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Bonn climate negotiators remain confident

UN climate secretary Patricia Espinosa described the mood as positive

Climate negotiators meeting in Bonn to work out the details of how the Paris Agreement will operate are still confident of the progress they are making despite threats by the US to withdraw. **Junior Isles**

Climate negotiators from nearly 200 nations gathering in Bonn, Germany, last month expressed confidence and optimism, despite the threat of an American exodus from the Paris Agreement.

At the close of the conference to discuss implementing the agreement to limit global warming, United Nations climate secretary, Patricia Espinosa said "it was a truly successful meeting", with the mood among delegates being positive despite negative signals from the US government.

Delegates were meeting in Bonn to specifically create a "rule book" for implementing the Paris Agreement. The meeting marks the halfway point between the climate conference in Paris and the conference next year where a rule book will be adopted.

The Paris Agreement needs such an operating manual because many details have not been decided. For instance, Article 13.13 requires countries to "adopt common modalities, procedures and guidelines (…) for the transparency of action and support". But what countries report, when, and how, is still unclear.

The most important issue in Bonn, however, was the form of the "ratchet mechanism". The climate plans that countries have submitted (Nationally Determined Contributions or NDCs) would push global warming to 2.6-3.7°C above pre-industrial levels, meaning countries will fall short of the goal of limiting warming to "well below 2°C" and "to pursue efforts to limit the temperature increase to 1.5°C".

Countries are supposed to ratchet up their commitments and to submit increasingly ambitious NDCs. The ratchet process will be based on "global stocktakes" every five years, at which countries will determine whether they are on track. But how the stocktakes will work is currently under negotiation.

The first informal one, known as the "Facilitative Dialogue", will take place in 2018 parallel to the adoption of the rule book and the publication of the IPCC special report on the 1.5°C goal.

As the Bonn meeting wound to a close, Mohamed Adow, Christian Aid's International Climate Lead, said: "The Bonn session was a technical meeting meant to work out the details of how the Paris Agreement will operate, and we're pleased that the negotiators, have weathered uncertainty from the US, rolled up their sleeves and got on well with the job at hand.

"Some feared that the indecision around American involvement would have rattled the negotiators, but on the contrary, they have actually shown their resolve and recommitted to the Paris Agreement."

The climate agreement has been

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Businesses urge Trump to remain in Paris Agreement

A growing number of businesses are joining the call for the US to remain in the Paris climate agreement amid speculation that US President Donald Trump may be about to withdraw the US from the global emissions reduction plan.

GE Chairman Jeff Immelt recently said: "We are for staying in the treaty. I think global engagement is a good thing."

Speaking at Georgetown University, Immelt said the business community had "kind of moved on" in the climate change debate. "As a company we think that climate change is real. Withdrawing from the Paris accord is not going to change one thing that we do regarding energy efficiency... and I think all business is going to feel the same way."

Immelt said the Paris agreement represented a business opportunity as well as a reason to develop technology and pursue innovation.

In May, Royal Dutch Shell said it "very much supports" the action plan, adopted in December 2015, and backed by 195 countries, to limit global warming to well below 2°C above pre-industrial levels.

Shell said it was committed to making its business resilient over time to the transition from fossil fuels to renewable energy required to meet the Paris targets.

Although he heads an oil gas major, Shell's CEO Ben van Beurden said the US should stay in the climate agreement. "We believe climate change is real," he said. "We believe that the world needs to go through an energy transition to prevent a very significant rise in global temperatures. And we need to be part of that solution in making it happen."

Exxon Mobil, Chevron and BP have also pledged their support for the Paris climate pact. Exxon CEO Darren Woods wrote in a blog post the Paris accord creates "an effective framework for all countries to address rising emissions".

Both Shell and GE are part of a group, known as the Energy Transitions Commission (ETC), which in late April backed a plan for a transition to a low-carbon energy system. The group, which includes business leaders, representatives from international institutions and environmental groups, says it is possible to meet the world's growing need for energy while stimulating economic development and social progress.

Lord Adair Turner, who heads the ETC, estimated that many countries could source around 90 per cent of their electricity from renewables by 2035 at a system cost – including battery storage and gas-fired plants for back-up – of less than 7 ¢/kWh.

Launching its report, 'Better energy, Greater prosperity', Lord Turner said: "We are ambitious but realistic. Despite the scale of the challenges facing us, we firmly believe the required transition is technically and economically achievable if immediate action is taken.

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ratified by 146 states. However, Espinosa said that while this represents a "heavy weight", she hopes "the US will continue". The European Union, meanwhile, called the agreement "irreversible and non-negotiable", with Miguel Arias Cañete, European commissioner for climate action and energy, saying in a written statement that "developed and developing countries together, will defend the Paris Agreement".

Agreement is "irreversible and non-negotiable" says Cañete

US President Donald Trump was expected to announce a decision on the Agreement after returning to Washington after the G7 Summit.

Over 200 global investors, managing more than $15 trillion in assets, recently called on the G7 member countries to stay in the Paris Agreement and drive its swift implementation.

The group of investors sent the letter to G7 country members, including the United States, Canada, France, Germany, Italy, Japan and UK, underscoring the urgency of action by G7 nations to implement the global climate pact and deliver their emissions reduction commitments.

Delegates in Bonn emphasized the benefits of developing renewable energies stating that the air will become cleaner, new jobs will be created, sustainable use of domestic resources will be improved, and countries would benefit financially.

The latest United Nations report on energy efficiency technologies published in May shows that low-carbon technologies apparently aid clean air, save water and cut land use, and could reduce 25 billion tonnes of greenhouse gas emissions and 17 million tonnes of particulates a year.

"We are on the right track. We know that cleaning up the air we breathe gives rise to huge benefits to both human and environmental health, and we know, too, that low-carbon energy efficiency technologies can help us reduce damaging climate change," said Erik Solheim, Executive Director of the UN Environment Programme (UNEP) in a press release on the new report.

Entitled 'Green Technology Choices: The Environmental and Resource Implications of Low-Carbon Technologies', the report, released at the Vienna Energy Forum, was compiled by a group of experts in natural resource management hosted by UN Environment.

The panel examined eight energy efficiency technologies and 36 sub-technologies across buildings, industry and transportation and provided a global assessment of the benefits, risks and trade-offs encountered when energy efficiency technologies are deployed alongside low-carbon electricity supply technologies.

Among its findings, the report notes that research confirms that demand-side technologies reduce greenhouse gas emissions, as well as many other environmental impacts. Under the 2°C scenario, low-carbon energy production and energy efficiency technologies have the potential to cut about 25 billion tonnes a year of greenhouse gas emissions by 2050, which is about 34 per cent lower than the emissions under business-as-usual.

EU power plants face emissions crackdown

- A third of large-scale coal fired plant capacity affected
- Technology available to meet new limits

Junior Isles

Large combustion plants in the EU will have to meet stricter emission limits by 2021 under a new EU law. The new standards, described in a "best available techniques reference document" for large combustion plants, known as 'BREF' requirements, represent significant additional financial stress for much of a coal power fleet already under pressure and struggling to remain profitable.

Under new rules approved by member states, power plants will have to cut the amount of toxic pollutants such as nitrogen oxides they emit. The stricter limits will apply to all 2900 plants operating in the EU including coal fired power stations as well as biomass, oil and gas power plants and offshore rigs.

According to the European Commission, large combustion plants account for a big share of air pollutant emissions across the EU – 46 per cent of sulphur dioxide, 18 per cent of nitrogen oxide, 39 per cent of mercury and 4 per cent of dust – which are said to be a significant contributor to premature deaths.

"Air pollution is the prime environmental cause of premature death in the European Union," said Enrico Brivio, a spokesman for the European commission. According to estimates, the move could save more than 20 000 lives annually.

Cutting pollution from coal plants will be particularly beneficial. Around 280 coal fired plants in the EU produce nearly 25 per cent of EU-generated electricity, but account for more than 70 per cent of EU sulphur dioxide emissions and 40 per cent of nitrogen oxide emissions in the sector.

According to an analysis published by the Institute for Energy Economics and Financial Analysis (IEEFA), more than 100 separate plants – representing one-third of Europe's large-scale coal-fired power plant capacity – face costly air quality upgrades or closure as a result of the new limits.

There had been concerns in some countries, such as Bulgaria, that power plants would be forced to close down under the new limits or that electricity prices would go up, but Brivio said "the European law does not require the closure of Bulgarian plants and will not increase the price of electricity".

National authorities will be able to use a derogation, or form of exemption, when costs would be disproportionate compared with the environmental benefits, Brivio said, while respecting environmental safeguards.

The IEEFA noted, however, that higher costs would be inevitable. Gerard Wynn, a London-based IEEFA energy finance consultant, said: "The cost of compliance will be prohibitive for many of these installations, given the market outlook and other headwinds. Owners will either have to make significant investment and technical changes in just four years, or decide to close the plants altogether or significantly restrict their operating hours. Whichever way they turn, additional cost is unavoidable."

The European Power Plant Suppliers Association (EPPSA) welcomed the decision. In a press release it stated: "EPPSA believes that for most of the existing Large Combustion Plants (LCPs), the implementation of the conclusions are economically and technically feasible through the state-of-the-art technologies."

It noted, however, that "some existing power plants in Europe will find it challenging to reach all the defined emission levels. In such cases, the exceptions from the IED [Industrial Emissions Directive] may apply".

The EU's IED, its main for instrument regulating pollutant emissions from industrial plants, entered into force in 2011. It sets EU-wide emission limits on large combustion plants for certain pollutants.

However, the directive has been criticized for exemptions, which have allowed more than half of Europe's coal plants to exceed limits for harmful pollutants, according to a report by environmental groups last year.

Power industry focuses on renewables, says report

Declining project costs are driving investment towards renewables as the industry continues to transition to more decentralised and intelligent energy systems, finds a new report.

According to 'Global Power Industry Outlook, 2017', a new analysis from Frost & Sullivan's Power Generation Growth Partnership Service programme, lower project costs and continued regulatory support for renewable energy in key markets will see global renewable power investment reach $243.1 billion in 2017.

The outlook, which examines power market trends, including installed capacity, investment, and regional growth across coal fired, gas fired, nuclear, hydro, solar PV, wind and biomass power, shows solar photovoltaic (PV) as the fastest growing segment, followed by wind. By 2020 non-hydro renewables will account for 65 per cent of global power investment.

Notably, it said 73.4 per cent of power generation investment in Europe will be for renewable technologies, while Russia and CIS buck the trend and focus on nuclear and hydropower. It also noted that there will be an overall increase in global coal capacity, even as the utilisation rate of existing coal fired plants falls in most regions, adding that investment is now firmly on a downward trend.

Solar PV will continue to witness high growth rates, with investment forecast to increase by 11.5 per cent to $141.6 billion in 2017. China will be the largest market in terms of solar revenue investment but the fastest growth will come from India, where renewable investment is set to increase by 24 per cent per year to 2020.

The report's findings echo EY's latest Renewable Energy Country Attractiveness Index (RECAI) where China and India have now surpassed the US at the top of the 40-country ranking.

Ben Warren, EY Global Power & Utilities Corporate Finance Leader and RECAI Chief Editor, said: "Movements in the index illustrate the influence of policy on renewable energy investment and development – both productive and detrimental. Supportive policy and a long-term vision are critical to achieving a clean energy future."

The US' fall to third in the table – the first for the US since 2015 – follows a marked shift in US policy under the new administration.

The report identifies the US government's executive orders to roll back many of the past administration's climate change policies, revive the US coal industry and review the US Clean Power Plan as key downward pressures on renewable investment attractiveness.

- The global installed capacity of utility-scale solar generating stations passed 100 GW during the first quarter of 2017, according to figures released by large scale PV experts Wiki Solar.

Wind capacity to hit 800 GW by 2021

Wind power capacity is forecast to hit 800 GW by 2021 according to the Global Wind Energy Council's (GWEC) 'Global Wind Report: Annual Market Update', released in New Delhi in May.

In its rolling five-year forecast, GWEC sees just under 60 GW installed globally in 2017, a more or less flat 2018 and then growth again out through the end of the decade to bring total installations up to just over 800 GW by the end of 2021, with the annual market rising to 75 GW in that year.

According to the update, cumulative capacity grew by 12.6 per cent to reach a total of 486.8 GW in 2016, as 54 GW was installed during that year. Wind power penetration levels continue to increase, led by Denmark pushing 40 per cent, followed by Uruguay, Portugal and Ireland with well over 20 per cent, Spain and Cyprus around 20 per cent, Germany at 16 per cent; and the big markets of China, the US and Canada get 4, 5.5, and 6 per cent of their power from wind, respectively.

GWEC's 2016 figures were in line with those released by Navigant Research, which also showed that new wind turbine installations exceeded 54 GW in 2016. Navigant's 'World Wind Energy Market Update 2017' report noted that this reflects a downturn of 14 per cent annually from 2015's record year, due largely to a decrease in China.

"The wind industry in 2016 had another stellar year with 54.3 GW of new wind capacity added," Jesse Broehl, senior research analyst with Navigant Research commented.

Broehl said that the drop in capacity installation in China, plus recent mergers and acquisitions, "shook up" the annual ranking and market shares of global wind turbine manufacturers. As a result, more Western turbine vendors are in the top 10 ranking in 2016 versus 2015 – some with record capacity additions.

Vestas, which regained its long time No.1 status globally for annual wind installations, experienced double-digit growth rates, as did most of its competitors.

The top 10 wind turbine vendors in terms of 2016 new annual capacity are Vestas followed in order by GE, Goldwind, Gamesa, Enercon, Siemens, Nordex, Envision, Ming Yang, and United Power.

