment in renewable energy.

Analysis by Moody's indicates that wind, solar and hydropower capacity in the country will rise, reaching a share of 59 per cent of the generation mix by 2022, up from 53 per cent at the end of 2014.

Investment in renewables in Spain has restarted following a four-year moratorium. The country's renewable energy incentive scheme received approval last month from the European Commission.

So far two renewable energy auctions have been held this year in Spain, awarding a total of around 4 GW of wind and the same for solar. The forecast rise in renewable energy capacity will "offset the closure of 4.5 GW of domestic coal capacity and help keep a lid on power prices", said Niel Bisset, Senior Vice President at Moody's.

Spain's incentive programme for renewables provides generators with a premium on top of the market price of electricity, and replaces the country's previous feed-in tariff system. The use of competitive auctions will help keep costs down for consumers, Moody's said, but will increase operators' exposure to price risk as the investment return on the new projects will primarily be merchant driven.

"However, large utilities such as Endesa S.A. and Gas Natural SDG, S.A. have the scale and diversity to manage this risk, although smaller operators may need to adopt a more conservative capital structure to cope," commented Bisset.

Last month the Spanish Wind Energy Association (AEE) said that installed wind capacity in Spain would reach 28 000 MW by 2020, up from 23 000 MW in 2015. In a recent report, AEE also said that Spain could reach 40 000 MW of installed wind energy capacity by 2030.

AEE based its forecast on the 2015 Paris Agreement goals of achieving an 80 per cent reduction in emissions by 2050. To meet these targets, it would need to add 1200 MW of onshore wind capacity per year after 2020. The electricity system could be completely decarbonised by 2040, it added.

"The current energy model is not compatible with European objectives," said AEE CEO, Juan Virgilio Márquez. "Energy planning… must give long term visibility. Also, the market must offer an adequate investment environment and the fiscal framework must be correct."

- Portugal's Department of Energy has approved a 20 MW wind farm in Batalha and a 28 MW wind farm in Tarouca with a combined investment value of €50 million. The government has also recently approved 14 solar photovoltaic projects worth €381 million and with a combined capacity of 521 MW. A further 2 GW of wind, solar and biomass projects are in the licensing process.

Jordan investigates SMR and PBMR technologies

■ MOUs signed with Rolls-Royce and X Energy ■ Saudi link approved

Siân Crampsie

Rolls-Royce says that a memorandum of understanding (MOU) it has signed with the Jordan Atomic Energy Commission (JAEC) indicates the growing interest in small modular reactor (SMR) technology worldwide.

The UK firm will conduct a technical feasibility study for the construction of a Rolls-Royce SMR in Jordan.

Harry Holt, President of Nuclear, Rolls-Royce, commented: "With demand for global energy set to rise due to new technologies such as electric cars and increasing requirements for water desalination and district cooling, international interest in Rolls-Royce small modular reactor technology is growing."

The two organisations will work together to define the technical, safety, economic and financial requirements for constructing an SMR power station in Jordan for electricity generation and water desalination. The outcome of the feasibility study will be used to inform an investment decision by JAEC to move forward to project delivery phase.

"SMRs offer unique opportunities to address many of the challenges confronting Jordan, in particular water scarcity and small grid size, through the introduction of nuclear in the country as part of the energy mix," said Dr. Khaled Toukan, Chairman JAEC.

Rolls-Royce is leading a consortium of British companies to design a small modular reactor power station to deliver low cost, low carbon energy to help the UK meet its carbon commitments. The SMR could produce reliable energy for as low as £60/MWh – competitive against wind and solar – and through its innovative approach to modular construction, can avoid the complexities, delays and overspends often associated with large infrastructure projects.

Jordan is currently developing its first nuclear power plant, and is also exploring the possibility of using other nuclear reactor technologies.

Last month it signed a MOU with US firm X Energy to asses the company's advanced nuclear reactor – known as the Xe-100 – and its potential for deployment in Jordan.

The Xe-100 is a 200 MWt (76 MWe) high temperature gas-cooled pebble bed modular reactor (PBMR) being developed by X Energy, which is also developing TRISO-based fuel forms.

X Energy's activities are supported by $40 million of private investment and a five-year, $53 million US Department of Energy Advanced Reactor Concept Cooperative Agreement award.

Jordan's first nuclear reactor is expected to be ready by 2023, while the second will go online by 2025. The projects are seen as being essential to meeting growing energy demand in Jordan and improving the country's energy security.

■ Jordan's cabinet has given approval for a project to build a power interconnection with Saudi Arabia. Jordan's the National Electric Power Company (NEPCO) and the Saudi National Electricity Company will start technical and financial feasibility studies for the project, which aims to enhance the stability and reliability of electricity networks in both countries.

Hydrogen Council calls for action

■ $20-25 billion annual investments required

■ Annual demand for hydrogen could increase ten-fold by 2050

Hydrogen could play a key role in the energy transition and help economies to decarbonise, according to an industry association.

The Hydrogen Council, a CEO-level coalition bringing together companies in the energy, industrial and transport sectors, says that hydrogen could account for almost one-fifth of total final energy consumed by 2050 around the world if deployed at scale.

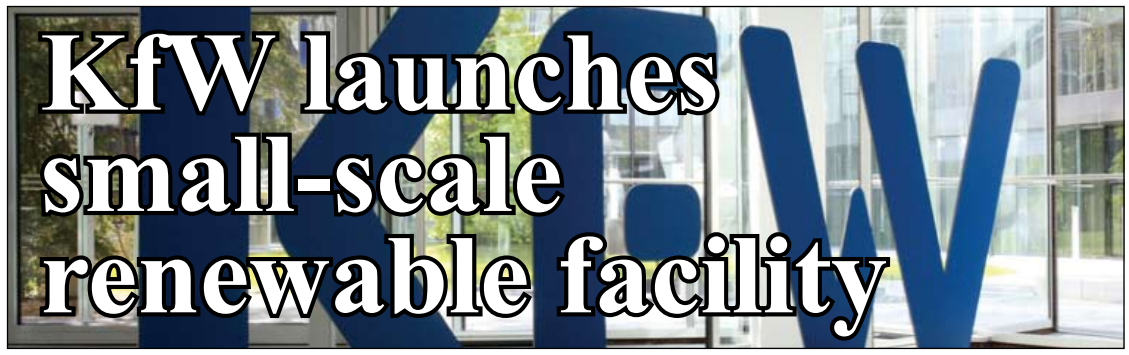
This would reduce annual CO_2 emissions by roughly 6 gigatons compared to today's levels, and contribute roughly 20 per cent of the abatement required to limit global warming to two degrees Celsius.

In a report launched on the sidelines of COP23 in Bonn last month, the Hydrogen Council said that investments of approximately $20 to $25 billion annually for a total of about $280 billion until 2030 would be required to achieve this scale.

However it said that attracting such investment would be feasible given the right regulatory framework. It has identified a number of sectors where hydrogen could have an impact, including power generation and energy storage, transport, industry processes and feedstocks, and heating.

"The world in the 21st century must transition to widespread low carbon energy use," said Takeshi Uchiyamada, Chairman of Toyota Motor Corporation and co-chair of the Hydrogen Council. "Hydrogen is an indispensable resource to achieve this transition because it can be used to store and transport wind, solar and other renewable electricity to power transportation and many other things. We are encouraging governments and investors to give it a prominent role in their energy plans. The sooner we get the hydrogen economy going, the better, and we are all committed to making this a reality."

The Hydrogen Council sees the potential for hydrogen to power about 10 to 15 million cars and 500 000 trucks by 2030. Overall, the study predicts that the annual demand for hydrogen could increase ten-fold by 2050 to almost 80 EJ in 2050 meeting 18 per cent of total final energy demand in the 2050 two-degrees scenario.



KfW launches small-scale renewable facility

German development bank KfW is targeting development of sub-50 MW renewable energy projects in Africa through a new facility.

Alongside its partner, the African Trade Insurance Agency (ATI), KfW will use the new instrument to support projects in sub-Saharan Africa and help developers of small- and medium-scale renewable power plants overcome financing challenges.

The German Federal Ministry of Economic Cooperation and Development (BMZ) through KfW will provide funding of up to €32.9 million to the facility, which is designed to provide a viable solution to one of the biggest challenges facing independent power producers (IPPs) operating in Africa, specifically the requirement to provide project lenders with a liquidity guarantee.

The facility will help independent power producers to achieve financial close, KfW said. "The Regional Liquidity Support Facility (RLSF) will address a key challenge in renewable energy project finance and de-risk private sector investments," said Günther Nooke, Personal Representative of the German Chancellor for Africa, BMZ. "We are pleased to provide the funding to this innovative instrument underlining Germany's commitment to the objectives of the African Renewable Energy Initiative (AREI)."

According to the International Energy Agency (IEA), sub-Saharan Africa's renewables capacity is forecast to grow by 73 per cent (24.4 GW) over the period 2017-22. Small- and medium-scale projects are also seen as a good solution to energy deficits in certain parts of the region, because they are easier to implement and can target energy requirements at source.