Car firm gears up for storage

Mercedes' collaboration with Vivint Solar is a key element of Daimler's electrification strategy.

Siân Crampsie

Germany's Mercedes-Benz has formed an alliance with Vivint Solar in a move that will strengthen its position it in the growing home energy storage market.

The two companies have announced plans to introduce a joint offering to the US market that combines Mercedes' battery technology with Vivint's expertise in designing, installing and servicing solar energy systems.

The collaboration is the first for Mercedes Benz Energy in the US solar market and is a further indication of the growing interest of the motor market in electrification and related technologies.

Last month, Mercedes' parent company Daimler laid the foundation stone for a €500 million, 20 hectare battery production facility near Dresden, Germany.

The facility will quadruple Daimler's battery production capacity in Germany and help it to rival Tesla, which has built its own giant battery facility in Nevada, USA.

Tesla has also gained a foothold in the home energy storage and solar power markets with the launch last year of its Powerwall device and the takeover of SolarCity.

Vivint is one of the largest solar energy installers in the USA and the collaboration with Mercedes is its first in the storage sector. The company hopes that the move will broaden the appeal of solar energy to customers.

"With energy storage to complement rooftop solar, Vivint Solar customers will be able to have more control over the renewable energy they generate," the company said in a statement. "In addition to providing a backup power source if the grid goes down, the new combined solution may help customers reduce energy costs."

Vivint will offer energy storage systems of up to 20 kWh, comprised of modular 2.5 kWh batteries. It will initially offer the system to customers in California, which is a key market for solar panels and where customers have time-of-use tariffs and will be able to use storage devices to cut energy costs.

The falling cost of batteries – achieved in part by the onset of mass production facilities – is making them a viable technology for homeowners and businesses. Daimler last year launched a home battery storage offering in Europe and the expansion of its production facilities and Mercedes' tie-up with Vivint are key elements of its electrification strategy.

Brazil auctions transmission licenses

Investors will plough around $4 billion into Brazil's electricity sector after the country's energy regulator auctioned 31 licenses for new power transmission lines.

The regulator, Aneel, said that it sold 31 out of 35 available licenses at the April auction and that the process was highly competitive thanks to a recent increase in the allowable rate of return on transmission investments.

Winning bidders included Sterlite Power, which secured two projects worth a total of $200 million. The company is thought to be the first Indian power company to make a major investment in Brazil.

The auction is a key part of Brazil's plans to boost investment in key infrastructure such as roads, ports and energy transmission. In the electricity sector, increasing amounts of renewable energy capacity is creating a need for new transmission lines.

The April auction follows a successful auction in 2016, which saw licenses awarded to companies such as Brookfield Asset Management, Equatorial Energia and EDP Energias do Brasil.

The 31 concessions sold in April equates to just over 7000 km of new power lines and substations with a total capacity of 13 132 MVA. They will be built in 19 states with operators holding licenses for 30 years.

Sterlite Power will construct a 114.4 km, 230 kV transmission line in the state of Rio Grande de Sul, and a 145 km, 230 kV line in the state of Pernambuco. It bid at a 58 per cent discount to the bid price for the first project and 28 per cent for the second, according to its CEO, Pratik Agarwal.

According to Brazil's Mines and Energy Ministry, Brazil added 9.5 GW of new electricity generating capacity to the grid in 2016, 90 per cent of which was renewable.

Brazil's electricity generating capacity now stands at 150 GW, including 10.1 GW of wind and 14 GW of biomass. Hydropower still has the lion's share of the generating mix with almost 97 GW of installed capacity.

A major new hydropower project was recently put on hold, however, after a federal court suspended its operating license.

Norte Energia, developer of the 11.2 GW Belo Monte hydropower project in Para, has failed to properly execute the delivery of basic sanitation works and its license was suspended in early April.

It now expects the $26 billion project to be fully operational in January 2019.

Brazil added 9.5 GW of new generating capacity in 2016

Wind energy marches on in US

The US onshore wind sector had one of its most successful quarters ever at the start of 2017.

The American Wind Energy Association (AWEA) says that 2000 MW of new wind generating capacity was installed in the US in the first quarter of 2017, the strongest quarter since 2009.

It is expecting activity to remain strong in 2017, similar to 2015 and 2016, it added. Texas and Kansas are the two leading states, AWEA said in its US Wind Industry First Quarter 2017 Market Report.

Activity in the offshore wind sector is also expected to ramp up.

Make Consulting said in May that some 2.2 GW of offshore wind is expected to be installed in US waters by 2026, with the first full-scale projects reaching commercial operation in 2021.

According to Make, the increase in the offshore wind capacity will be mostly supported by robust state-level policies in the northeast region, with Massachusetts setting the goal of 1.6 GW of commissioned offshore wind capacity by 2027, and New York proposing to add 2.4 GW of offshore wind power to the energy mix by 2030.

In the onshore wind sector, the industry is now in the third year of a five-year phase-out of the production tax credit (PTC), the main support mechanism for wind. There are now 41 US states with utility-scale wind power plants, and the total installed wind capacity in the country is 84.1 GW, according to AWEA.

AWEA also says that there is now over 9 GW of wind power capacity under construction, and almost 12 GW in advanced development. Some 42 per cent of this activity is in Texas and the Plains states, and 37 per cent in the Midwest.

In May, US Democratic Senators Edward Markey, Sheldon Whitehouse, and Congressman Jim Langevin reintroduced legislation that would extend tax credits for the offshore wind industry beyond 2019.

The Offshore Wind Incentives for New Development (Offshore WIND) Act would extend the 30 per cent Investment Tax Credit for offshore wind through 2025.

The legislation would help developers move forward with new offshore projects, where planning and permitting times tend to be longer than for onshore projects.

The industry remains concerned about the potential impacts of President Donald Trump's energy policy, however.

Georgia Power takes on Vogtle

Georgia Power, owner of the Vogtle nuclear power plant in Georgia, USA, says that work is continuing on the project while it finalises a new agreement with Westinghouse.

The two companies have agreed an interim deal that will enable Georgia Power, a unit of Southern Company, to take over the project management of Vogtle's new units from Westinghouse, which has filed for bankruptcy protection.

Last month, media reports indicated that Georgia Power had agreed to cap Westinghouse's liabilities on the delayed nuclear plant project, a move that will help to ease the financial stress of Westinghouse's parent company, Toshiba.

The agreement would peg Toshiba's guarantees for the unfinished Vogtle plant at about $3.6 billion, payable over at least three years, *Reuters* reported, citing people familiar with the matter.

The deal would also depend on the owners of the V.C. Summer Nuclear Station power project in South Carolina reaching a similar deal with Westinghouse, *Reuters* said.

In a statement last month, Georgia Power said that it would "take all actions necessary to hold Westinghouse and Toshiba accountable for their financial obligations". It added: "Georgia Power will continue work to complete its full-scale schedule and cost-to-complete analysis and work with the project Co-owners (Oglethorpe Power, MEAG Power and Dalton Utilities) and the Georgia Public Service Commission to determine the best path forward for customers."

Westinghouse is building four new AP1000 nuclear reactors in South Carolina and Georgia under fixed price engineering, procurement and construction (EPC) contracts, with guaranteed completion dates and associated liquidated damage provisions that materially shift the risks of future cost overruns and delays to Westinghouse.

Both projects are behind schedule and over budget – Vogtle 3 & 4 by around $7 billion and VC Summer 2 &3 by around $5 billion.

Coal, nuclear cuts loom under new Korean president

■ Plans to scrap Shin Kori 5 and 6 ■ Ten coal fired plants to close

Syed Ali

Coal and nuclear power generation are to be scaled back under South Korea's new president.

In the run up to his election on May 9, following the impeachment of Park Geun-hye in March, Moon Jae-in laid out plans to lower South Korea's reliance on coal and nuclear power, pointing to a need to shift to renewable energy.

South Korea, Asia's fourth-largest economy, gets 40 per cent of its electricity from coal, 30 per cent from nuclear, 20 per cent from natural gas, and the rest from oil and renewables.

Under the current power supply plan, in addition to building 11 nuclear reactors by 2029 – three of which are already under construction – South Korea plans to add 20 more coal fired power plants by 2022.

The policy changes are expected amid growing concerns over pollution and the safety of nuclear energy. Kim Jwa-kwan, head of President Moon's energy policy team, said they planned for nuclear and coal power to account for 18 per cent and 15 per cent, respectively of power supply by 2030, while the contribution of liquefied natural gas would increase to 37 per cent to support the growth of renewables.

Moon will also scrap a plan to build Shin Kori No.5 and Shin Kori No.6 nuclear reactors, on which construction began last year, and revamp the country's nuclear power expansion programme.

Following his election Moon immediately declared that 10 of the nation's coal plants, aged 30 years or older, be shuttered temporarily next year and then altogether before the end of his five-year term.

While many South Koreans concerned by soaring levels of pollution welcome the move, Kim Dong-sool, a professor of environmental studies at Kyung Hee University, criticised the government for rushing the process.

He told the *Financial Times*: "Even though the new government's plan to shut down the coal fired power plants is encouraging, I doubt whether it has thoughtfully considered the economic costs," he said.

"I also wonder how the government is going to tackle the energy supply and demand after shutting down the coal fired power plants."

Currently there are 59 coal fired power plants in operation across the nation. The 10 old plants have an installed capacity of 3.3 GW, which is 10.6 per cent of the installed capacity of all plants (31.3 GW). However, they emit 19.4 per cent of emissions from the total number of plants.

Taiwan outlines wind plans

Taiwan's Ministry of Economic Affairs (MOEA) has unveiled further details and progress of the nation's eight-year green energy development plan, one of the ambitious projects under the Forward-looking Infrastructure Development Plan to phase out nuclear plants by 2025.

To facilitate its goal, Taiwan will be raising electricity generated from renewable energy from 4.8 per cent in 2016 to 20 per cent, and natural gas plants to 50 per cent from 32.4 per cent in 2016 in the next eight years, said Lin Chuan-neng, director-general of Bureau of Energy under MOEA. Reliance on coal plants will reduce from 45.4 per cent in 2016 to 30 per cent by 2025.

MOEA aims to invest NT$684 billion ($22.74 billion) to increase electricity generated from onshore wind farms to 1200 MW and offshore wind farms to 3000 MW by 2025.

Taking advantage of the government's push to promote green energy, in May Northern Power Development Inc. said it plans to invest at least NT$150 billion to develop offshore wind farms off the Changhua County coast in partnership with Yushan Energy Pte Ltd.

Canada-based Northern Power and Singapore-based Yushan Energy in 2015 formed a venture, Hai Long Offshore Wind Farm Project Office, to facilitate the deployment of more than 100 wind turbines at two sites 40 km to 50 km offshore. The turbines, which are to have a total capacity of 1.2 GW, are to start commercial operation by 2023 or 2024.

Hai Long expects to receive approval from the Environmental Protection Administration by the end of the year and other permits from other government agencies by June next year.

About 22 companies at home and abroad have submitted plans to build offshore wind farms, according to statistics from the Ministry of Economic Affairs.

In a separate move, in May Danish fund management company Copenhagen Infrastructure Partners (CIP) said that it acquired three proposed offshore wind projects with a total capacity of up to 1500 MW, developed by Fuhai Wind Farm Corporation in Taiwan. The projects, located off the Changhua coast in the Taiwan Strait, are in the approval process and are still subject to a final investment decision.

Taiwan is also focusing on new grid technologies to help integrate renewables into the system. Smart grid technology is one of six key research areas under National Energy Program Phase II (NEP II) Smart Grid Focus Centre.

Commenting on the significance of smart grid technology at the All Energy Exhibition and Conference in Glasgow, Scotland, Dr. Chen Yen Haw, Deputy Director of the Taiwan Institute of Economic Research, said: "Smart grid is the key component required to integrate the value chain between green energy and traditional energy."

Egat reorganisation eyes renewable future

The Electricity Generating Authority of Thailand (Egat) is expected to undergo an organisational change in order to be less dependent on fossil fuels.

In a meeting at the end of April, Permanent Secretary to the Ministry of Energy Areepong Phuchaum, in his capacity as Chairman of Egat's Executive Board, cited the need for the state-owned utility to adapt to the constantly developing world where an increasing number of countries are turning to solar energy for electricity generation.

Areepong said the global power generating trend is shifting to renewables, starting from Europe and the US, with more countries turning away from fossil fuels.

"Some global oil firms like PTT plc have diversified into petroleum exploration and production, mining and power storage. Egat also needs to adjust its business strategy to keep up in a changing world," he said.

Egat aims to have 2000 MW of renewable capacity by 2036, up from 513 MW currently supplied by domestic solar plants.

Coal cancellations as India focuses on solar

India has cancelled a proposed coal fired mega project and sidelined a coal production plan as it shifts focus to green energy.

The government of Indian state Gujarat recently cancelled a 4 GW coal power ultra-mega power project due to existing surplus generation capacity and a desire to transition from fossil fuel-based energy sources to renewable power.

The specific reason given for cancelling the project was the already substantial installed capacity – around 30 000 MW – in the state, with the government adding that building a new conventional coal power plant simply did not make sense.

It is a decision that mirrors moves across the country to decrease reliance on coal, and contradicts claims from Australian politicians that India is in desperate need of more coal.

Domestic coal production is also being scaled back. In May the central government decided to put aside the project known as Utkarsh – a roadmap for achieving 1 billion tonne production by Coal India Ltd (CIL) by 2020 – due to a rapidly changing energy scenario in which the country needs less coal.

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 power capacity.

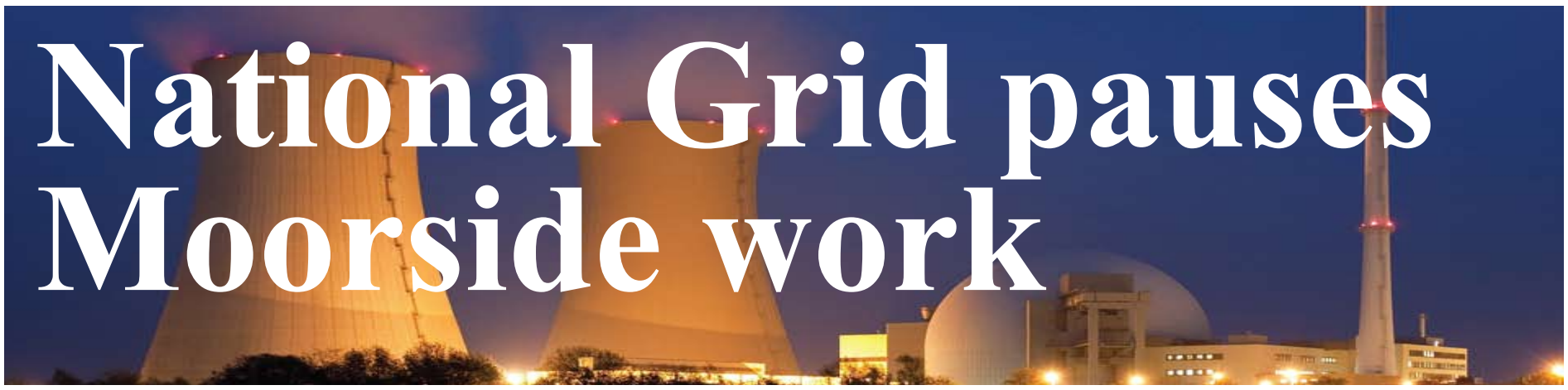
The last few years have seen a dramatic change in India's energy outlook, with the country seeing a rapid growth in solar power. It recently was reported that India had installed more renewable energy capacity over the last financial year than thermal power capacity.

Mercom Capital predicts that as much as 10 GW of new solar generating capacity will be installed in India this year, and just weeks ago the Tamil Nadu Generation and Distribution Corporation launched a 1500 MW solar tender. Tamil Nadu is expecting bids below INR4 ($0.062) / kWh till June 15.

As at the end of the first quarter of 2017, India's cumulative solar installations have reached 12.8 GW.

Meanwhile, efforts to stimulate wind power growth received a boost last month with the Ministry of New and Renewable Energy (MNRE) announcing that a Memorandum of Agreements (MoAs) has been signed between PTC India and distribution companies of Uttar Pradesh, Bihar, Jharkhand, Delhi, Odisha and Assam. The MoAs are for purchase of 1000 MW wind power under MNRE's first wind auction Scheme.

■ India has approved the setting up of 10 indigenous Pressurised Heavy Water Reactors (PHWRs) nuclear power plants with a total capacity of 7000 MW. A government statement said: "The Cabinet's decision reflects the government's commitment to prioritise the use of clean power in India's energy mix, as part of low-carbon growth strategy and to ensure long-term base load requirement for the nation's industrialisation."



National Grid pauses Moorside work

Work on a new 160 km-long power line planned for northwest England has been put on hold because of uncertainty over the future of a new nuclear power plant.

National Grid said it was "pausing" work to consent the connection for the Moorside nuclear power plant, being developed by NuGen near Sellafield, Cumbria.

The decision was taken because NuGen, a joint venture between Japan's Toshiba and Engie of France, said last month that it would carry out a strategic review of the project in light of Toshiba's financial troubles.

Engie has also pulled out of the project, selling its stake to Toshiba, owner of US nuclear firm Westinghouse, which has filed for bankruptcy protection.

"At the end of March, it became clear we at NuGen had to take a step back due to these circumstances and revisit some fundamental elements on which we had been building the programme to deliver Moorside," said NuGen CEO Tom Samson at a briefing last month. "As has been reported we took the decision to "hit the pause button" in order to explore our options to move forward to our objective – which is to deliver the next generation of low-carbon baseload electricity by the mid-2020s."

The Moorside connection is part of National Grid's North West Coast Connections project and will involve the construction of two double 400 kV circuits along the west coast. The project has been granted Nationally Significant Infrastructure Project (NSIP) status but has stirred controversy because its route impacts the Lake District National Park.

"NuGen has announced it is conducting a strategic review to look at its ownership and technology vendor," National Grid said in a statement. "As a result of focusing their efforts on this review, NuGen are pausing work on their development consent order for Moorside. In light of this, we have decided to pause our work to consent NuGen's connection and take the time to understand NuGen's programme to make sure our projects are aligned."

Samson said there were a "universe of options" to explore – but that NuGen could not exercise those options unilaterally, and had launched a strategic review, sanctioned by the NuGen board and in consultation with the UK government. Its options include new investors, technology and financing solutions to ensure Moorside is delivered.

"The key exam questions are straightforward in the circumstances," added Samson. "What is the best option for Moorside in technology and funding, to allow us to progress this phenomenal project of national significance, with confidence."

NuGen said it has formed an independent panel of experts including the internationally-renowned nuclear expert Dame Sue Ion, and Norman Haste, an expert on construction who was involved in mega-projects like Crossrail, to assist in the review.

Samson added: "It is incumbent on NuGen to come up with answers to these difficult exam questions. Once we have completed the strategic review and consulted on our findings with the government we can begin to redefine our timelines – and then we will hit the fast-forward button."

EGEC report signals geothermal growth

The European Geothermal Energy Council (EGEC) has called for long-term financial and regulatory stability to enable the region to take full advantage of its geothermal resources.

EGEC President Ruggero Bertani says that legislative proposals in Europe will not provide sufficiently strong incentives to increase the share of geothermal energy in the mix.

According to Bertani, geothermal energy is one of the most efficient renewable heating and cooling technologies. While geothermal energy has seen rapid expansion in some parts of Europe in recent years, the true potential of the technology is far from being met, EGEC says.

In its latest annual market report, EGEC notes that there are now more than 100 geothermal power plants in Europe, with a combined installed capacity of 2.5 GWe. A further 26 projects are being developed and EGEC believes that installed capacity in 2020 will reach 3 GWe.

Much of the growth in the geothermal power market can be attributed to Turkey, which accounted for 91 per cent of new installed geothermal power capacity in Europe between 2012 and 2016.

Geothermal heat is also a success story for Europe, with 51 new plants entering operation between 2012 and 2016. Currently, there are 280 geothermal district heating plants in Europe, including cogeneration systems, EGEC says. The total installed capacity in Europe is now approximately 4.9 GWth, with the main markets for future years being France, Netherlands, Germany, and Hungary.

In the geothermal power sector, Turkey has added around 700 MWe of new capacity over the last five years, including the 24 MWe Kubilay I plant developed by Bestepeler Enerji Üretim Ticaret, two 25 MWe plants developed by Kipas Holding, and Karadeniz Holding's 12 MWe Umurlu II plant.

Geothermal development in Turkey has been encouraged by a combination of feed-in tariff support, excellent geothermal resources and oil and gas sector expertise.

8 MW turbines turn at Burbo Bank Extension

- Burbo Bank Extension is "game-changing" project
- UK tops wind farm finance table

Dong Energy says it is showcasing the rapid innovation taking place in the offshore wind sector with the commissioning of the first 8 MW wind turbines at the Burbo Bank Extension project.

The Danish energy firm last month officially opened the 258 MW offshore wind farm in Liverpool Bay, UK, the first site in the world to use the MHI Vestas 8 MW machines.

Dong also last month said that it had generated the first power from the Race Bank offshore wind farm in the UK, which uses Siemens 6 MW turbines.

"Burbo Bank Extension showcases the rapid innovation in the offshore wind industry. Less than ten years ago at Burbo Bank, we were the first to install Siemens 3.6 MW wind turbines and in this short time, the wind turbines have more than doubled in capacity," commented Dong Energy Chief Executive Henrik Poulsen. "Pushing innovation in this way reduces the cost of electricity from offshore wind and will help to advance the offshore wind industry across the world."

Reducing costs and risks has been a key focus of the global offshore wind sector and the Burbo Bank Extension was described as "game-changing" by RenewableUK. "Today's turbines are the most efficient ever – driving down the cost of electricity for consumers," said Emma Pinchbeck, RenewableUK's Executive Director.

Both Burbo Bank Extension and Race Bank have been instrumental in developing the UK's offshore wind supply chain. Some two-thirds of the blades for the 91 turbines for Race Bank will be manufactured at Siemens' Hull blade factory, while Burbo Bank Extension is the first offshore windfarm in the UK to use UK-manufactured blades.

According to WindEurope, the UK was the largest market in Europe for wind farm finance.

WindEurope says that in 2016, Europe raised a total of €43 billion for the construction of new wind farms, refinancing operations, project acquisitions, and public market fundraising. Out of €27.6 billion reached in new asset financing, offshore wind accounted for a record-breaking €18.2 billion, while onshore wind new asset financing dropped by five per cent to €9.4 billion.

The UK was the biggest market in 2016 with €12.7 billion raised for new onshore and offshore projects, Germany came second with €5.3 billion.

Wind is the winner in latest Spanish auction

- UNEF seeks legal action
- Forestalia wins 1.2 GW

Spain is set to attract renewable energy investors to its power market once more following a successful auction in May.

The country's government said that it awarded 3 GW of capacity – the majority of it onshore wind energy – in the auction, which resulted in contracts for €42/MWh.

This is the maximum discount allowed under the Spanish tendering system and is the lowest level ever awarded in an onshore wind tender in Europe, according to WindEurope.

The country's solar sector says the auction was poorly designed and favoured wind energy.

The auction awarded 2979 MW to wind farms, 1 MW to solar installations, and 20 MW to other technologies. Spanish wind firm Forestalia won 1.2 GW of contracts, followed by Gas Natural Fenos with 667 MW and Enel with 540 MW, according to reports.

WindEurope welcomed the outcome of the auction, which comes after a three-year investment hiatus in Spain's renewables sector caused by retroactive cuts to fiscal support mechanisms for renewables.

"The tender results show how onshore wind is today the cheapest option for new power generation," said WindEurope CEO Giles Dickson. "Some may think wind energy no longer needs subsidies. But it was the fact the auction offered a guaranteed minimum income that attracted investors and ensured there were enough bids to deliver the low price.

"And this is the point – it's not subsidies but revenue stabilisation mechanisms, addressing the risk of wholesale price volatility, that will be critical to the deployment of onshore wind across Europe at competitive costs."

Spain's solar association, Unión Española Fotovoltaica (UNEF), said it would seek legal action in the wake of the "discriminatory" auction.

In a statement, UNEF said that the auction was poorly designed because, in the event of a tie between offers, the technology offering more equivalent generation hours wins.

As wind and solar plants offered the same bid in the auction, wind projects were therefore given preference.

ETC report points to clean energy opportunities

The targets of the Paris climate agreement are achievable and meeting them will stimulate economic growth and social progress, ETC says.

Siân Crampsie

A new report says that global carbon emissions could be halved by 2040 as long as governments, investors and businesses take action to put the energy transition into action.

The Energy Transitions Commission (ETC) – an organisation made up of leaders from a diverse range of public and private sector organisations – has published a flagship report setting out pathways to limit global warming while maintaining global economic development and social progress.

According to the ETC, the goal of the Paris accord, to limit global warming to below 2°C, could be attained by decarbonising power generation and extending electrification to sectors such as transport, building, aviation, shipping and other heavy industries.

"We are ambitious but realistic," said Adair Turner, ETC Chair. "Despite the scale of the challenges facing us, we firmly believe the required transition is technically and economically achievable if immediate action is taken."

Clean electrification alone could deliver half of the carbon emissions reductions required to reach 20 Gt of emissions by 2040. Rapidly falling costs in the renewable energy and battery technology sectors "make cost-effective, clean electricity unstoppable", ETC says.

The ETC report, 'Better Energy, Greater Prosperity', also notes that there is untapped potential in energy productivity, i.e., the energy intensity of GDP growth. Growth of three per cent per annum could be achieved with the right policies, it says.

ETC also believes that the energy transition will deliver social benefits, including improved air quality, as well as economic opportunities. "This is not just another plan; it's a better plan," says Ajay Mathur, co-Chair of the ETC. "We show how the world can remove barriers to transform challenges into opportunities, not only in advanced economies, but also in emerging countries."