The RLSF is designed to help IPPs developing renewable energy projects to obtain the liquidity they need in the event that their off-taker (frequently a state-owned entity) delays payment, KfW said. The facility will provide immediate cash collateral supported by guarantees to a commercial bank that will in turn open a standby letter of credit to the benefit of the IPP.

The amount provided will enable the IPP to operate and service the debt for up to six months.

Strong growth forecast in global storage sector

The global energy storage market is on the cusp of a major period of expansion thanks to the growing need for flexibility in electricity grids around the world.

A new report from Bloomberg New Energy Finance (BNEF) indicates that the global energy storage market will double six times between 2016 and 2030, rising to a total of 125 GW/305 GWh.

The projected growth of the sector will mirror that achieved by the solar industry from 2000 to 2015, during which the share of photovoltaics as a percentage of total generation doubled seven times.

BNEF predicts that in the 15 years to 2030, as much as $103 billion will be invested globally in storage solutions, both behind the meter and at utility-scale.

Investment will be spread roughly equally across the Americas, Asia Pacific and Europe, Middle East and Africa regions, it said.

BNEF energy storage analyst Yayoi Sekine, lead author of the report, said: "The industry has just begun. With so much investment going into battery technology, falling costs and with significant addition of wind and solar capacity in all markets, energy storage will play a crucial part in the energy transformation."

The BNEF report shows that there will be eight key markets accounting for 70 per cent of storage installations: the USA, China, Japan, India, Germany, UK, Australia and South Korea. One-quarter of all deployments will be in the USA.

Structural issues hit Siemens and GE

■ Siemens power group bears brunt of losses ■ Energy remains core to new-look GE

Siân Crampsie

"Unprecedented challenges" in the world's changing energy markets are causing industry technology stalwarts Siemens and GE to implement aggressive restructuring plans.

The two companies last month revealed job cuts and plans to boost business operations to improve financial performance amid falling demand for gas turbines.

"The power generation industry is experiencing disruption of unprecedented scope and speed," Siemens management board member Lisa Davis said. "With their innovative strength and rapidly expanding generation capacity, renewables are putting other forms of power generation under increasing pressure."

Siemens said it planned to cut around 6900 jobs – equivalent to two per cent of its global workforce – predominantly from its power and gas business.

Around half of the job cuts would be made in Germany, Siemens added. The move would "increase capacity utilisation at production facilities, drive efficiency, and enhance expertise by bundling resources", the company said.

GE's new agenda includes a reduced dividend and a renewed focus on energy, aviation and healthcare. In an analysis of its energy business, GE highlighted its market-leading position and strong technology portfolio, but noted that the market would remain challenging into 2019.

It said that gas would remain a key contributor to the energy mix in the long term.

Siemens last month reported a big rise in net income in spite of losses at the company's renewables division and a "significant decline" at the power and gas unit.

Net income rose 9.9 per cent to €1.29 billion in the three months to the end of September. Fourth-quarter profit at the power and gas unit plunged 40 per cent to €303 million, as revenues were cut by a fifth to €3.65 billion.

Global demand for large gas turbines has fallen drastically and is expected to level out at around 110 turbines a year, Siemens said. By contrast, the technical manufacturing capacity of all producers worldwide is estimated at around 400 turbines.

Earlier in November Siemens Gamesa announced plans to cut 6000 jobs from its 27 000 global workforce in an effort to enhance competitiveness and improve financial performance.

The wind turbine manufacturer announced disappointing results for fiscal 2017 and a below-forecast outlook for 2018. "Our financial performance is still not at the level we're all aiming for," said Markus Tacke, CEO of Siemens Gamesa. "But it's clear that we are making positive progress as we carry out our plan to make this company an industry leader.

"Our integration efforts are proceeding ahead of schedule, and I'm confident that the decisions we're making will allow us to better respond to changing market conditions, and to better serve our customers and other stakeholders."

Centrica sees aggregation as core part of strategy

Centrica is aiming to make demand aggregation a core part of its offering after buying Dutch firm REstore NV.

The UK energy giant has paid €70 million for REstore, which currently manages 1.7 GW of peak load from a portfolio of industrial and commercial (I&C) customers across Belgium, the UK, France and Germany.

Its services help these customers to optimise the use of their energy resources while offering ancillary services to the electricity grid, including frequency response and capacity markets.

The REstore business will be integrated into Centrica's Distributed Energy & Power unit, which provides energy analysis, asset optimisation and energy solutions to large energy users.

The acquisition is a key part of Centrica's strategy to move away from large, centralised power generation assets and into distributed generation and 'smart' energy services.

It recently released a new research report that concluded that the use of distributed energy devices such as batteries, together with energy efficiency devices, could help the UK's I&C sector to make significant savings on annual energy spend.

Centrica said that the acquisition of REstore would complement its earlier purchases of Panoramic Power, Neas Energy and ENER-G Cogen.

"The acquisition will also further expand Centrica's geographic footprint into new European markets," Centrica added.

Jorge Pikunic, Managing Director of Centrica Distributed Energy & Power, said: "This acquisition is an important step forward in the delivery of our strategy, expanding on our offer to business customers to help them take control of their energy and gain competitive advantage.

"REstore's proprietary technology and track record with large I&C customers will add to our optimisation capabilities and enable growth opportunities as global markets for flexibility continue to evolve."

REstore's co-founders Pieter-Jan Mermans and Jan-Willem Rombouts, said: "There is clearly a momentum in the market right now so we are thrilled to be working with Centrica to further scale the go-to-market of REstore's software solutions and demand response services in the UK, North America and other international markets."

Blockchain startup puts plans into action

Startup firm 4New plans to build the world's first blockchain-integrated waste to energy plant.

Siân Crampsie

Waste-to-energy startup company 4New says it will use a recently won $25 million equity injection to get three proposed new power plants in the UK up and running.

The cash injection from USA-based Mirach Capital is conditional on 4New successfully raising further funds for its novel plans to create a circular economy-style waste-to-energy business underpinned by blockchain.

4New CEO Sandeep Golechha told *The Energy Industry Times* that the startup is aiming to raise a further $25 million through an initial bitcoin offering as well as tapping the private equity market.

The funds will finance the construction of three new waste-to energy plants in the UK, two of which are in an "advanced" stage of development with planning permission and grid connections, Golechha said.

The firm's proposed power plants would be capable of processing around 40 000 t/year of waste, which it hopes can be sourced from local waste aggregators. Its entire business model is underpinned by blockchain, a digital ledger that could transparently document and track all of the regulatory and compliance requirements associated with the waste industry, as well as process payments.

4New says that its proposals address a number of issues, including clean energy generation and waste disposal. Its offering would allow waste industry firms to trade for waste and energy transactions using 4New's digital coins.

It is aiming to complete construction of its three power plants by the end of 2018.

4New is planning three waste-to-energy plants

Market momentum drives M&A deals

An increase in mergers and acquisitions (M&A) activity in Europe and the Americas has driven deal value across the global power and utilities sector to a two-year high in Q3 2017, according to EY.

Five megadeals in the Americas resulted in M&A deal value reaching $53 billion, nine times the value recorded in Q2 2017 and the highest since Q3 2015. Meanwhile, better-than-expected economic activity in Europe saw Q3 deal value increase to $16.9 billion, up 60 per cent from $10.6 billion in Q2.

According to EY, the newly found momentum in the market is expected to continue, helped in part by an expected uptick in global economic performance and improved credit access.

"With unanticipated levels of M&A activity across the power and utilities sector, particularly in the Americas and Europe, all major engines of global dealmaking are now moving firmly upward," said EY Global Power & Utilities Transactions Leader, Matt Rennie. "Deals in Q3 indicate that private equity is likely to be the biggest story across the sector over the next 12 months."

EY's most recent Power and Utilities Capital Confidence Barometer (CCB), a survey of executives in the power and utility industry, also indicates that technological change in the energy sector is creating pressure for energy companies to address the impacts of digitalisation.

"The pace of disruption and innovation is compelling power and utilities companies to review their portfolios more regularly," said Rennie. "And megadeals in the third quarter of 2017 highlight how industry consolidation is increasing and creating larger, and more diversified portfolios around the world.

"Those companies that can better identify emerging trends will be able to readjust their portfolios and recycle capital to take advantage of new growth areas."

Americas

American Hydro boosts Belize plant

American Hydro has won a contract to upgrade the Mollejon hydropower plant in Belize, Central America.

American Hydro, a subsidiary of Wärtsilä Corporation, will provide Belize Electric Company (BECOL) with equipment and technical support to enhance the efficiency and performance of the 25 MW power plant, located on the Macal River near Belize City.

In the first stage of the project, American Hydro will overhaul the G1 unit and replace old turbine components to increase overall plant efficiency. The agreement includes new turbine runners, stationary turbine seals, wicket gates and rehabilitation of essential operating components as well as technical support of disassembly, installation and commissioning.

Installation and commissioning of the G1 unit is set to be completed in June 2018, prior to the Belize rainy season.

Tyr chooses Siemens for Hickory Run

Try Energy has selected Siemens as its technology partner for the 1000 MW Hickory Run Energy Center power plant in Pennsylvania, USA.