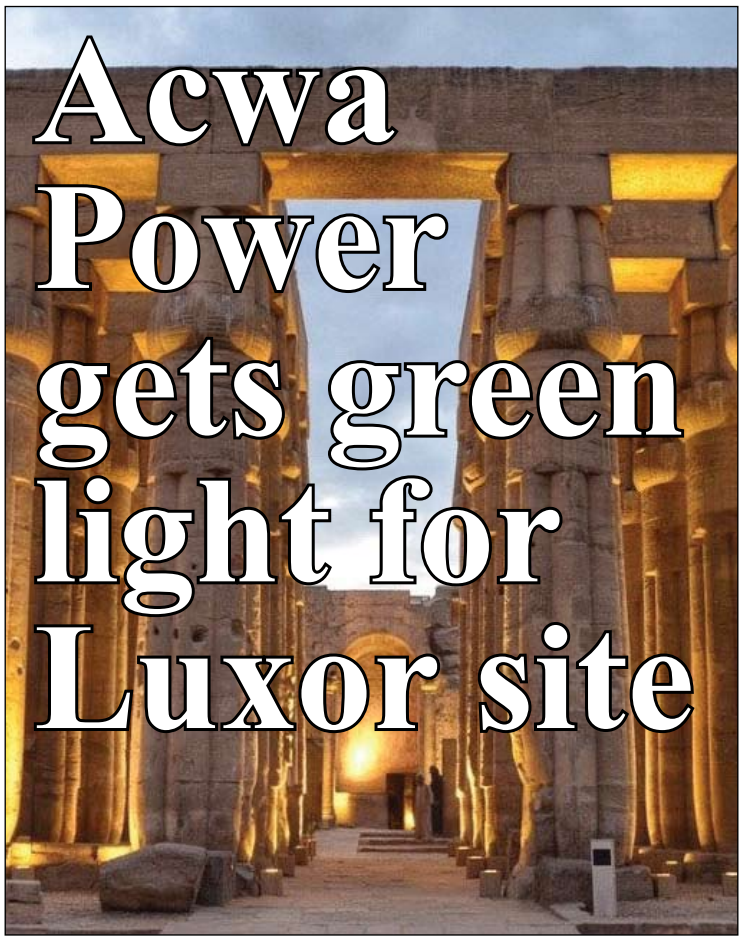
The ETC's commissioners includes representatives from BlackRock, Veolia, BHP Billiton, the World Bank and Sustainable Energy for All.

The report describes how to cut annual carbon emissions from 36 Gt today to 20 Gt by 2040 (compared to 47 Gt expected by 2040 in a business as usual scenario), and how further emissions reductions can be achieved in the second half of the century, while ensuring universal access to energy.

This can be achieved through four interdependent pathways, says the ETC, which stresses the importance of strong public policies.

Policies should include "meaningful carbon pricing, phase-out of fossil fuels subsidies, R&D and deployment support for low-carbon technologies, robust standards and regulations, appropriate market design, and public investment in transport and urban infrastructure", it says.

Strong policy will also help to reduce risks and lower the cost of capital for long-term investment. "Extra support will be required for developing countries with the greatest investment requirements and more limited access to capital," ETC says.



Acwa Power gets green light for Luxor site

Acwa Power is set to build a $2.2 billion gas fired combined cycle plant in Luxor, Egypt, after the government confirmed that land for the site was available.

The 2250 MW plant was originally slated for constriction in Dairut city, but a lack of transmission capacity in the region made the project unviable.

According to local reports, Egypt's Ministry of Electricity has completed negotiations with Luxor governorate to allocate land to the project for a 25-year period. It is aiming to sign agreements with Acwa next year covering various aspects of the project, including gas supply, state guarantees, and the land agreement.

Egypt is also expanding its solar energy capacity.

In May the European Bank for Reconstruction and Development (EBRD) said it was considering the provision of loans for 16 solar power projects that will be built under Egypt's feed-in tariff (FIT) system.

A total of $497.7 million in financing is being lined up for the solar plants, which represent 750 MW in capacity.

The projects include a portfolio of six 50 MW plants being developed by Scatec Solar ASA, a 120 MW portfolio being developed by Acwa Power, a 100 MW portfolio of EREN Renewable Energy and Access Infra Africa, as well as projects involving ib vogt and EDF Energies Nouvelles.

EBRD has previously unveiled plans to provide loans of up to $500 million to finance the construction and operation of projects under Egypt's FIT scheme. It is expected to decide on the latest loans on June 7, 2017.

All of the facilities will be located in the proposed 1.8 GW Benban solar complex in Aswan province.

Eskom investigated over PPA stance

- Nersa takes complaint forward
- 37 IPPs affected

Eskom could be fined heavily if an investigation finds that it is in breach of its license conditions for refusing to sign power purchase agreements (PPAs) under South Africa's renewable energy programme.

The South African Renewable Energy Council (SAREC) says that regulator Nersa has responded to a complaint made in 2016 over Eskom's refusal to sign PPAs with developers who had won licenses to build renewable energy plants under the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).

Nersa has examined the October 2016 complaint, filed by the South African Wind Energy Association (SAWEA), and says that it has found there are sufficient grounds for a full investigation.

SAREC and a number of other parties affected by Eskom's stance have joined the complaint, SAREC said in a statement. It has requested that if Eskom is found to have breached its license conditions, it should be fined ten per cent of its annual turnover per day.

"We'd like to reiterate that our primary intention is to achieve financial closure of power purchase agreements," commented Brenda Martin, SAWEA CEO. "It remains our hope that Eskom will comply with the legal framework for power purchase, so that penalties do not need to be imposed on Eskom."

Eskom said last year that it would not sign any further PPAs because the increased levels of variable generation were putting a strain on its grid. Its decision has affected 37 independent power producers (IPPs).

SAWEA, however, believes that Eskom's stance is incompatible with government policy, the law of the land, and its own licence conditions. As the monopoly electricity company in South Africa and the single buyer of energy from IPPs, Eskom is obliged to sign contracts with developers who have been awarded licenses by the government, SAREC says.

SAWEA says that the Nersa investigation could be completed by June 2017.

- Enel has started operating the 111 MW Gibson Bay wind farm in Kouga, Eastern Cape province. The wind farm features 37 of Nordex's N117/3000 turbines and was built at a cost of $206 million.

Iran and EU plan nuclear safety centre

Iran and the European Union are preparing to establish a nuclear safety centre in the Islamic Republic, as well as establish a programme for nuclear research and training.

The plan was announced following a trip to Tehran by European Climate Action and Energy Commissioner Miguel Arias Cañete for the first ever Iran-EU Business Forum on Sustainable Energy.

Following the meeting, Head of the Atomic Energy Organization of Iran (AEOI) Ali Akbar Salehi said that several rounds of discussion on the plans had already taken place. He added that the proposed nuclear safety centre would extend services to regional countries as well.

Salehi said Iran and the EU also plan to set up a roadmap based on Euratom – a complementary research programme for nuclear research and training.

He added that Iran and the EU plan to draw up a five-year plan for bilateral cooperation and noted that the union would "most likely" supply the €20 million credit required for the project.

The nuclear safety centre falls under the framework of the Joint Comprehensive Plan of Action (JCPOA), an agreement signed by Iran and P5+1 group of countries in 2015.

- Iran has inaugurated the country's largest solar farm near the city of Isfahan. The 10 MW generating facility was built by Iran's Ghadir Electricity and Energy Company and Greece's Metka and covers an area of 20 hectares. The new solar power complex is part of plans in Iran to reach an installed renewable energy capacity of 5000 MW by 2020.

PGE acquires EDF assets

■ EDF approves Edvance JV ■ Assystem makes Areva NP offer

Siân Crampsie

EDF has taken further steps forward in its €10 billion disposal plan with an agreement to sell Polish assets to PGE Polska Grupa Energetyczna.

Under a €1.4 billion deal, PGE will acquire eight combined heat and power (CHP) plants from EDF as well as a number of heat distribution networks.

EDF started negotiations with PGE and a consortium of other Polish energy companies in January 2017 over the sale of the assets after the Polish government blocked the French firm's wish to sell them to IFM Investors and EPH.

The Polish government said that it was concerned about energy security and put the assets – which include CHP plants in Gdynia, Gdansk, Kraków, Wroclaw, Torun, Zielona Góra, Zawidawie and Siechnica – on a list of companies deemed important for national energy security in order to be able to block their potential sale.

The sale, which also includes the heat distribution networks of Czechnica, Torun, Zawidawie and Zielona Gora, is a key element of EDF's plan to dispose of non-core assets to raise capital for its acquisition of French nuclear group Areva NP.

That deal also made progress last month when EDF said its board had approved a plan to create a joint venture with Areva NP to house the two firms' engineering activities.

The new joint venture, called Edvance, will be responsible for the basic design and implementation of projects involving nuclear islands and control systems for reactors under construction, both in France and abroad.

EDF will own 80 per cent of the new company, while Areva NP will own the remainder.

In a statement EDF said that the creation of Edvance is an important step in the reconstruction of the French nuclear industry. It added that the new company is being set up independently from EDF's deal for a controlling stake in Areva NP, which is expected to close at end of 2017.

Last month Assystem S.A., a French engineering consultancy, announced that it had placed an offer to buy a five per cent stake in Areva NP for €125 million.

The move would enable the company to strengthen its partnership with EDF as well as play a role in the restructured French nuclear industry, it said in a statement. The valuation is consistent with that in the agreement drawn up between EDF and Areva in 2016.

EDF is set to acquire up to 75 per cent of Areva NP as part of a broad plan by the French government to rescue the country's nuclear sector.

Toshiba reshuffles

Toshiba has announced plans to restructure its business in a bid to maintain its operational integrity in the face of financial uncertainties.

The beleaguered Japanese conglomerate has been rocked by the financial woes of its USA-based nuclear power plant business, Westinghouse, and says that it will split its four in-house companies into wholly-owned subsidiaries.

The move is necessary for the company to retain the special construction business licenses required to do business in Japan, it said. The split would clarify the new companies' responsibilities to market and customers, it added.

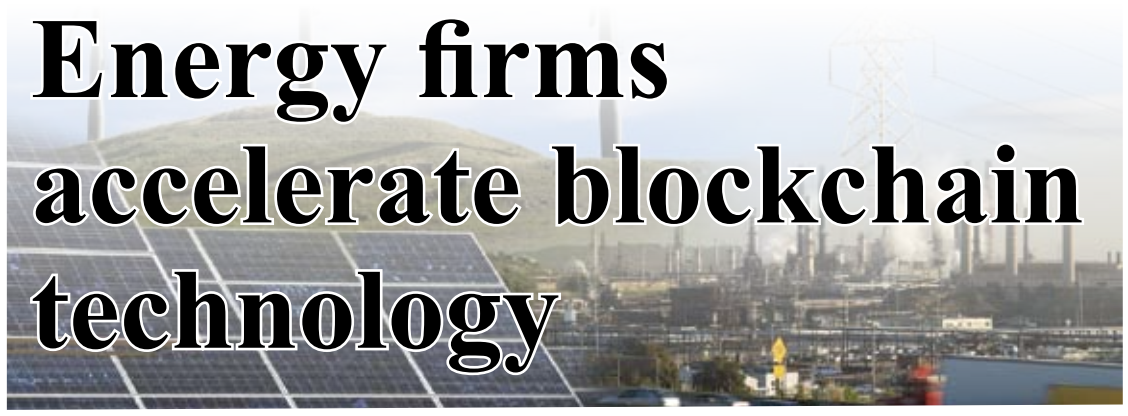
Last month Toshiba published unaudited results in which it forecast a return to profit in the year ending March 2018, after booking a net loss of ¥950 billion for the 2016-2017 fiscal year.

Toshiba is attempting to sell its chip business, worth around ¥2 trillion ($17.9 billion), a move that would boost its financial position but leave it with few growth drivers, according to analysts.

In March Westinghouse filed for bankruptcy protection in the USA. The firm's finances have been hurt by a slowdown in the new nuclear build sector and cost overruns at two US nuclear power plant projects.

Toshiba will merge its Infrastructure System & Solutions company into Toshiba Electric Service Corporation. Its Storage & Electronic Devices Solutions will be split off, while its Industrial ICT Solutions Company will be merged into Toshiba Solutions Corporation. In October, it will split off its in-house company, Energy Systems & Solutions Company, and the Nuclear Energy Systems & Solutions Division, and transfer them to a newly established company.

Energy firms accelerate blockchain technology



■ Energy Web Foundation secures funding
■ TenneT and IBM collaborate on pilot

Siân Crampsie

The Energy Web Foundation (EWF) says that it has secured first round funding of $2.5 million thanks to support from a consortium of global energy companies.

EWF is a non-profit organisation with a mission to accelerate the use of blockchain technology in the energy sector. It has won the support of ten companies – Centrica, Elia, Engie, Sempra, Shell, SP Group, Statoil, Stedin, Tokyo Electric Power, and TWL – a move that will enable it to embark on commercial deployment of blockchain technology in the energy sector.

EWF is a partnership between Rocky Mountain Institute and Grid Singularity. It says that blockchain technology could revolutionise the energy sector by reducing transaction costs.

"The main challenge of the electricity sector in the 21st Century is to integrate more renewable energy into the grid in a cost-effective fashion in a context of largely flat or diminishing demand. The only way we know how to do this is by automating the demand side – by allowing many more participants in the grid. That means automation at the distribution edge, and integration of this automation with wholesale markets," Hervé Touati, a managing director at RMI and president of EWF, said.

Separately, TenneT announced in May that it had joined forces with sonnen, Vandebron and IBM to develop two pilot projects aimed at developing the first 'blockchain' distributed database for managing the electricity grid in the Netherlands and Germany.

"These pilot projects are part of TenneT's broader strategy of preparing the electricity system to accommodate the growing volume of renewable energy," said TenneT CEO Mel Kroon.

Touati added that blockchain technology would be a key building block of the 21st Century grid. "It also provides much higher levels of cyber security essentially for free – which addresses, as a by-product, one of the key concerns of utility executives when it comes to distributed energy resources."

Blockchain technology reduces transaction costs by keeping a single logical copy of transaction records – avoiding the need for reconciliation and settlement. It can be used to reduce the cost of utility bills or the need for working capital in wholesale market gas or electricity transactions. It can also allow energy devices such as batteries and water heaters to transact with each other at the distribution edge to provide support to utilities and grid operators.

Wärtsilä aims for storage success

Wärtsilä is positioning itself to become a key player in the global energy storage market.