Siemens will supply its H-class gas turbine technology for the new gas-fired combined cycle power plant, which has been designed for fast, flexible operation.

Siemens Financial Services is providing an equity investment and will own 20 per cent of the project alongside Tyr Energy, Inc. and Kansai Electric Power Co., Inc. Siemens has also signed a long-term service agreement for the plant, which is due to start operating in 2020.

Wärtsilä to build Curaçao plant

Aqualectra, the utility company of Curaçao, has placed an order with Wärtsilä to build a 39 MW power plant.

The turnkey project will provide much needed additional generating capacity and provide Aqualectra with the fast starting capacity and flexibility needed to complement the addition of more wind power capacity to the island's system, Wärtsilä said.

The new plant will operate on four Wärtsilä 34DF dual-fuel engines running initially on heavy fuel oil (HFO), but switching to liquefied natural gas (LNG) fuel at a later date. The Wärtsilä solution will add needed reliability to the grid, and when running on LNG will notably reduce the utility's environmental impact. The plant will be equipped with continuous emissions monitoring capability.

Asia-Pacific

Sembcorp wins India wind contract

The renewable energy business arm of Singapore-based Sembcorp has won a bid to set up a 250 MW wind power project in India.

Sembcorp Green Infra won a tender conducted by the Solar Energy Corporation of India (SECI) on behalf of the government of India's Ministry of New and Renewable Energy (MNRE) and will develop the wind farm in phases.

Power generated from the wind farm will be sold to SECI under a 25-year power purchase agreement. It will start operating in 2019.

Kum Shing awards Black Point contract

Kum Shing E&M Limited has awarded Shanahan Engineering a significant project management services contract for the first Siemens H-Class gas turbine combined cycle unit at Black Point Power Station in Hong Kong.

The contract covers a suite of project management services from Shanahan Engineering's Dublin headquarters; including management oversight, pre-planning, key construction management processes, delivery of key personnel and the use of Shanahan Engineering's weld management systems.

The new unit at Black Point will add another 550 MW to the existing 2525 MW power station.

Kepco inks Vietnam deal

Korea Power Electric Corp. (Kepco) has signed a 2.6 trillion won ($2.3 billion) deal to construct a coal fired plant in Vietnam.

A consortium of Kepco and Japanese trading firm Marubeni will be in charge of construction as well as the operation of the 1200 MW power plant in the Nghi Son 2 economic zone in the central province of Thanh Hoa, about 200 km south of Hanoi.

Construction of the plant will begin later this year with the aim of completion by the end of 2021.

Hanwha to build floating solar power farm

A consortium led by Hanwha Chemical has been selected as a preferred bidder by the Korea Rural Community Corporation (KRCC) to build a 100 MW floating solar power plant in Dangjin in South Korea's South Chungcheong province.

Construction of the project is due to start in 2019. It will span 1.2 km^2 of water and will be the world's largest floating solar plant by capacity when it starts operating in 2020.

Europe

Siemens Gamesa to deliver 60 MW in Greece

Siemens Gamesa has secured three new orders from two local IPPs for the supply of 60 MW for three onshore wind farms in Greece.

One IPP has ordered 8 units of G114-2.0 MW at the Kali Hitsa wind farm (16 MW), located in the Aetolia-Acarnania region, in the south of the country, and twelve G90-2.0 MW at the Litharoserma wind farm (24 MW), located in the same region.

Additionally, a third project has been awarded by another local IPP to Siemens Gamesa for the supply of ten turbines of 2 MW (20 MW).

The turbines will be supplied during the second half of 2018 and the company will provide operations and maintenance services at these three wind farms for the next ten years.

EIB backs Markbygden

The EIB has signed a €180 million financing agreement with a project company sponsored by GE and Green Investment Group Limited backing the construction of the largest onshore wind farm in Europe.

GE and Green Investment Group have announced plans to build the 644 MW first phase of the Markbygden 1101 wind farm in northern Sweden, using 179 GE 3.6 MW wind turbine units installed near Piteå.

"This fascinating project supported by the EIB is taking the use of wind energy to a new level," said Alexander Stubb, EIB Vice-President responsible for EIB operations in northern European countries. "It will help Sweden to expand its renewable energy sector even beyond the objective set by the EU and makes the continent more sustainable and greener."

Of the EIB financing €100 million are backed by the European Fund for Strategic Investments (EFSI). Some €80 million of the EIB financing is covered by a guarantee provided by the German Export Credit Agency, Euler Hermes.

NKT secures Moray East PBA

NKT has signed a Preferred Bidder Agreement (PBA) with Moray Offshore Windfarm East Ltd for delivery and installation of export cable systems on the 950 MW Moray East wind farm off the coast of Scotland.

The scope of works includes the manufacture of approximately 185 km of 220 kV AC offshore export cables, installation by the NKT Victoria cable-laying vessel, and burial of the cable.

The final order is conditional upon final negotiation of the EPC contract and the project owner making a final investment decision (FID) for the offshore wind farm, NKT said.

RTE gets smart

ABB has been selected by French grid operator RTE to deploy its ABB Ability Network Manager control system to enable operators to monitor and control the grid more efficiently.

The ABB Ability Network Manager SCADA/EMS system (Supervisory Control and Data Acquisition/Energy Management System) is a scalable solution that will help monitor and control the network with thousands of substations to ensure high system reliability across all of France, including Paris. ABB's consortium partner, Atos Worldgrid, will be responsible for the system integration and maintenance of the system.

"Our ABB Ability Network Manager control system will enable RTE to manage and optimise the transmission network across France and help maximise the reliable and efficient delivery of clean power to millions of consumers," said Massimo Danieli, head of ABB's Grid Automation business within the company's Power Grids division.

International

GE supports Iraq power sector

Iraq's Ministry of Electricity has signed an agreement worth over $400 million with GE Power for the construction of 14 turnkey electricity substations and the refurbishment of a number of existing substations.

The project will bring much needed power to areas of the country facing significant energy shortages and "represents a major milestone in… efforts to strengthen Iraq's power transmission sector," according to Mussab al-Mudaris, spokesperson of the Iraqi Ministry of Electricity. GE said it would support the government's efforts to finance the project funding through various financial institutions, including export credit agencies and commercial banks.

GE will develop the substations to connect power plants spread across the governorates of Ninawa, Salah Al Din, Al Anbar, Karbala, Baghdad, Qadisiyyah and Basra to the national grid.

Several of the locations, in conflict affected areas, are continuing to recover and are in immediate need of reliable power infrastructure.

GE Power has previously provided power generation equipment for some of the power plants that the substations will be connected to, including the 3 GW Basmaya power plant.

Doosan inks South Africa coal plant deal

South Korea's Doosan Heavy Industries & Construction has won a $1.05 billion order from a Korea Electric Power Corporation-led consortium for the supply of key equipment for a new coal fired power plant in South Africa.

Doosan said it would provide the boilers and turbines for the plant, and that it would officially sign a contract for the deal in May 2018.

In 2016 Kepco and its partner Marubeni won a contract to build a coal fired power plant in Thabametsi, Limpopo province.

Vinci lights up Senegal solar

Vinci Energies has been awarded a €26.8 million contract to build eight solar photovoltaic power plants in Senegal.

The contract was awarded by Societe d'Electricite du Senegal, or Senelec, and was financed by the German bank KfW and Senelec. Vinci Energies will have 10 months to complete the project, with handover scheduled for July 2018.

The company says that the plants will have a combined generating capacity of 17 MW.

Azito plans upgrade

GE's Power Services business has signed an agreement with Azito Energies SA to upgrade two gas turbines at the company's combined cycle power plant in the Ivory Coast.

GE's hardware upgrade and Operations Optimization digital solutions will help increase power output by up to 30 MW and will equip Azito with the insights it needs to increase efficiency and improve operations at the power plant. The project, located in the Yopougon district, marks GE's first GT13E2 MXL2 gas turbine upgrade order in sub-Saharan Africa.

The upgrade is also expected to deliver a combined cycle efficiency increase, resulting in significant fuel savings and reduced CO_2 emissions. GE's solutions will also extend inspection intervals for the gas turbines, reducing maintenance and repair expenses, which, in turn, will reduce overall plant costs and result in improving profitability.

Fortum-Rusnano orders Vestas turbines

The Fortum-Rusnano investment fund has signed an agreement for the supply of 14 turbines from Vestas Wind Systems for a 50 MW project in Russia.