The Finland-based firm has signed an agreement to acquire Greensmith Energy Management Systems Inc., a USA-based energy storage technology firm. It has also announced plans to offer hybrid engine-storage plants worldwide.

According to Wärtsilä, the acquisition of Greensmith will enable Wärtsilä to expand its footprint in the energy storage market and position itself as a leading global energy systems integrator.

Greensmith has developed an energy management software system called GEMS, and also offers a Commercial and Industrial (C&I) and micro-grid solution called OMNI4. It was responsible for deploying around one-third of total US energy storage capacity in 2016, Wärtsilä said.

In a statement, Wärtsilä said that it expects the energy storage market to grow "exponentially". The company is aiming to become a global systems integrator with full in-house capabilities specialising in solutions that offer the combination and optimisation of different forms of power generation, energy storage and demand side management.

In May, Wärtsilä announced that it would add energy storage solutions to its existing solar-engine hybrid power plant offering. It believes that hybrid solutions "are increasingly becoming financially attractive", particularly in areas where fuel prices are high and the penetration of renewable power sources is significant.

The acquisition of Greensmith will provide Wärtsilä with energy management system software that can optimise the use of hybrid power plants.

"Together with Greensmith we will become a global energy systems integrator. Greensmith provides unparalleled software and energy storage knowledge and we provide our global footprint, EPC expertise and large sales network. A perfect match," said Javier Cavada, President at Wärtsilä Energy Solutions.

Combining its engine-based generation with storage and solar will increase Wärtsilä's opportunities in markets where flexible generation is required. Earlier this year it booked an order to supply two gas fired 50 MW Smart Power Generation plants to energy services company Centrica in the UK. The plants will generate balancing power into the national grid with the ability to provide electricity in less than two minutes from start to full load.

Speaking alongside Centrica and Baringa Partners at a recent press gathering in London, UK, Melle Kruisdijk, Vice President Europe, Wärtsilä, said that with the increasing amount of renewables, "the flexibility challenge is becoming more and more important".

Mark Futyan, Merchant Power Director at Centrica said that several things were happening that was driving the value of flexibility.

He noted: "We see much less value and longevity in centralised [power plants] and much more value and need for flexibility." This, he said, will see the company investing more in peaking, and flexible power plants, as well as storage as battery costs continue to fall.

Americas

Siemens secures Pampa LTSAs

Siemens has signed agreements with Argentina's Pampa Energia to provide long term service agreements (LTSAs) for two power plants.

One agreement covers the SGT5-2000E gas turbine operating at the Genelba 21 simple cycle power plant for a period of 10 years. The other is an eight-year service and maintenance agreement for the two SGT5-4000F gas turbines and the SST-5000 steam turbine in operation at the Genelba combined cycle power plant.

Both plants are located in Marcos Paz, Province of Buenos Aires, Argentina, and produce a combined 825 MW of electricity.

The agreements cover spare parts, repairs, logistics support, field services as well as Siemens Power Diagnostics, part of the company's Digital Services for Energy portfolio of data-driven solutions. For Genelba 21, Siemens will upgrade the gas turbine blades with Siemens' Si3D blades. At the Genelba plant, Siemens will upgrade the inlet guide vane system (IGV) on the plant's turbines.

Exelon selects GEH for nuclear contract

Exelon Generation has awarded an integrated outage contract to GE Hitachi Nuclear Energy (GEH) for its entire fleet of boiling water reactor (BWR) nuclear power plants and three pressurized water reactor (PWR) units in the USA.

Under the $140 million outage services agreement, which runs through the completion of the spring 2021 outage season, GEH will provide a full portfolio of outage and inspection services to Exelon's fleet of 15 BWR units throughout the Mid-Atlantic, Midwest and Northeast. In addition, GEH will service the R.E. Ginna PWR in Ontario, New York and the two PWRs at Calvert Cliffs in Lusby, Maryland.

The agreement includes assisting with refuel floor activities and performing under-vessel and inspection services for Exelon's BWRs.

Asia-Pacific

Wärtsilä bolsters Pakistan presence

Wärtsilä has signed a five-year agreement with Technomen Kinetics Private Limited (TKL) covering the operation and maintenance of two gas fired power plants in Pakistan.

Under the operations and maintenance (O&M) deal, Wärtsilä will optimise the performance of the two 50 MW plants, located in Nooriabad, near Karachi. The agreement covers areas including technical support, maintenance planning, performance monitoring, recruitment, management and training of local personnel, and logistics management.

The two identical plants are equipped with five Wärtsilä 34SG gas engine generator sets and one steam turbine generator.

UGL to build Australian solar farms

UGL has secured engineering, procurement and construction (EPC) contracts worth $117 million to design and build two new solar farms in Australia.

UGL will provide EPC services for the Collinsville Solar Farm in Queensland and the White Rock Solar Farm in New South Wales. It has also been tasked to provide operation and maintenance (O&M) services at both solar farms.

POSCO secures Vietnam contract

POSCO Energy has secured a $2.5 billion project to build a coal-fired power plant in Vietnam.

The company will build a 1200 MW plant in Dong Hoi, Nghe An province, on a build-operate-transfer (BOT) basis. It expects to break ground in 2022 and complete construction by 2026, according to reports.

The new Quynh Lap II power plant will be the second coal-fired facility built by POSCO in Vietnam following the Mong Duong II power plant, which started operating in 2015.

Europe

GE wins Spanish supply contract

GE has landed a deal to supply 1.2 GW of wind turbines to Forestalia Group, which won 40 per cent of the capacity auctioned in Spain's recent 3 GW renewable energy sale.

Through the Sociedad Aragonesa Transeuropea de Energias Renovables, Forestalia secured a contract from Spain's energy ministry to develop a 1.2 GW wind farm in Aragon. GE said it would supply wind turbines from its 3 MW platform for the project. It will also supply the hardware for a 300 MW wind farm that Forestalia was awarded in a January 2016 tender.

Velan selected for Hinkley C

Velan is to provide NNB Generation Company with nuclear valves for the primary and safety auxiliary systems of the two new EPR reactors proposed for the Hinkley Point C project in southwest England.

The contract includes the supply of high-pressure gate valves and globe valves, manually or electrically operated, as well as check valves, which will be designed and manufactured at the group's two French production units.

NNB Generation is a subsidiary of EDF Energy and Areva NP.

The value of the contract is $55 million.

RES to build Tynemouth storage plant

RES has been awarded an EPC contract to build a 25 MW energy storage facility for Enel S.p.A. in Tynemouth, northeast England.

The Tynemouth project was developed by Element Power and is now owned by Enel S.p.A. It successfully participated in National Grid's competitive tender for Enhanced Frequency Response (EFR) in 2016.

RES will build and operate the plant using its RESolve battery-based energy storage system. It expects to start construction on the project in the summer of this year with full commissioning of the project due in early 2018.

Areva NP wins Paks deal

Areva NP and its Hungarian partner evopro systems are to update the reactor protection system of the Paks nuclear power plant's four units.

The scope of the company's contract includes a comprehensive software update of the existing digital safety instrumentation & control (I&C) system that Areva NP implemented as a replacement between 1999 and 2002. Areva NP will undertake a range of activities from planning up to on-site testing as well as the modernisation of maintenance and test equipment.

The project will be completed in 2019.

Eoltech adds 500 MW

Eoltech has won repeat contracts with major French customers to deploy an advanced multi-source wind energy index to refine the monitoring of 24 wind farms.

Eoltech's IREC-Index will enable the firm's clients to check the consistency of their fleet's output against the available wind resource. The contracts cover 500 MW of onshore wind capacity in France.

IREC-Index enables wind farm operators to detect potential turbine performance discrepancies. It uses data from several different sources, reinforcing the consistency and robustness of this energy index while addressing the challenge of managing data homogeneity in time.

Deutsche Windtechnik lands UK contract

The UK arm of Deutsche Windtechnik has concluded an agreement with investment group Zephyr for the maintenance of 61 Siemens wind turbines.

The SWT 2.3 MW wind turbines are installed at the Causeymire and Farr wind farms in Scotland. The five-year contract covers full maintenance, including selected large components, and starts in June 2017.

International

Tunisia plans renewable capacity

Tunisia's government has issued a tender for the installation of 210 MW of renewable energy capacity.

Héla Cheikhrouhou, Minister of Energy, Mines and Renewable Energies, told media at a recent conference that the government was seeking companies to build projects with capacity of 10 MW and 30 MW, as well as micro-projects rated between 1 MW and 5 MW. A committee has been created to select projects based on the experience and skills of the developer as well as project sites and environmental impact studies.

Akenerji selects GE Predix software

GE has signed a deal with Turkey's Akenerji to deploy its Predix operations optimisation software at the 904 MW Egemer Elektrik Uretim A.S. natural gas combined cycle power plant.

The software will help Akenerji to tackle operational issues at the plant and allow more profitable use of the project, located in Erzin Hatay, Turkey, under existing electricity market conditions.

Serhan Gencer, CEO of Akenerji said that innovative solutions were needed for operators to compete in Turkey's complex market environment and that the software would give it increased visibility and insights at every level of operation.

Installation of the software will start in late 2017.

Siemens expands Qatar power network

State-owned utility Qatar General Water & Electricity Corporation (Kahramaa) has awarded Siemens a contract for the expansion of the power transmission network in Qatar.

Under the €790 million contract, Siemens will deliver 35 turnkey super and primary substations for Phase 13 of the Qatar Power Transmission System Expansion project. It has also received a second order from Kahramaa to supply and install more than 2000 medium voltage switchboards for the 11 kV distribution network.

Siemens will be responsible for the design, engineering, supply, installation, and commissioning of the substations for the 400 kV, 220 kV, 132 kV, 66 kV, and 11 kV voltage levels, including gas insulated switchgear, transformers, and control and protection equipment.

Completion is scheduled for 2019.

ABB wins $30 million Congo order

Société nationale d'électricité (SNEL), the national electricity company of the Democratic Republic of the Congo (DRC), has placed an order with ABB for a partial upgrade of the Inga-Kolwezi high-voltage direct current (HVDC) power transmission link.

The 1700 km Inga-Kolwezi link transmits power from the Inga hydropower station on the Congo River to the mining district of Katanga in the southeast of the country. It also exports the excess power to the Southern African Power Pool countries.

ABB will carry out a refurbishment of the link that will boost transmission capacity, enhance grid reliability and extend its life span. Its project scope includes system studies, supply of key equipment such as high voltage apparatus and commissioning.

The upgrade will increase the capacity of the link from 520 MW to 1000 MW. The contract is part of the FRIPT project financed by Glencore and managed by Congo Energy, a subsidiary of Forrest Group International.

Turkish IPP orders Wärtsilä extension

The technology group Wärtsilä will supply equipment for an extension to a power plant owned by Yesilyurt Enerji Elektrik Uretim A.S, a Turkish independent power producer (IPP).

The order comprises four Wärtsilä 50SG engines running on natural gas to create a 73 MW extension to an existing 145 MW power plant in Samsun, on Turkey's Black Sea coast.

Following the extension, the plant will mainly be used for grid stability operations, Wärtsilä said. The company built the plant in 2011 with a capacity of 128 MW, later extending it to 145 MW.

The equipment will be delivered during the coming months, and the extended power plant is scheduled to be operational by December 2017.

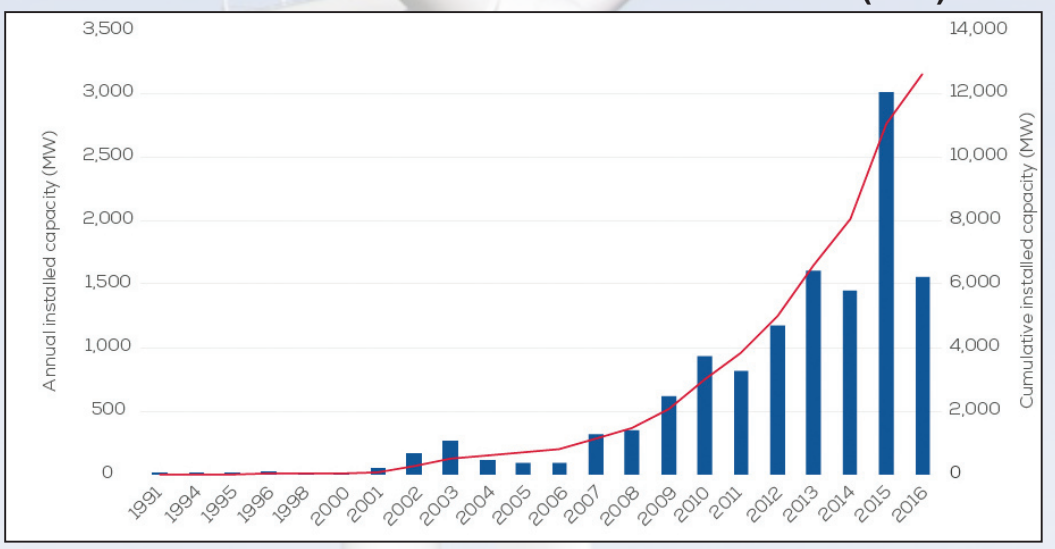
GE to supply Ghana's Bridge Power project

GE has announced it is to supply the power generation equipment for the 400 MW Bridge Power plant project in Tema, Ghana.

The equipment scope includes GE's TM2500 gas turbine generator sets and steam turbines in a combined cycle configuration, and will be used in the first phase of the project. The order marks the first use of the TM2500 gas turbine in combined cycle configuration globally.