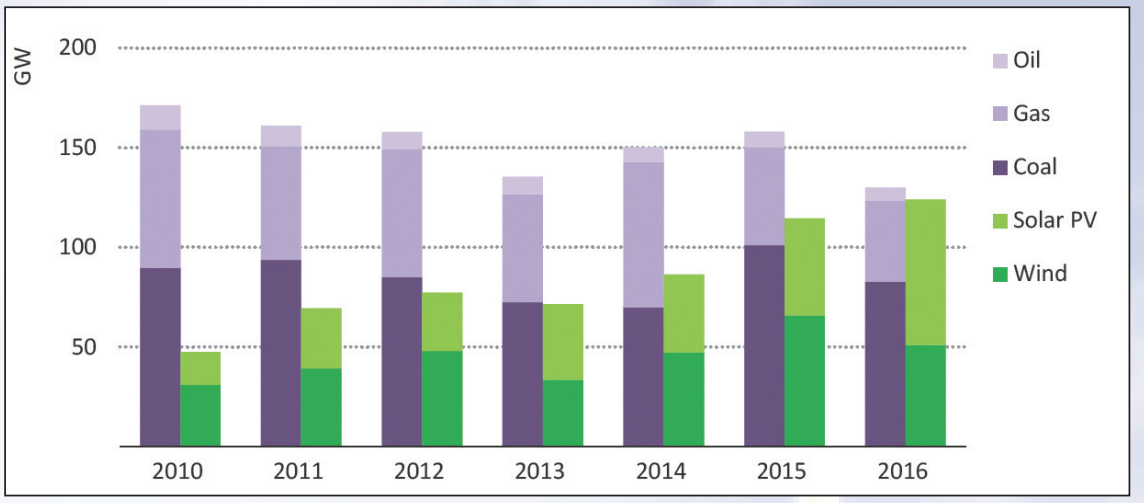
The project is the first in a series of projects set to be delivered in Russia by Fortum and state-run nanotechnology company Rusnano after they jointly won a 1 GW tender earlier this year.

Vestas has been signed up to supply turbines for the projects and says it will build manufacturing facilities in Russia to comply with local content requirements.

The first project is due to start operating in early 2019.

The 1 GW of wind turbines to be installed by the investment fund are slated for commissioning in the 2018-2022 period. Fortum and Rusnano each hold per cent stakes in the investment vehicle.

Global power generation capacity additions for fossil fuels, wind power and solar PV



World Energy Outlook 2017, © IEA/OECD, Figure 6.1 , page 231

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Recent developments in regional power sector policies included in the New Policies Scenario

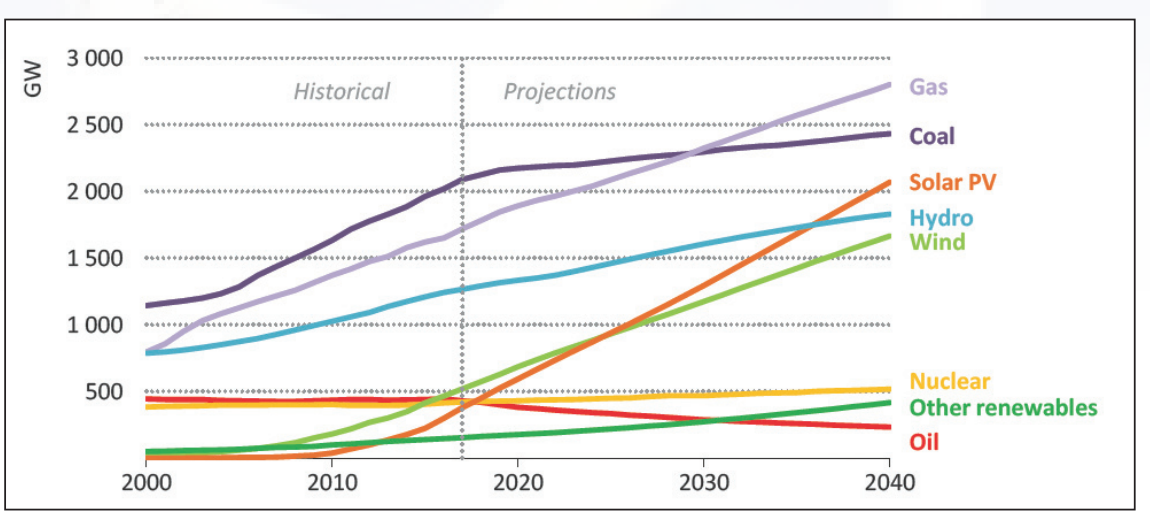
Region	Policy	Authority	Release date	Impact on outlook by source			
				Renewables	Nuclear	Gas	Coal
China	13th Electricity Development Five-Year Plan (to 2020)	NEA	December 2016	↑	↑	↑	↓
India	Draft National Electricity Plan (to 2022)	CEA	December 2016	↑	↑	↑	↓
Korea	Proposed energy pillars (to 2025)	New admin.	2017	↑	↓	↑	↓
France	Announced energy policy (to 2025)	New admin.	2017	↑	↓	–	↓
European Union	No new coal power plants post-2020	26 of 28 countries	2017	–	–	↑	↓
Indonesia	PLN electricity supply business plan (2017-2026)	PLN	March 2017	↑	↑	↑	↓
Canada	Phase out traditional coal-fired power plants by 2030	New admin.	November 2016	↑	–	↑	↓
United States*	Removal of Clean Power Plan (to 2030)	New admin.	2017	↓	–	↓	↑

*For the United States, impacts are indicated relative to the case in which the Clean Power Plan is enforced.

Note: NEA = National Energy Administration in China; CEA = Central Electricity Authority in India; admin. = administration; PLN = Perusahaan Listrik Negara, the state electricity company in Indonesia.

World Energy Outlook 2017, © IEA/OECD, Table 6.2, page 241

Installed power generation capacity by type in the New Policies Scenario



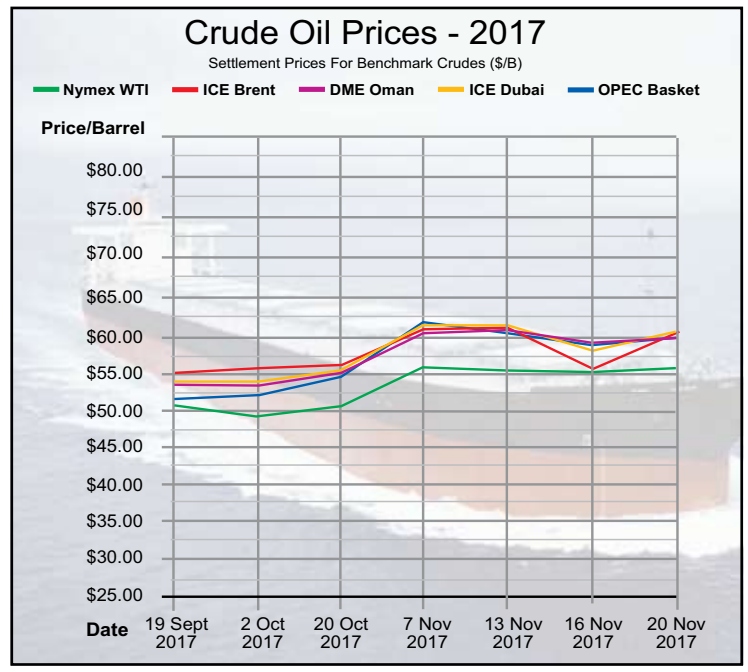
World Energy Outlook 2017, © IEA/OECD, Figure 6.6, page 244

Source: World Energy Outlook 2017

Oil

US shale oil to challenge conventional producers for years to come

- US to become largest exporter of LNG and net exporter of oil by mid-2020s
- Shale oil will slip into decline by 2030



David Gregory

As it was in 2014, when Saudi Arabia upped oil production in an attempt to force US shale (or tight) oil out of the market, shale oil remains a major source of concern for Opec, Saudi Arabia and other non-Opec oil producers.

With Brent crude oil prices finally scratching above $60/b and West Texas Intermediate in the high $50s, Opec's efforts to restrain oil production by its members and its non-Opec allies appear to finally be paying off. But with oil back in that price range, it only serves to encourage US shale producers to pump harder and make profits as long as the opportunity exists.

As oil prices have returned to an upward motion – but only after Opec and non-Opec implemented production cuts – shale oil output has increased and is now marked to become the primary source of crude oil output in the US.

Last month Opec released its annual *World Oil Outlook* report and in it identified the challenge that US shale oil would pose for conventional oil producers in the year ahead. Opec projected US shale oil growing to 7.5 million b/d by 2021, from its current output of 5.1 million b/d, which is up by 25 per cent from a year ago.

But Opec does not expect the US shale challenge to last forever, shale oil will finally begin to taper off in 2025 and then slip into decline by 2030, at which point Opec will return to prominence with an oil output capacity of 41.1 million b/d. With the rise of US shale oil and US oil exports in the near term, US producers are likely to pose a formidable competitor for market share from now and well into the 2020s.

But even if US shale production does begin to slide at the end of the next decade, what about all the other shale deposits in other areas of the world that are not yet being exploited? Shale oil, whether US or not, may be a commodity on global energy markets for a long time to come. And by 2030, the energy scheme could be much different than today, with renewable systems developed in ways that we really don't see now.

The Paris-based International Energy Agency (IEA) acknowledged the impact that US shale oil is having in its *World Energy Outlook 2017*, but it also painted a picture of global energy change.

"Four large-scale shifts in the global energy system set the scene for the *World Energy Outlook 2017*," the IEA said in the introduction to the annual report. "The rapid deployment and falling costs of clean energy technologies, the growing electrification of energy, the shift to a more services-oriented economy and a cleaner energy mix in China, and the resilience of shale gas and tight oil in the United States.