The 400 MW Bridge Power and liquefied petroleum gas (LPG) import, storage, and transportation infrastructure project will address Ghana's long-term energy requirements by providing enough electricity for the equivalent of up to 17 per cent of the country's capacity. Upon completion, it will be Africa's first LPG fired power plant and the world's largest plant of its kind.

Cumulative and annual offshore wind installations (MW)



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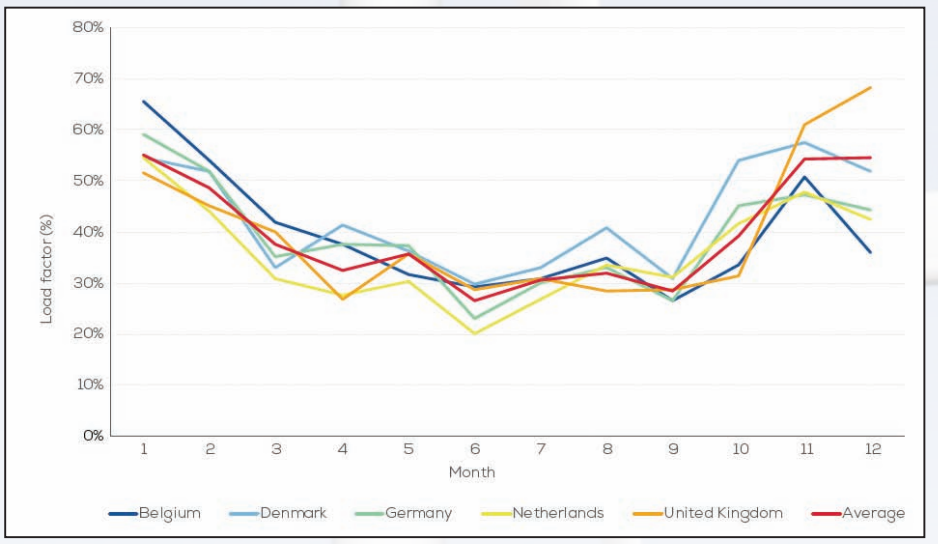
Monthly national load factors of offshore wind in 2016 (percent)



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Number of wind farms with grid-connected turbines, no. of turbines connected and no. of MW grid-connected at the end of 2016 per country

COUNTRY	BE	DK	DK	ES	FI	IE	NL	NO	SE	UK	TOTAL
Country	BE	DE	DK	ES	FI	IE	NL	NO	SE	UK	Total
No. of Farms	6	18	13	1	2	1	6	1	5	28	81
No. of turbines connected	182	947	517	1	11	7	365	1	86	1,472	3,589
Capacity Installed	712 MW	4,108 MW	1,271 MW	5 MW	32 MW	25 MW	1,118 MW	2 MW	202 MW	5,156 MW	12,631 MW

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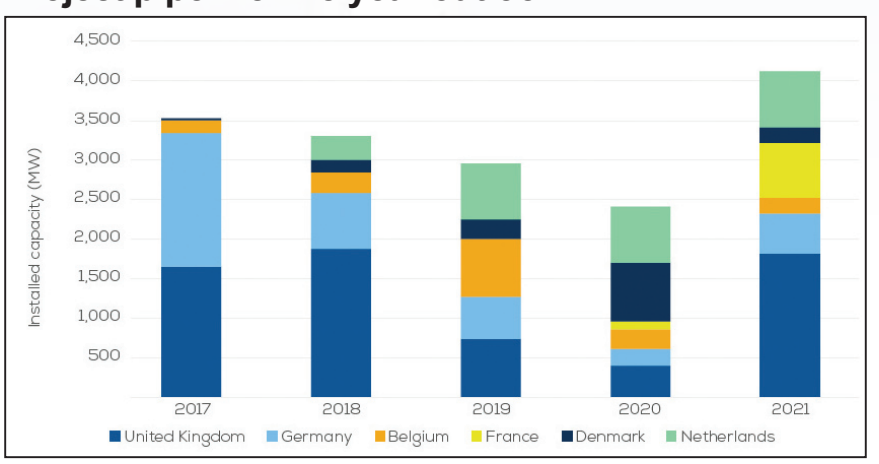
Project pipeline five year outlook



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Source: The European offshore wind industry – Key trend and statistics. WindEurope

Oil

Riyadh and Moscow seek to revive oil market

- Extending the cut would reduce inventories in OECD
- Market can be back in balance by March 2018

David Gregory

Saudi Arabia and Russia have concluded that another nine months of restricted oil production should do it. According to the calculations made by the two oil giants, the oil market can be back in balance by March 2018, provided that other oil producers agree to continue with output cutbacks that were put in place at the start of this year. For the most part, those countries that signed up to the deal have complied with the reductions that they agreed to make. Compliance was reported to be around 96 per cent as of mid-May, including Russia, which has taken several months to scale back its crude oil output.

It must be borne in mind, however, that prior to the agreement to reduce production, oil producers were pumping as much crude as they could so that when the deal was finally agreed to match production in October 2016, the countries were already pumping significant quantities and scaling back did not really involve any genuine cuts at all.

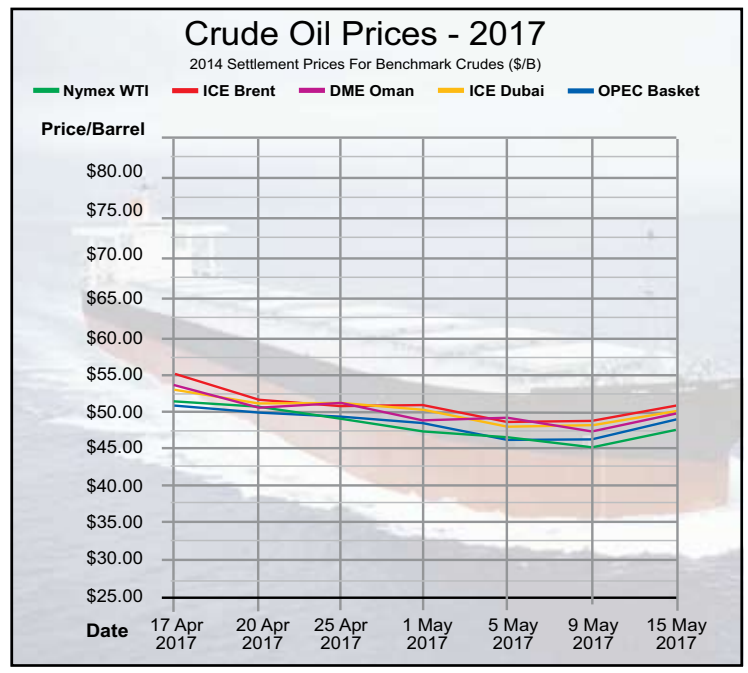
While the cutback in production has provided some momentum to oil prices, it has also encouraged the US shale oil producers to come back into the picture – in a big way. The US Energy Information Administration (EIA) said in its May monthly report that US production averaged 8.9 million b/d in 2016 and it put 2017 output at 9.3 million b/d and 2018 output at 10 million b/d. The EIA also estimated that stocks of crude oil and liquid fuels averaged an increase of 0.4 million b/d in 2016 and forecast a stock build of 0.2 million b/d in 2017 and 0.5 million b/d in 2018.

The EIA forecast that shale oil output would increase by 122 000 b/d in June to 5.4 million b/d, almost matching the 124 000 b/d growth in production during May. The comeback of shale oil has shown that Saudi Arabia's attempts to force shale oil out of the market has failed.

Up until their meeting in Beijing on May 15, speculation had centered on whether Opec and its non-Opec partners in the production cut deal would endorse extending the cut until the end of the year. Opec was due to meet in Vienna on May 25 (as *TEI Times* goes to press), but most Opec countries seem to be prepared to extend the cut if it can get prices back in a range where revenues will meet budget requirements. Libya and Nigeria have been exempt from the agreement due to internal oil industry problems, but both countries are showing signs of increasing output; Libya especially, which is now back to an average of 800 000 b/d. It had been down to under 300 000 b/d.

A statement released by Saudi Energy Minister Khalid Al-Falih and Russian Energy Minister Alexander Novak said the market showed "healthy demand dynamics" that "would more than offset the production growth in countries outside the group of nations engaged in this voluntary effort."

To meet the target of bringing global inventories into the five-year average range – the average was 2.71 billion barrels in January this year – Opec will need to keep its output at 31.7 million b/d and Russia will have to stick with



11.15 million b/d. Stocks are currently a little above 3 billion barrels.

"Market stability and predictability are crucial for ensuring that stable and sustainable investments are made in a timely manner, supporting future oil supply, in order to meet incremental global demand, as well as to offset declines in some regions," the joint statement said.

Falih and Novak agreed to "do whatever it takes to achieve the desired goal of stabilising the market and reducing commercial oil inventories to their five-year average level, as well as to underscore the determination of oil producers to ensure market stability, predictability and sustainable development".

Bloomberg reported after the statement that extending the cut would significantly reduce inventories in the OECD countries and erase much of the glut of oil that has hit Opec and other crude producers like Russia very hard. But not only is Opec facing low prices and large inventories, there is also a decline in demand.

The International Energy Agency (IEA) reported in its May *Oil Market Report* that demand growth for the first half of 2017 fell by 115 000 b/d and that demand growth is expected to average 1.3 million b/d for the year, or 97.9 million b/d.

As we see time and again, oil is a volatile industry that bounces between boom and bust. Where the market will be in March 2018 is anybody's guess.

Gas

Green light for BRUA pipeline boosts EU energy security

Permits have been issued for the Bulgaria-Romania-Hungary-Austria (BRUA) gas pipeline. Construction of the pipeline is now expected to start at the end of the year marking an important step in Europe's bid to expand its sources of gas.

Mark Goetz

Romania's Energy Ministry in March issued permits to proceed with the construction of its section of the Bulgaria-Romania-Hungary-Austria (BRUA) gas pipeline, a significant piece of the vertical corridor energy transport concept meant to link the national gas grids in Southeast European countries and contribute towards overall energy security within the European Union.

BRUA is one of the key components of market integration and diversification of supply in Eastern Europe. Ultimately, the EU sees the interconnection of members' gas grids from the Baltic to the Aegean and further connection to hubs in Central Europe.

The 550 km pipeline, which will cross southwest Romania, will export gas produced by Romania, but also transport gas introduced through the Southern Gas Corridor and the Interconnector-Greece-Bulgaria (IGB) pipeline, which is also expected to start construction around the end of 2017. The Southern Gas Corridor, which will transport gas from Azerbaijan to Bulgaria and Europe, is well underway.

Azeri gas is due to arrive in Europe in 2019 and other sources of gas will likely arrive in the form of LNG at a floating storage and regasification unit (FSRU) that could be placed in northern Greece. BRUA will have an initial capacity of 1.75 billion cubic metres per year (bcm/year) and later increase to 4.4 bcm/year. IGB will have an initial capacity of 3 bcm/year and be expanded to 5 bcm/year in time. Both projects are included on the European Commission's Projects of Common Interest (PCI). The EU has so far provided €180 million towards the project and Romania will itself invest €220 million.

BRUA is also being supported by the European Bank for Reconstruction and Development (EBRD), which recently held its Annual Meeting 2017 in Cyprus. During the meeting a panel addressed the topic of integrating Eastern Europe's gas markets in which the director general of Romania's gas transport company Transgaz, Petru Vaduva, took part.

Vaduva said that when the Trans Adriatic Pipeline (TAP) was selected to be the pipeline system to carry Azeri gas to Europe and not Nabucco, Romania realised that it needed to "get close to [the Azeri] source of gas because we wanted to diversify."

TAP will run across northern Greece, Albania, the Adriatic Sea to southern Italy, whereby the Nabucco proposal would have carried Azeri gas through Bulgaria, Romania, Hungary and Austria. BRUA and vertical corridor is the EU's alternative to Nabucco, but the capacity is much smaller as Nabucco had been originally designed to carry up to 30 bcm/year of Caspian Sea region gas into Central Europe.

BRUA came about through the EU's Central and Southeast Europe Gas Connectivity project, Vaduva said. Like its neighboring countries, Romania wanted to diversify its sources and have transparency in prices. But he said that rather than carrying a large financial risk [as would have been the case with Nabucco], Romania decided on a pipeline project that could be scaled up and fit its own national grid system better. Romania's hydrocarbon resources make it capable of meeting its own gas demand for most the year, he pointed, with the exception being the winter months.

Romania sees BRUA as a risk, but it will serve as the interconnector that does not now exist between Romania and Bulgaria, and Romania and Hungary. The pipeline will connect the Central European market with the Southern Europe market and will impact the price of gas, even when volumes are not large, he said. Adding that while the system will be expensive to build, as an EU member, Romania recognises the pipeline's purpose.

Other projects in Eastern Europe meant to diversify sources and secure supply are LNG delivery points in Lithuania and Poland, and at Krk Island in Croatia. These projects would be used to supply not just the host countries, but also neighbouring states and eventually all of them would work to keeping the entire region well supplied with gas reasonably priced.

Another member of the panel at the Nicosia gathering, energy security specialist John Roberts, pointed out that while the interconnecting gas infrastructure will work well towards transparent pricing and multiple sources, and that they will meet the normal demands of Southeast Europe's market, the region was still an island. Roberts questioned the ability of the interconnectors to genuinely meet demand if there was a supply cutoff – suggesting a situation similar to what occurred when Russia stopped shipping gas through Ukraine in 2006 and 2009.

Roberts said that what Southeast and Eastern Europe needs is a large system capable of transporting and supplying 10 to 15 bcm/year with import terminals in the Baltic, Adriatic, Aegean and Black Seas. Europe needs to think strategically and practically about a regional gas supply system, he said.

Electrification: a winning strategy for Europe

A recent report published by Eurelectric shows that the progressive electrification of sectors such as transport, heating and cooling, will bring tangible benefits for European society.
Kristian Ruby

A key challenge in today's energy world is how to cost-effectively decarbonise the European economy. As the European Union pursues its commitments to the Paris Agreement on climate change, the decarbonisation of the European electricity sector will be key. Cost-effective decarbonisation is crucial if Europe is to remain competitive in the global market place.

With heating and cooling, and transport sectors still contributing around 66 per cent of Europe's greenhouse gas emissions, these sectors pose a key challenge to unlocking Europe's sustainability potential. This is particularly the case when we take into consideration their decentralised nature, as well as their high dependency on fossil fuels.

Heating and cooling in European buildings and industries constitutes 50 per cent of our energy consumption. Together with the 32 per cent for transport, they represent the largest shares of energy demand across Europe. Currently, 85 per cent of heating and cooling is produced from fossil fuels. This means that there is a vast potential to both decarbonise and save fuel in these sectors. While some options to this are widely known, such as electric vehicles (EVs), much more can be done – especially if we consider the overall potential of electrification.

'A Bright Future for Europe', a report Eurelectric published recently, shows that the progressive electrification of sectors, such as transport and heating and cooling, will bring tangible benefits for European society, economically and environmentally, as well as in terms of benefits for consumers.

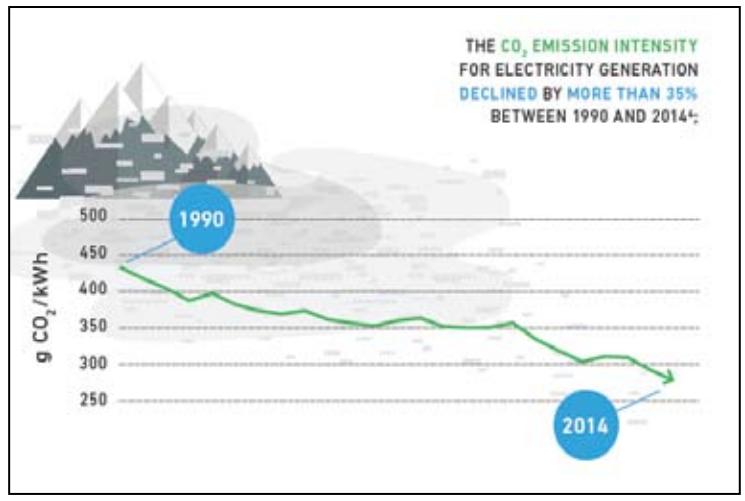
The carbon intensity of electricity production in the EU has reduced by over 35 per cent since 1990, which is significantly quicker than all other major energy carriers. The sector is fully committed and is demonstrating real achievements on the path towards decarbonisation with huge investments in renewable energy. The policy reforms currently being discussed under the Clean Energy Package are set to accelerate the decarbonisation of electricity further.

As electricity becomes increasingly decarbonised, it provides a key part of the solution to reduce greenhouse gas emissions in other sectors.

In the transport sector, switching to electricity is already a no-regret option for reducing GHG emission today. When calculating the indirect GHG emissions related to the production of electricity, using today's average European electricity mix, an EV requiring 10 kWh per 100 km is responsible for less than 50 gCO_2/km. This represents a fraction of the carbon emissions produced by even the most efficient conventional cars available on the market today, and significantly lower than the average target under current regulation for all new cars of 95 gCO_2/km by 2021. In addition, the efficiencies delivered by an electric engine are three times that of an internal combustion engine (ICE) due to lower heat losses during the energy conversion process.

But policy measures such as ambitious emission targets for cars and vans, separate zero-emission car targets, improved test cycles and charging infrastructure requirements are necessary to ensure emission reductions and further deployment of EVs.

In the heating and cooling sector, the scope for further emission reductions can be huge, and so is the scope for economic benefits. The increased use of electricity in heating and cooling could open the door to energy import savings of around €45 billion per annum.



From commitment to results: observing electricity's decarbonisation journey

In order to harvest the benefits, a level playing field between energy carriers is needed, however. The legislation must revise and differentiate between the primary energy factors for different energy sources. New and innovative finance instruments should be developed to accelerate deployment of heat pumps and similar technologies.

Reducing the fossil fuels burnt in our cars and houses has many other advantages. In urban areas in particular, electrification can have significant environmental and health benefits. Electricity in transport and heating can reduce air pollution in cities. The use of electric buses, trains and light trains can drastically improve air quality, traffic congestion and noise pollution. But electrification offers much more than just downstream decarbonisation. It can improve efficiency, strengthen security of supply and empower Europe's energy customers.

The value proposition of electricity in European society today is therefore magnified by the fact that these sectors can benefit from the electricity sector's clear commitment and trajectory towards carbon neutrality. With Europe pursuing an ambitious decarbonisation agenda, we must move towards a true valuation of electricity in achieving a competitive and decarbonised European economy.

Using electricity in sectors such as transport and buildings will not only reduce GHG emissions. But it would effectively also mean that the emissions from these sectors are capped as they are *de facto* brought under the EU Emissions Trading System (EU ETS). Given that the power sector's GHG emissions are capped under the EU ETS, any potential increase in electricity demand will come at a net zero increase in overall emissions.

What does this mean in practice? An increase in EV use across Europe will lead to an increase in electricity demand; however, no additional carbon will be emitted due to the emissions from the electricity sector being capped under the EU ETS. This will effectively result in a reduction in actual GHG emissions of 100 per cent for every internal combustion engine that is replaced by an EV.

To make this happen, significant investment in renewables and other low carbon generation will continue to be necessary in coming years. The most effective way towards a low-carbon European economy is through a clear, predictable carbon price signal that will allow industry to invest in an efficient and sustainable manner.

This is why we have consistently advocated for a strong EU ETS. We are convinced that this is the best way to provide affordable, reliable and sustainable electricity to the EU economy and to achieve Europe's decarbonisation objectives in a cost-efficient manner.

Only the combination of an effectively reformed EU ETS and an improved EU electricity market design can lead to proper price signals from the relevant markets to drive investments in mature low carbon technologies. When considering the current reform of the EU ETS and the proposals tabled in the Clean Energy Package, we stress the importance of strengthening the ETS in the current reform to address the huge oversupply of allowances that has depressed the carbon price for so many years and has hindered the ETS from fulfilling its potential.

Electricity from carbon-neutral generation is the cleanest energy carrier, making electricity the main vector for a decarbonised energy future in Europe.

Electrification is the key vehicle for a decarbonised, competitive and energy independent Europe. It is a winning strategy that will add value to the everyday lives of European citizens. At the same time it will support the European economy, whilst driving the pursuit of the EU's decarbonisation ambitions and its commitments to the Paris Climate Agreement.

Kristian Ruby is Secretary General of Eurelectric. To read 'A Bright Future for Europe' , visit: http://www.eurelectric.org/media/318404/electrification_report_-_a_bright_future_for_europe-2017-030-0291-01-e.pdf.

Ruby: As electricity becomes increasingly decarbonised, it provides a key part of the solution to reducing greenhouse gas emissions in other sectors

Floating the idea of commercial offshore wind

Floating offshore wind is far beyond the proof-of-concept phase and is now set to see demonstration at scale. Major cost reductions and far lower technical and commercial risk are set to follow.
David Appleyard

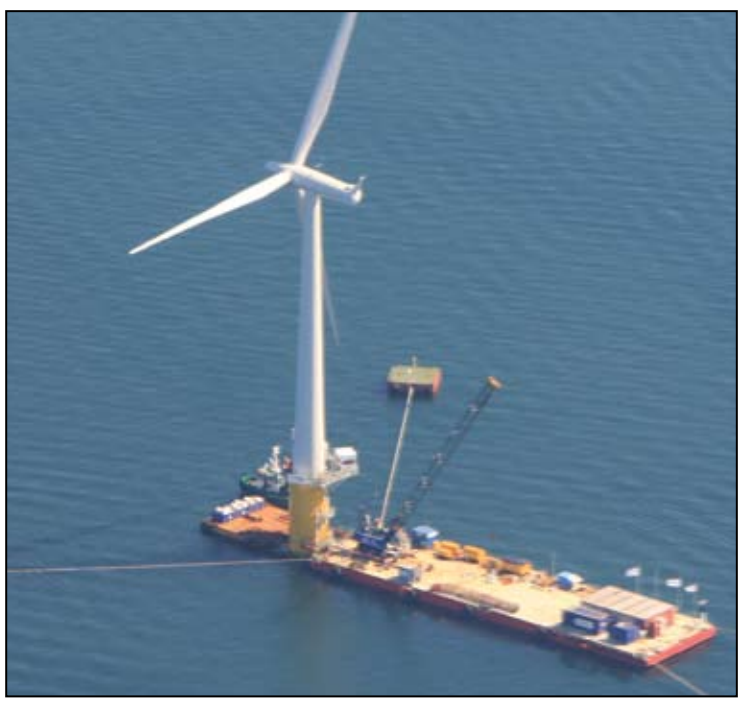
In waters much more than about 50 m in depth, the economics and feasibility of current offshore wind turbine foundation technology – typically monopiles driven into the seabed – becomes more challenging. With shallow sites in Europe and elsewhere increasingly developed, floating offshore wind turbine technology is therefore expected to become a major contributor to global renewable energy production over the coming years.

Somewhat tentatively, that process has already begun. According to recent analysis from Bloomberg New Energy Finance, some 237 MW of floating offshore wind capacity is expected to be installed by the end of the decade. This figure is dwarfed by the more than 6 GW of offshore wind capacity currently in the UK alone, but nonetheless potentially marks the first glimmers of a blazing future market.

As Andrew Scott, Programme Manager for Offshore Renewables at the UK's Energy Technologies Institute, explains, floating wind turbines will not be in the distant oceans but more likely somewhere between 20-80 km off the coast.

"This is not about going a long way offshore. It is allowing us to effectively put wind farms in places where it is windy and reasonably close to where power is going to get used, even if the water is quite deep, say 50-100 metres, where that is," he said.

Scott believes the biggest immediate demand is thus more likely to be in countries that have non-Continental shelf coastlines with very deep near-shore waters, for example off the west coast of the USA, in the Mediterranean off the south of France and around countries like Japan and New Zealand.



The 2.3 MW Hywind demonstration project being installed in 2009. *© 2009 Jarle Vines*

Several floating wind turbine 'foundation' designs have emerged as leading contenders and are now set for full scale demonstration. In a report published in December last year, the International Renewable Energy Agency (Irena) concludes that technical innovation will be a key driver of an offshore wind boom, noting that a number of main technologies for floating wind turbine platforms are being explored. These include spar-buoy designs such as the Hywind concept, tension-leg platforms per Glosten's PelaStar and semi-submersibles like the Windfloat design developed by Principle Power. There are also hybrid floating wind/wave concepts being developed.

Scott observes that the principles of floating wind farm technology are already well established in the oil and gas industry, though heavily modified for application in offshore wind. "Fundamentally it's a technology transfer from oil and gas. There's certainly good designs out there, quite a lot of them have drawn on the experience of an industry who've been making floating structures for exploration or production for decades."

Scott suggests that the key to floating offshore wind is therefore an issue of commercial risk reduction rather than technology fundamentals: "It simply comes down to cost and risk. What floating offshore wind needs to be able to do is demonstrate that it has the potential to be at least as and really significantly more cost-effective than fixed bottom foundations. And OSW energy costs using fixed bottom foundations have come down drastically in cost over the last five or six years."

This is a point echoed by Una Brosnan, Business and Strategic Development Manager, Energy, UK & Europe at Atkins. Brosnan noted: "The rate of technology development in offshore wind surpassed initial expectation in its move to industrialisation on fixed bottom solutions. We have already seen next generation turbines – 6 MW to 8 MW – being deployed on substructures which have rapidly evolved to push boundaries and succeeded in the face of design, installation and fabrication challenges to realise projects such as Dudgeon, with its XL monopiles and 6 MW turbine. The success of this technology development, alongside industry commitment to driving innovation and cost reduction, is reinforced by surpassing the 2020 target of £100/MWh [$130/MWh] in 2016."

Irena notes that at least 10 concept developers are trying to move towards full-scale demonstration. "They've got to demonstrate that they're going to be going to be cost competitive," said Scott, adding: "It's introducing a new technology and that new technology brings risk, there's got to be a big enough market out there for developers to actually want to invest in new floating technology."

He points to the UK's offshore wind market as an example. "The UK could probably go up to about 20 or 30 GW of offshore wind without having to put in floating offshore wind. That doesn't mean that floating offshore wind wouldn't be cheaper in quite a lot of those cases, but it probably wouldn't be a big enough market for developers to actually take the 'floating' risk."

Brosnan also emphasizes the importance of this issue, saying: "With floating wind projects now moving to demonstration and pilot stages in the UK and France, we need to harness these learnings with the commitment from industry to progress the commercialisation of floating wind projects in order to meet the global opportunities in emerging markets in Europe, the US and Japan."

The ETI's Floating Wind Technology Insight paper concludes that floating wind has the potential to deliver a levelised cost of energy (LCOE) of less than £85/MWh ($110/MWh) from the mid-2020s onwards.