On the resilient presence of US shale oil, the IEA said: "A remarkable ability to unlock new resources cost-effectively pushes combined United States oil and gas output to a level 50 per cent higher than any other country has ever managed; already a net exporter of gas, the US becomes a net exporter of oil in the late 2020s.

"In our projections, the 8 million b/d rise in US tight oil output from 2010 to 2025 would match the highest sustained period of oil output growth by a single country in the history of oil markets. A 630 billion m^3 increase in US shale gas production over the 15 years from 2008 would comfortably exceed the previous record for gas," the IEA said.

"By the mid-2020s, the United States becomes the world's largest liquefied natural gas (LNG) exporter and a few years later a net exporter of oil – still a major importer of heavier crudes that suit the configuration of its refineries, but a larger exporter of light crude and refined products," the agency added.

US shale production is an issue that big oil producers like Saudi Arabia and Russia are going to have to deal with for some time. The economies of those countries dependent on high oil prices, and perhaps their efforts to restrain production will in fact reduce the glut that has materialised and filled storage facilities in recent years.

But it is a challenge that conventional oil producers will face – as the glut subsides and prices go up, shale oil will be there to counteract any reduction in Opec or non-Opec production that is made.

Gas

Alaska LNG project gets new chance with Chinese agreement

Alaska's proposed LNG project has been thrown a lifeline with the Chinese now considering investment in the infrastructure and buying the gas from the project.

Mark Goetz

An agreement signed last month in Beijing during a visit to the Chinese capital by US President Donald Trump holds the promise of launching the Alaska LNG project. Until the signing of a memorandum of understanding between the State of Alaska, the Alaska Gasline Development Corporation (AGDC), and several major Chinese companies, the future of Alaska's proposed LNG project was uncertain, and even though the Beijing agreement is just an initial step towards its materialisation, there appears to be good prospects that it will go ahead.

Alaskan Governor Bill Walker had failed to persuade the companies operating on the North Slope, the source of the gas for the project, to join the project. With the Chinese now considering investment in the infrastructure and buying the gas, all ExxonMobil, ConocoPhillips and BP will have to do is supply it.

The MOU is non-binding but now there will at least be serious discussion and the Chinese entities have the capital available to invest the $43 billion that the project is estimated to require.

Alaska, AGDC, the China Petrochemical Corporation (Sinopec), the China Investment Corporation (CIC) and the Bank of China have promised to draw up a plan by end of 2018, that includes the construction of a 1300 km gas pipeline stretching from the Alaskan North Slope to a 20 million t/year capacity liquefaction plant on the Kenai Peninsula near Anchorage on the state's southern shore.

Sinopec is the world's largest oil and gas company based on its $455.5 billion revenue. In a statement released after the agreement, it said it is "interested in the possibility of LNG purchase on a stable basis from Alaska LNG." CIC is China's sovereign wealth fund and Bank of China is the fourth-largest bank in the world. CIC would likely take an equity stake in the project and Bank of China is seen as providing a large slice of the financing.

The deal "brings the potential customer, lender, equity investor, and developer together with a common objective of crafting mutually beneficial agreements leading to increased LNG trade between Alaska and China," Keith Meyer, president of the AGDC, said at the agreement signing ceremony.

"We call it debt for capacity," Meyer said. "We're getting debt, we're paying with capacity. It makes for a beautiful fit between the two. We need the funding to build the project, they want the capacity, so it really gets the benefit for both parties working together."

Between now and end of 2018, the US and Chinese sides of the agreement are to work together to study project investment requirements, the arrangement of financing, and LNG marketing. Once that is complete, the parties will make a final investment decision in 2019 and if approved Alaska LNG could be exporting by 2025.

A solid deal with long-term commitment by China to buy natural gas produced by the US is seen as making a considerable improvement in US-China trade relations. US companies investing in domestic LNG projects see Chinese and Asian markets as important targets for US exports that in the next decade are expected to rank among top producers. China, meanwhile, is headed towards becoming the world's largest energy consumer.

According to the MOU signed in Beijing, Sinopec would purchase 75 per cent of Alaska LNG exports, and AGDC would target the remaining 25 per cent to Japan, Korea and Vietnam.

LNG is expected to account for a third of China's gas consumption in 2025. Its demand is expected to grow to 330 billion cubic metres (bcm) per year in 2020, compared to 206 bcm in 2016. China is taking serious steps to reduce its reliance on coal to alleviate serious pollution problems.

China already consumes huge volumes of gas that arrive via pipeline from Russia and Turkmenistan. Its main LNG suppliers are Qatar, Malaysia, Australia and Oman.

Alaska and the US have the gas resources to make Alaska LNG and a number of other new and planned LNG projects successful.

Alaska's North Slope alone has a gas resource estimated at 35 trillion cubic feet, the equivalent of 990 bcm, enough to keep China and many other places supplied with gas for a very long time.

The perfect storm for M&A

As renewables continue to grow in the generation mix, energy businesses are turning to artificial intelligence and big data to improve forecasting. According to a recent report by BDO, this is creating a perfect storm for merger and acquisition activity.
Jakob Sand

Renewables will be the fastest-growing source of electricity generation over the next five years, according to the International Energy Agency. In 2016 some 138 GW of new power capacity came online – almost 11 GW more than the previous 12 months. Already in 2016 wind, solar, biomass, waste-to-energy, geothermal, small hydro and marine energy sources between them added 138.5 GW, up from 127.5 GW in 2015. The 2016 figure was the highest proportion in any year to date, equivalent to 55 per cent of all the generating capacity added globally.

However, renewables fundamentally transform the electricity sector. Fluctuating feed-ins, changed load curves and low electricity prices all present substantial challenges for incumbent players. In these uncertain times, energy businesses are adapting their strategies and are looking to artificial intelligence (AI) and big data to improve energy forecasts. As a result, the scores of energy start-ups and new solutions hitting the market make the marriage of machine learning and renewables a very promising space to watch, and one that often leads to quick-fire mergers and acquisitions.

Sand: large companies may have to resort to M&As to avoid losing market share

Over the first half of 2017 the M&A trend gathered momentum, with energy and renewables enterprises acquiring big data and (AI) companies.

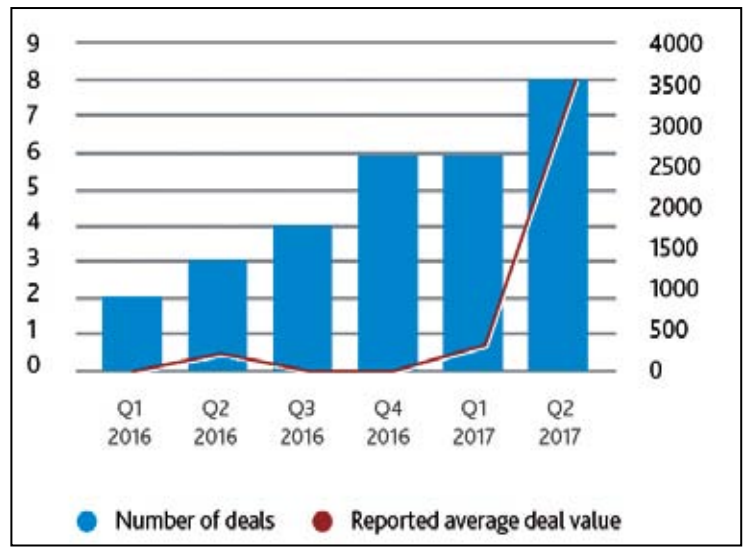
Data from BDO's M&A database shows how the average deal value for these kinds of mergers and acquisitions has shot up from $500 000 to $3.5 million, while deal numbers have been climbing steadily through the last couple of years. And these are the early stages of an acquisition trend that will continue for years to come.

To operate the grid more efficiently and keep fossil reserves at a minimum, operators need to have a better idea of how much wind and solar power to expect at any given time.

The way to generate such insights is through using big data analytics and AI to radically improve prediction models. But adoption is slow: utilities understandably are not the fastest-moving sector in the world given the vast scale and complexity of energy grids and power plants, tied to cross-border political negotiations. However, we are starting to see a marked shift where both the production (power plants, wind turbines, solar panels) and distribution sides (e.g. energy grid and storage) are adapting and starting to integrate new technologies.

AI will allow a transition to an energy portfolio with increased renewable resource production and minimal disruptions from the natural intermittency that comes with these sources due to variable sunlight and wind intensity. For example, when renewables are operating above a certain threshold, either due to increases in wind strength or sunny days, AI-powered energy management software would automatically reduce production from fossil fuels, thus limiting harmful greenhouse gas emissions.

The opposite would be true during times of below-peak renewable power generation, thus allowing all sources of energy to be used as efficiently as possible and only relying on fossil fuels when necessary.



Big data analytics and renewable energy M&A deals 2016 - 2017 Q2

Additionally, producers will be able to manage the output of energy generated from multiple sources to match social, spatial, and temporal variations in demand in real-time.

AI can screen large stacks of data for a wide range of factors that may impact performance, e.g. layout and location of a site, contractual offtake agreements, type of equipment, grid connection, weather, and operation and maintenance costs can all help predict a possible financial rate of return. For example, consider a wind farm. With location data, the software can use public data sets to calculate the last few decades of wind speed and determine the project's overall performance. Location can also help determine the project's profitability in the market. California or the UK could be a better market than, for instance Texas.

Specific types of equipment and manufacturer matter, too. If an investor considers a certain type of wind turbine, data can be pulled to determine that the turbine in a given location will need $2 million of replacement parts in the next five years. It could indicate that in year seven, the probability that something is going to fail, potentially resulting in a shutdown of the site will be 50 per cent.

Making the demand for electricity 'intelligent' means that vital capacity can be provided when and where it is most needed and pave the way for a cleaner, more affordable, and more secure energy system. The key lies in unlocking and using demand-side flexibility so that consumers are not impacted and are appropriately rewarded.

In the USA, PowerScout uses machine learning and big data to find smarter ways to sell solar panels to customers, while kWh Analytics offers risk management solutions to protect investments in solar. Again, AI plays a central role in their solutions.

Major tech companies are also investing and working to establish themselves in the space. For example, IBM Research has already partnered with 200 companies that use its solar and wind forecasting technology. And IBM is far from the only big company pursuing these solutions. Google, for example, has launched its Project Sunroof. Data from CB Insights shows how the two, along with other big tech companies have been making scores of AI acquisitions.

The same goes for some of the companies specialising in technological solutions for renewable energy, such as NEXTracker, which acquired the start-up BrightBox Technologies to 'enable smart and connected solutions for the renewable energy market'. NEXTracker was itself acquired by Flextronics International for $330 million.

In Europe, grid operators are currently finalising plans to launch a digital information exchange platform that will serve as a basis for developing new digital applications to manage electricity flows and take up growing amounts of renewable energy. In the meantime, many of the 2595 clean energy start-ups tracked by AngelList are already bringing their products and services to market. It leads to a situation where many large companies may have to resort to M&As to avoid losing market share to the new kids on the block.

Jakob Sand is a Partner at BDO, Leader of BDO's global technology, life sciences, media & entertainment and telecommunication transactions practice. BDO's report titled: "Why big data, AI and renewables are the perfect M&A storm" can be downloaded at www.BDO.global.

A selection of 2017's significant energy and AI/big data M&A

August 2017: Wildan Group buys Integral Analytics for $30 million

Sub-trend: demand forecasting/smart grid

Why it is interesting: Integral Analytics has built a software suite that helps utilities integrate distributed energy resources. Its solutions tap sources of data like econometrics and customer-owned power assets to help understand how customers use power and how that usage could change. This helps the power utilities plan the right level of resources and be well positioned for the future.

May 2017: Itron acquires Comverge for $100 million

Sub-trend: demand forecasting/smart grid

Why it is interesting: Comverge uses machine learning to improve demand forecasts. It uses data to 'train' its prediction models to find the rules themselves. Over time, as the models 'learn' from more experience (more DR events), the forecasts become more accurate. Itron strengthens its portfolio of grid solutions with the industry's leading demand response offering while also paving the way for game-changing distributed energy management applications.

February 2017: Vepos acquires Utopus (amount undisclosed)

Sub-trend: big AI moving into renewables placement and smart grid forecasting

Why it is interesting: A merger involving IBM's clean energy research team. It forms one of the premier and likely best funded and technologically advanced start-ups. The company can rely on IBM's Watson systems to create weather predictions.

February 2017: Castrol buys Romax technology (amount undisclosed)

Sub-trend: AI used to reduce maintenance costs

Why it is interesting: Castrol and Romax partner to grow wind-turbine predictive maintenance business. The lubrication and maintenance of a wind turbine's expensive gearbox is critical to optimising its performance and reliability, and Romax's technology helps this through data-driven O&M, reducing O&M costs significantly.

The nuclear option

Despite the challenges facing new build projects, nuclear is still an important part of the energy mix in some countries.
Junior Isles visited the site of the Hanhikivi 1 reactor in Finland – a project that could rebuild confidence in the industry.

As the cost of electricity from wind and solar continues to plummet, many industry observers are questioning whether nuclear still has a place in the future energy mix – especially in Europe. High capital costs and persistent overruns on budget and construction schedules have dogged projects in Finland and France. At the same time, nuclear is a technology that is not well suited to a market where plant owners are looking for flexible forms of generation to complement the growing amount of renewable generation.

But arguably, for some countries it still makes sense. Despite the well-publicised problems at the ongoing Olkiluoto 3 (OL3) project, Finland has not been put off. Site preparations are ongoing at Fennovoima's Hanhikivi 1 project in Pyhäjoki – a new nuclear plant that will play a key role in providing zero-carbon baseload power at a competitive price.

Nuclear currently produces around 30 per cent of Finland's electricity, a figure that could rise to between 40 and 45 per cent when OL3 and Hanhikivi 1 come on line.

Commenting on plans to increase the nuclear share, Liisa Heikinheimo, Deputy Director General of the energy department at the Ministry of Employment and Economy said: "In the government programme, coal use has to stop in 2020… then it will be a play of mostly renewables and nuclear for electricity production.

When OL3 comes on line, nuclear will account for around 36-37 per cent of production. When we add Fennovoima [Hanhikivi 1] it will be more than 40 per cent but not more than 45 per cent; it depends on what happens with the Loviisa units." Discussions are ongoing as to whether their operating licence will be extended.

Jorma Aurela, Chief Engineer at the Ministry's energy department added: "Finland is a flat country. Hydropower is over 10 per cent but less than 15 per cent, and that will remain the same. We have a specialty that is peat power and we have 4-5 per cent in our electricity production [mix]. In 2010, at the time we decided to build Fennovoima's project, we also made too other big decisions. The first was for energy efficiency and the second was to have 6 TWh coming from wind power by 2020."

He also noted that due to an expensive feed-in-tariff of about €80/MWh to support onshore wind, the Ministry is currently lobbying the government to convert more wood from the country's extensive forest to biofuels for power production.

Acknowledging that replacing base load coal fired capacity at a competitive price will be challenging, he said: "Nuclear is not even being discussed because we have made the decision to commit to it."

The price of power from Hanhikivi 1 was obviously a key factor in the decision to build the project. At €50/MWh, the price of power from the plant is not only lower than renewables, it is notably far lower than the price that will be delivered by other high profile new build projects recently agreed.

During a recent press presentation on the project in Helsinki, Toni Hemminki, CEO, Fennovoima said: "In the first years of operation we will start with a price of €50/MWh. This is significantly lower than the UK [Hinkley Point C] project, which has a strike price of €92.50/MWh… the owners believe the business case is robust."

Fennovoima is a company operating under the 'mankala principle', i.e. it will sell all the electricity generated at the plant to the owners at cost price in proportion to their ownership. This price includes operating and financing costs, as well as the organisational costs of the company. The mankala principle has been widely used in Finland's energy sector for decades – about 40 per cent of the electricity in Finland is produced by the mankala companies.

Voimaosakeyhtiö SF, a Finnish holding company, owns 66 per cent of the shares in Fennovoima. Its shareholders include over 60 major Finnish industry corporations such as Outokumpu and Fortum, and local energy utilities. As these companies require a high amount of energy for their operations, a reliable and stable priced power supply is crucial for their businesses.

RAOS Voima owns the remaining 34 per cent of the shares. The company is a 100 per cent Finnish subsidiary of Rosatom, the Russian conglomerate that is also supplying the plant. RAOS Voima plans to sell its share of the electricity from the plant on the NordPool market.

Hanhikivi 1 will require a total investment of about €6.5-6.7 billion, depending on the cost of interest payments. Around 25 per cent of the required project financing (about €1.7 billion at the time of plant start-up) will be provided as equity from the owners. The remaining 75 per cent will be in the form of debt financing. It has already been agreed that about half (€2.4 billion) of this debt financing will be sourced from the Russian Federation National Welfare Fund. The other half of the debt (about €2.6 billion) is currently under negotiation but will be covered by export credit agencies and foreign commercial banks. These loans will predominantly be used to cover the supply of power island equipment and reactor components.

Hemminki: the owners believe the business case is robust

The project is based on tried and tested Russian nuclear technology. Steam generated from a third generation VVER-1200 pressurised water reactor will be used to drive a 1200 MW Arabelle steam turbine supplied by GE (formerly Alstom).

Commenting on the choice of technology Hemminki said: "When we moved from 1600 MW to 1200 MW, in the negotiations, Rosatom was the best candidate to provide the best business case. The 3+ Generation has all the safety features proposed by the various authorities post-Fukushima. There are about 37 VVER plants operating well around the world. They are working well at Loviisa; their availability is among the top five in the world." He said, however, that it was the total business package – the financing and the technology – that allowed Fennovoima to make the final investment decision.

Fennovoima was expecting STUK, the Finnish nuclear regulatory agency, to grant a construction licence in 2018 but this is now not expected until 2019.

Minna Forsström, Fennovoima's Project Director, commented: "STUK has to ensure this is a safe nuclear power plant. So the safety assessment is clearly key. STUK has a lot of questions and requirements – there can be more than 10 000 requirements in this process. It's a complicated process.

"They have to really understand the project. Talks with STUK on the construction license are very active. The dialogue is constant; we meet with them every few days."

How the delay on the construction license will affect the planned 2024 completion date is unknown. "We are discussing the situation in detail with our supplier, Rosatom, who will give the schedule," said Hemminki. "Any delay, however, will not affect the price of the project," he added.

With the spectre of OL3 still looming large, Hemminki says the company has learned from TVO's experience with that project. "We have hired a lot of people that have come from TVO, Fortum and STUK. The tactic is to figure out what we can do differently from the beginning. We have already taken a number of issues into account… One key is that we have to make sure the plant design is more mature than in previous projects."

In the meantime, site preparation is under way on the project, which will employ 4000 people at the peak of construction – more than the town of Pyhäjoki.

The argument for nuclear is largely based on its climate credentials – it is a technology that offers large base load generation with zero carbon emissions.

"We keep talking about climate change," said Hemminki. "We strongly believe that we are part of the solution in the fight against global warming. When the industry and analyst are looking at how to avoid exceeding the 2°C limit agreed in the Paris climate accord, nuclear plays quite a significant role. Nuclear produces about 2500 TWh globally. Under the IEA scenarios, if we want to meet the climate targets nuclear would have to increase to 6500 GWh per year by 2040. This is roughly one Hanhikivi 1 per month between now and 2040."

If Hanhikivi 1 can be delivered at least close to schedule and budget, it will go a long way to restoring nuclear's credentials as a financially viable zero-carbon option in Europe and more importantly, keeping the technology as part of the solution in combatting climate change.

Site preparations are ongoing at Fennovoima's Hanhikivi 1 project in Pyhäjoki

The prototype has been running on the test bed since March last year

Changing the diesel game

MAN Diesel & Turbo recently unveiled what it has dubbed "the game changer" – a family of reciprocating engines designed for both power and marine applications that has industry leading power output and efficiency. **Junior Isles** reports

The use of reciprocating engines that run on fuel oil or even gas may at first glance seem to go against the drive for a cleaner energy sector. But as countries move to cut emissions, with wind and solar taking a rapidly growing share of the energy mix, many operators are recognising the value of reciprocating engines in complementing the variability of these renewable energy sources. This, combined with a move to greater decentralisation, is seeing power plant owners and operators call for recip engines with ever-higher power outputs and better electrical efficiency.

In response to the market demand, MAN Diesel & Turbo recently unveiled what it has dubbed "the game changer" – a family of recip engines designed for both power and marine applications that has industry leading power output and efficiency. The 45/60CR is a medium-speed 4-stroke engine with a power output of up to 26 MW – the highest power density in its class – and a fuel efficiency of more than 50 per cent.

Introducing the new engine at a press launch in Augsburg, Germany, Alexander Koerber, General Project Manager 4-stroke engines, MAN Diesel & Turbo, noted: "After extensive market analysis, we set the boundary conditions for the engine output and then identified the main features needed for the engine."

Key features included: low lifecycle costs, which requires high efficiency for low fuel consumption; high power density; compact design; low emissions; high permissible back-pressure, so as not to reduce the power of the engine if an after-treatment system is installed; no derating at high ambient temperature; high reliability, which also lowers lifecycle costs; and easy installation.

In addition to being designed to cover power and marine applications requiring 8-26 MW of power, the plan is to have versions of the engine capable of running on liquid fuels, gas or dual fuel. This means there will be a number of cylinder configurations. In order to minimise development costs, MAN Diesel & Turbo therefore defined three major modules: the power unit; the base engine and the turbocharger module.

Koerber explained: "The power unit – essentially the piston, cylinder head and liner – depends on the fuel type, i.e. whether it is liquid fuel, dual fuel or gas. The base engine – the crankcase and base frame – does not depend on fuel type; it only depends on the number of cylinders. So regardless of the application or the fuel type, you always have the same base frame. The turbocharger module, i.e. the turbocharger and associated piping, depends on the number of cylinders and heat exploitation but not on the application or fuel type.

"By combining these three major modules, we can create a variety of different application variants, without producing every single variant on its own. It also allows for an easier retrofit later on; for example if you want to change from liquid to dual fuel or to gas, it is relatively easy to do."

The end result is an engine that has two different cylinder configurations for power applications and seven for marine applications. For power applications, there are the 12V and 20V versions. With a power density of 1300 kW per cylinder this gives a power output range of 15.6 to 26 MW for the two designs.

Koerber, notes that the new engine has similar physical dimensions to its predecessor, the 48/60 but delivers 17 per cent or 1.2 MW more power. At the same time, efficiency is 3.5 per cent higher than the 48/60B, giving a fuel efficiency of more than 50 per cent even with attached pumps. This, says MAN Diesel and Turbo, reduces specific fuel consumption by up to 7 per cent.

The improvements make a significant difference to the bottom line. For power plant owners, the engine's enhanced performance means a 200 MW power plant can be built on 25 per cent less space with two fewer engines compared to when using the company's 18V 48/60 TS. This translates into a €11 million saving in capex.

If the plant is running in baseload (8000 h/year) with heavy fuel oil priced at €260/t, operating cost is reduced by 6 per cent or €60 million over a 15-year period, according to MAN Diesel & Turbo's calculations. At an electricity selling price of €0.08/kWh, the profit over the period is 35 per cent higher, amounting to €71 million over 15 years. The higher power output and fuel efficiency means the break-even time is cut by 24 per cent.

One of the keys to reaching the high power output and efficiency is two-stage turbocharging, which allows more energy to be drawn from the exhaust gas. Koerber explained: "You can extract more energy from the exhaust gas with two turbocharging stages because you can use the energy twice. And, both turbochargers, for the first and second stage, can be optimised in terms of size and efficiency." According to MAN, two-stage turbocharging leads to gains in efficiency of 1-1.5 per cent and lower fuel consumption. When combined with optimised injection timing for combustion, NOx emissions are also reduced.

With emissions being the main driver in the changing energy landscape, a burning question at the launch was: why has MAN Diesel & Turbo introduced a liquid fuel engine in 2017?

Stefanie Schatz, Product Manager, Product Management Sales Power Plants, MAN Diesel & Turbo, said: "Because the market told us so. There really is a need for a highly efficient engine in order to save resources, and later there is the possibility for retrofits to dual fuel and to gas."

She said the target markets are regions and areas where no gas is available. "Think about remote locations or islands. Our target markets are Asia Pacific, some countries in Africa, Latin America and countries in the Middle East. Here in Europe, there are also the Spanish islands.

MAN Diesel & Turbo says the engine's ability to maintain power output at high ambient temperature and altitude makes it ideal for countries in these regions. Again, this is largely attributed to the two-stage turbocharging. Like the 48/60TS, the 45/60 maintains full design power output at altitudes up to 2500 m. The 48/60B, with single stage turbocharging derates at altitudes above 1000 m. Unlike both its, predecessors, however, the 45/60 maintains maximum power output at temperatures above 50°C. "This is really good news for many of our customers," said Schatz.

Further, emissions inside the engine have also been reduced. According to MAN Diesel & Turbo, NOx levels have been cut by 5 per cent compared to the 48/60 TS, while SOx and CO_2 are 7 per cent lower. After-treatment, in the form of SCR catalyst and flue gas desulphurisation systems, can also be fitted to reduce NOx and SOx still further if necessary.

According to MAN Diesel & Turbo, the engine's improved emission performance, high efficiency and reliability make it well suited to baseload applications. At the same time, its black start and fast loading capabilities make it good for supporting renewables and other flexible peaking applications, as well as captive power plant for mines, cement plants and industrial CHP.

Journalists were able to verify some of the engine's performance credentials during the unveiling in Augsburg. This first prototype, a V-type 12-cylinder engine, showed it was capable of reaching a nominal load of 15.9 MW in just 28 seconds with an efficiency of 50.4 per cent at this load. According to MAN Diesel & Turbo, full load can be attained in 15 minutes from a cold start.

The prototype has been running on the test bed since March last year. Testing will be followed by commissioning of the first pilot in the field in August, with serial production starting in the second quarter of 2020.

MAN Diesel & Turbo is expecting the engine to be well received, and while it has opted to introduce the liquid fuel engine first, work is ongoing towards launching dual fuel and gas versions.

"There is still a need for liquid [fuelled] engines although of course we are aware of the [energy] transition," said Koerber. "We have started with the liquid fuel engine but the dual fuel and gas variants will be coming soon."

The launch of these cleaner burning versions will help strengthen the engine's role in the clean energy world of the future. As Dr Tilman Tütken, European head of sales for power plants at MAN Diesel & Turbo, summed up: "Everyone knows renewables are taking their share and we want to support them… so we have to be quick to balance load fluctuations. This requires a fast engine and this is a key feature that I like and one that or our customers like."

Junior Isles

No Bonn chance for clean coal

The argument over the future use of fossil fuels – especially coal – has become quite an emotive one, and the extent to which emotions run high on the subject were in clear evidence at the recent COP23 meeting in Bonn, Germany.

As the first set of negotiations since US President Donald Trump announced his decision to pull out of the Paris Agreement, fireworks were always on the cards. The touch paper ignited during a pro-coal presentation by the Trump administration on the sidelines of the conference.

When White House climate adviser George David Banks lauded the virtues of coal-fired power to ensure "universal access" to electricity, some were pushed over the edge. More than 100 activists interrupted the panel discussion, singing an anti-coal song to the tune of Lee Greenwood's 'God Bless the USA' before walking out.

While such behaviour is usually the preserve of more hardcore climate activists, many businesses and organisations are following their lead in their own way. Storebrand, Norway's biggest private pension provider, announced that it has divested from companies including German energy company RWE, Poland's PGE and Eskom Holdings of South Africa.

Its chief executive, Jan Erik Saugestad, said in Bonn that the decision is meant as a warning to utility companies to "clean up" their energy sources "or lose customers and investors". Storebrand said it hopes the much larger Norwegian Sovereign Wealth fund, which holds $1 trillion generated from the country's sale of oil, will follow its divestment decision.

Most notable at the conference was the announcement that 20 countries and two US states have formed an international alliance called 'Powering Past Coal' to phase out coal from power generation before 2030.

Illustrating the growing anti-fossil movement in the US, an unprecedented number of US states (15), cities (more than 300) and businesses (more than 150) were at COP23 to show America's continuing commitment to moving forward with tackling climate change.

A total of 20 US states, 110 US cities, and more than 1400 businesses have pledged to cut their fossil fuel emissions to ensure the US meets its commitment under the Paris Climate Agreement – even if the Trump administration acts on its intention to pull the US out. At the conference America's Pledge presented its official report on US climate action, analysing how US states, cities, businesses, citizens, and universities can support the Paris agreement even without federal action.

In a withering response to the promotion of coal by the US government, former New York City Mayor Michael Bloomberg said in a statement: "Promoting coal at a climate summit is like promoting tobacco at a cancer summit. It's also a denial of what's happening in the US – half of all American coal plants have been retired over the past six years."

While no one would dispute the need for universal access, Mr Bank's argument that there is any need for it to be done through the use of coal is flawed.

It is true that coal will remain in the global generation mix for decades to come and there is therefore a case for supporting the rationale that efforts to cut emissions from the existing coal fleet should continue. Cleaning up coal fired plant would definitely represent the biggest bang for the buck, and clean coal programmes might even lead to new technologies that enable the building of economic new clean coal fired power plants.

But the real question is: is there truly a need to build new large baseload coal fired plants in the changing energy landscape? Even when putting climate change aside, it is becoming increasingly difficult to justify the argument for new clean coal plant.

The promise of improved economics for carbon capture and storage (CCS) – the only technology that provides near-zero CO_2 emissions from fossil plant – has failed to materialise. Due to its high capex cost and the substantial energy penalty it incurs, only two commercial large scale plants are operating in the power sector – Boundary Dam, which began operating in Canada in 2014; and Petra Nova, which started up in the US this January.

Meanwhile, high profile projects like the Kemper project in the US, did little to help the cause. That project ended up $4 billion over budget and five years late before its owners decided to suspend all coal gasification operations.

Meanwhile, the falling cost of renewables has even weakened the argument for conventional coal fired units. Consequently, global coal use has gone into steep decline. China and India have cancelled plans for hundreds of new coal fired power plants and even in the US, the share of electricity coming from coal fell from 51 per cent in 2008 to only 31 per cent last year.

The impact of the plunge in solar PV costs in particular has been nothing short of phenomenal. Solar power tariffs appear to be in free fall in India, where prices have dipped below Rs2.5/kWh, more than 20 per cent lower than the average price of the Rs3.20/kWh charged by India's largest generation utility NTPC for electricity generated by its coal units.

No wonder India's appetite for coal fired generation is waning. The country installed more renewable energy capacity over the last financial year than thermal power capacity. The Draft National Electricity Plan 2016 states that India does not need additional non-renewable power plants until 2027 with the commissioning of 50 025 MW coal-based plants under construction and an additional 100 000 MW of renewable capacity.

But weakening economic competitiveness is not the only reason the growth rate of new large coal fired plants is slowing dramatically and will continue to do so, even in developing countries.

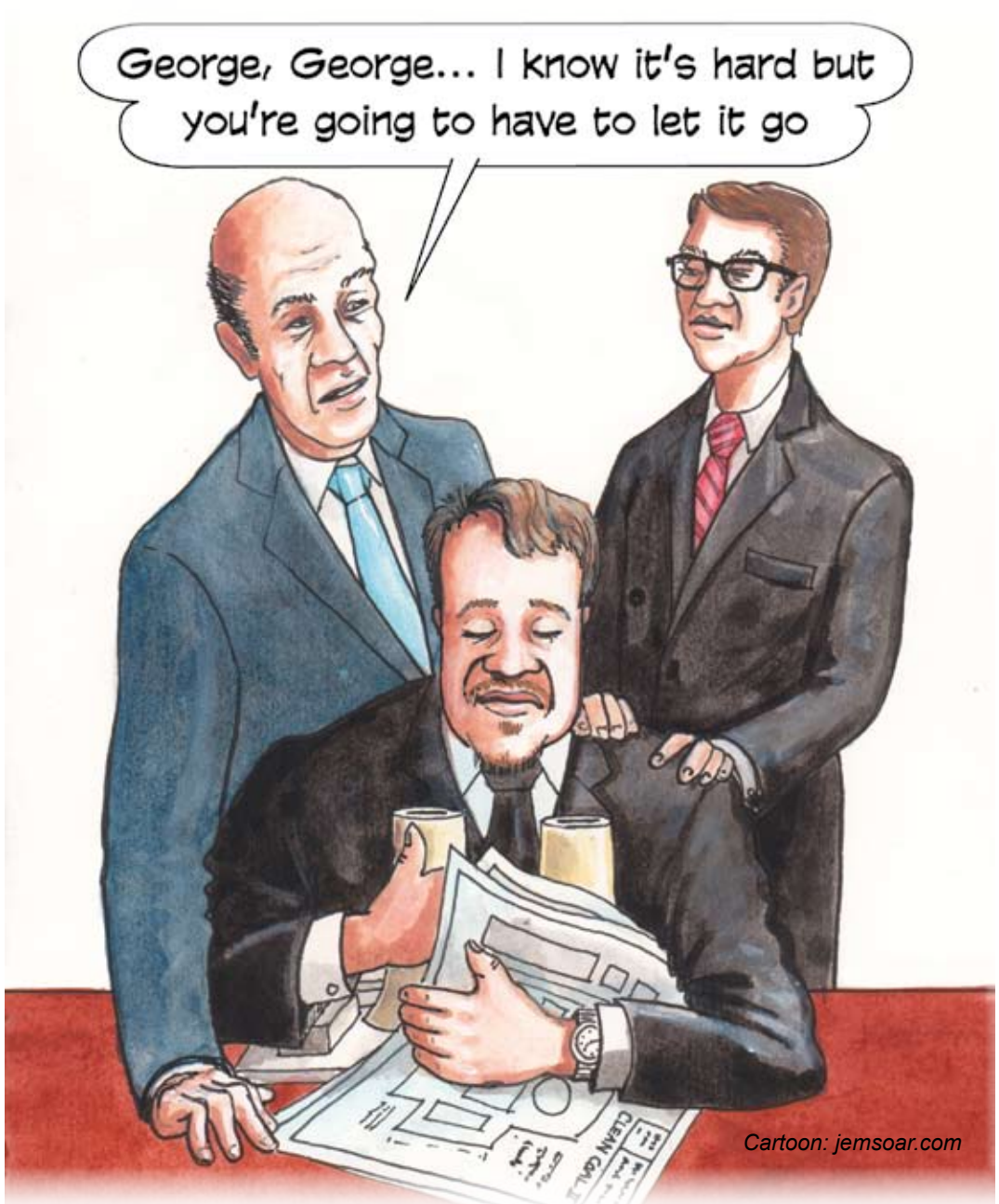
Mr Banks speaks of the need for access to electricity for all but his thinking is fast becoming out-dated. Rooftop or decentralised solar plus storage is a far more effective way of doing this compared with building large centralised fossil plants along with the grid connections that need to be built for evacuating the power to rural communities.

At COP23, Banks said Washington was "talking about a clean coal alliance, with perhaps Australia, India and countries in Africa". Some US delegates said such an alliance in time could include other coal-dependent countries such as Bangladesh, the Philippines and Poland.

While he might find allies in places like Australia and Poland, where the power system set up for large centralised coal plant and there is a vested interest in coal, support from Asian and African countries for any clean coal alliance may be less forthcoming than anticipated.

Many of these countries have the opportunity to in some ways leapfrog the electricity system developed in the west and move straight to the decentralised, smart electricity systems based on renewables and storage, which appear to be the future.

If this is the general direction of travel, whatever the US chooses to do will make little difference. This, combined with a global mood that demonstrates an unwavering commitment to tackle climate change, may find the coal industry needing more than a bit of good luck and backing from the Trump administration to survive in the long term.



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