Several full-scale multi-megawatt turbine projects have been demonstrated for extended periods over recent years. For instance Statoil's Hywind project was first deployed off Norway in 2009 and a semi-submersible design from Principle Power was installed off Portugal in 2011. Now though, substantially larger wind turbines are set to be deployed atop floating towers perhaps several hundreds of feet high. As offshore wind turbines are already in the 6 MW range and are looking at 8-10 MW for the near future, any commercially successful floating turbine platform must be able to support today's – and tomorrow's – cutting edge nacelle and rotor designs.

A swathe of recent project announcements is a clear indication of industry and political intent in this regard. Scotland is leading the charge, with close to 100 MW of floating wind power on the cards. A 30 MW Hywind installation is planned off Peterhead by Statoil this year, for example, featuring five 6 MW turbines and with production due to begin within six months. The last few substructures are set to be shipped to the Norwegian assembly site in June.

Hexicon's Dounreay 12 MW tri-float demonstration project and the Kincardine Floating Offshore Wind Farm have also been granted planning approval. Approximately 15 km south east of Aberdeen, Kincardine comprises a 50 MW project of up to eight machines and turbines with a maximum of 8 MW each. Both projects are expected to begin commissioning next year.

France, Portugal and Ireland have given the green light to floating wind projects in Europe. In March, for instance, Ireland's Gaelectric teamed up with French firm Ideol, to develop floating offshore wind energy projects in Irish waters with an initial 30 MW+ turbine array project, followed by a multi-GW commercial-scale extension on both Irish coasts. Atlantis Resources also teamed with Ideol this year for a further pipeline of 1.5 GW of UK capacity with a pre-commercial project of around 100 MW planned for commissioning by 2021. Meanwhile, Japan, Taiwan and the USA are also actively developing floating wind power technology demonstrators

Though still only emerging onto the market, floating offshore wind turbines potentially have a number of inherent advantages over their fixed cousins. For instance, without the need to tailor the foundations for a particular local geology and water depth, floating platforms can be more readily standardised. Furthermore, some floating designs can avoid the need for heavy lift vessels.

Scott said: "As turbines get bigger I think floating platforms will become more part of the solution.

"We are too early in the development of the technology to know if a standardized design [of floating foundation] will emerge. We might find that one or two different concepts actually gain traction because they actually work in particular niches."

Spar buoy designs, for example, need at least 100 m of water depth to work effectively, tension-leg platforms may prove to be more economical at depths less than that.

"If we are going to exploit all of the offshore resource available we need to have a range of foundation types that will allow us it to exploit everything from dry land right through to hundreds of metres of water," said Scott.

In March this year Giles Dickson, CEO of WindEurope, opened the Floating Offshore Wind Energy event in Marseille saying that by 2020 industry expects a 10 per cent cost reduction in floating wind technology.

Even that may be a pessimistic outlook given the dramatic reductions witnessed in fixed bottom installations, although this precipitous price fall was enabled to some extent by government support. As Brosnan said: "To build on the success and innovation rates to date in offshore wind, it is imperative that offshore wind continues to be deployed at scale. In order to achieve this, however, floating wind needs a clear route to allow commercialisation of technology, with policy and a support mechanism in place to support this emerging technology."

Scott echoes the need for a supportive policy framework for floating offshore wind development. "This needs to be a technology that's being developed now, so that developers and policy makers can start considering floating wind and areas that would suit floating wind from deployment of 2025 onwards."

He concluded: "It takes over eight years to actually develop a windfarm, so if you're talking about a wind farm that's going to come on stream in 2025, in fact you're going to be thinking about it now."

Storage on the fly

A flywheel with a new rotor construction looks set to deliver low-cost storage with vastly improved safety compared to existing designs. **Junior Isles** reports.

A single array of 200 flywheels, as shown, provides 1 MW, 1 MWh of power, with a floor space requirement of only 24m²

Solar photovoltaics (PV) is seen as a game changer in the supply of electricity – particularly for the 1.6 billion people still without access. However, the issue of energy storage remains crucial to it being used to its full potential. While the development and deployment of lithium ion batteries in particular, continues to make good progress as costs fall, the technology has its drawbacks.

In addition to the amount of energy they can store, one of the main problems that have plagued batteries is that they only have a certain amount of lifetime. If a battery stores and produces power too often, it will soon degrade and ultimately become permanently drained.

With the ability to operate for over 20-30 years and deliver over 500 000 cycles with no performance degradation, flywheels offer an alternative in certain applications. Some scheduled maintenance will be needed but it can be considered as a long life asset similar to say a pumped storage system.

Keith Pullen, Professor of Energy Systems in the School of Mathematics, Computer Science and Engineering at City University London, has been working on flywheels for over 20 years. He says battery degradation has been a particular challenge in the motor vehicle industry.

"It's the reason why in a Toyota Prius, for example, the engine comes on as soon as you put any real acceleration on, or the car goes above 20 mph. If you allowed the small hybrid battery to produce that power regularly, you'd only do it for six months before the battery would be destroyed… When you need power and lots of cycles for short spaces of time, the flywheel beats the battery hands down."

He added: "And when a battery fails, in a developing country it often ends up dumped, perhaps in a river, or dismantled in unsafe conditions even by children. A flywheel can be very cheap and easy to repair and maintain because it is a physical thing."

But despite some key advantages, flywheels have not caught on in the same way as batteries. One of the best known installations is the 20 MW flywheel system installed by Beacon Power in New York, USA, used primarily for frequency regulation.

Here, 200 flywheels each rated at 0.1 MW and 0.025 MWh are used to respond almost instantaneously to the ISO control signal at a rate that is 100 times faster than traditional generation resources.

Notably, unlike a battery installation, the flywheels are buried for safety reasons. A flywheel is a mechanical device specifically designed to efficiently store rotational energy. The flywheel rotor is typically made of solid steel or carbon fibre composites and rotates at speeds that can reach thousands of rpm.

Pullen points out: "If a rotor fails, a lot of energy is released in a very short space of time. There have been some cases, where flywheels have failed with devastating effect."

The amount of energy a flywheel can store is limited by the tensile strength of the rotor. While rotors made of carbon fibre composites are stronger and lighter than steel, which is the most common rotor material, it is expensive and difficult to mass manufacture. In addition, under circumstances this type of rotor can fail in an explosive mode and this means machines must be buried or have very strong containment if above the surface.

This led City, University of London to partner with UK-based Dynamic Boosting Systems Ltd (DBS) to develop a new type of flywheel. In a project led by Pullen, a steel rotor has been designed which allows the overall weight of the flywheel to be lighter than a flywheel with a carbon composite rotor.

Pullen explained: "Although the rotor itself is three to four times the weight of a composite rotor, the design allows the containment to be smaller and lighter. Therefore, the specific energy per [unit of] volume is better than carbon fibre composite."

While Pullen notes "there are a number of things that subtly come together," in the new design, the main breakthrough is in the construction of the rotor to allow low cost with much improved safety.

"The first thing is, we use steel for the rotor, which currently costs about £250/t. We need something like three quarters of a ton for 5 kWh including casing. Even if lithium ion comes down to the best prediction of $125/kWh in 10 years, we are still cheaper. The cost of each 5 kWh module in mass production would be of the order of £1000-2000."

But the key innovation of the new design is that the rotor is not made from a solid cylinder. Instead, it is laminated from steel sheets "off the rolling mill". The steel sheets are essentially bolted together using a special technique that avoids any stresses higher than would occur in a solid cylinder and removes tri-axial stresses.

Explaining the significance of the design, Pullen said: "In any metal, if there is a crack, that crack grows every time you go up and down in speed. In a monolithic single piece of steel – firstly it would be difficult to make it high strength. If it were to get a crack, it would grow and eventually the whole thing will go. Half a ton of steel rotating at the speed of sound would need a huge concrete bunker or thick steel to contain the two or three big chunks of steel it would break into.

However, if the rotor is made up of 100 sheets then we only have 100th the amount of energy. And it is improbable that two sheets will fail at the same time."

Pullen's team, in partnership with car company Nissan, has tested a 250 kJ flywheel and an integrated 25 kW motor-generator and proved that it is safe. In addition to being safe in operation, Pullen also notes they are safe in fire.

"We ran a test where we put a big crack in a rotor sheet and span it at a peripheral speed well over the speed of sound – until it burst. The test showed it didn't even dent the 10 mm thick casing."

Having proven the design is safe, the team is now building a bigger 5 MJ flywheel for use in the railway sector. This would have a rotor diameter of around 400 mm and height of 150 mm. Following this the next step will be to build a 5 kWh device for ground power. This would also have a rotor diameter of about 400 mm but would be 500 mm high.

According to Pullen, this is likely to be the standard size. This could deliver tremendous space savings. The Woodman Close substation in Leighton Buzzard UK is one of the largest battery installations in the country. At 6 MW/10 MWh, the installation has 35 000 units occupying an area of three tennis courts (760 m²). Pullen says an alternative of 2000 flywheels would provide 10 MW/10 MWh of power, with a floor space requirement of only 240 m² a third of that used at Leighton Buzzard.

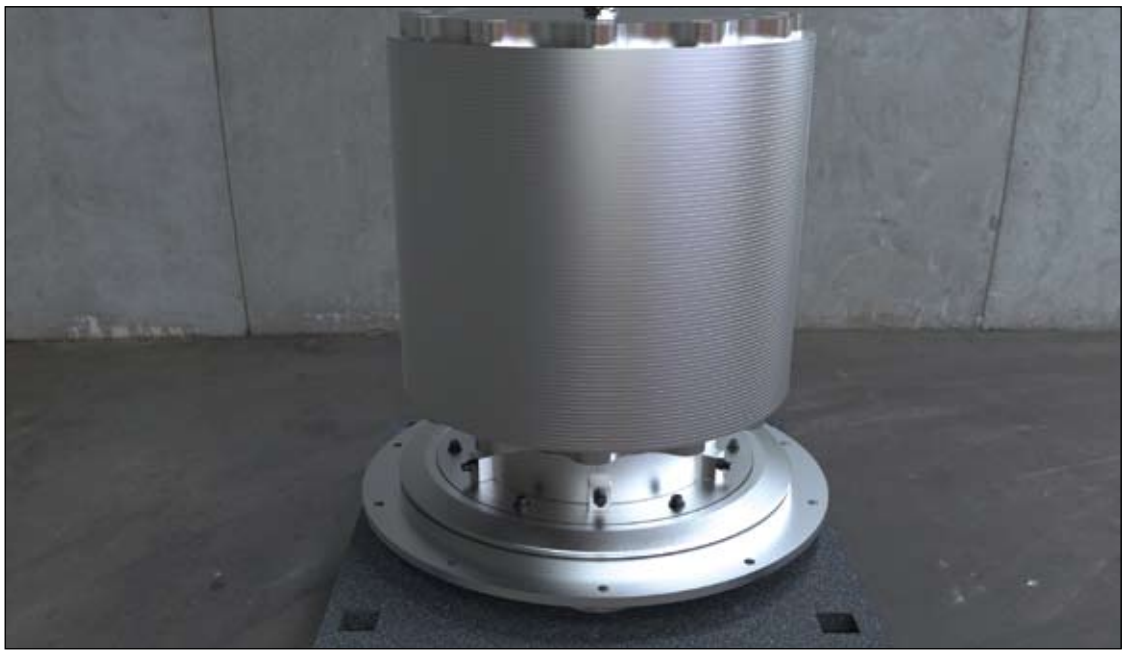
However, Pullen points out that it is not a case of this flywheel likely being a replacement for all batteries on the grid. "A better idea is to hybridise this with a battery for a much better solution," he said. "When there is short term, high power demand for stabilising the grid frequency (known as enhanced frequency response in the UK), you do that with a flywheel to protect the battery and then use the battery for longer term storage. The 5 kWh flywheel modules would then be equipped with 100 kW motor-generators so a bank of 200 flywheels could then produce 10 MW for up to 3 mins. This is where this could really take hold and change things, even facilitating second life use of expended electric car batteries."

Although the new flywheel is essentially still in the laboratory, Pullen believes the route to commercialisation could be fairly quick. He explained: "It can be ramped up quickly because the construction is all around known technology. All that is needed is the investment to get this up to product and in production." The company Gyrotricity, a spin-out from City and DBS, has been set up to facilitate this.

Funds are now being raised to build a ground power demonstration module. If funds can be raised quickly, Pullen expects this flywheel could be ready in 18-24 months.

With the growing need for grid stabilisation in developed countries as renewables take hold combined with the need for solar combined with storage in developing countries, the commercialisation and global rollout of the new flywheel could be rapid indeed.

Pullen summed up: "This flywheel has a very good future in both ground power and transport, particularly where longevity, high power-to-energy ratio and robustness are all important."



A 5 kWh laminated flywheel rotor with lower bearing support

Learning from cavemen

Junior Isles

Energy transitions are not new; they have been ongoing since cavemen first discovered fire. Over the centuries we have seen wood replaced by coal and the move to oil and gas. What is different this time, however, is the speed of change. The rate at which the energy industry is moving towards renewables is nothing short of staggering.

At the recent *Financial Times* Energy Transition Strategies, part of the FT Clean Energy Week, the changing energy landscape was a topic of hot debate.

Opening the conference, Wilfrid Petrie, CEO, Engie, UK & Ireland, said: "This transition to clean energy has not been smooth and will not be smooth. In the last six years, European utilities have had to write off €100 billion worth of assets. We have had to mothball 50 GW of gas fired power plants… It has been quite a significant transition, in fact it feels more like a revolution."

Commenting on the pace of change, he added: "This is because there are a certain amount of technologies available, the awareness today is bigger, the ability to mobilise the public is much greater than before and I think we can expect this energy revolution and the uprising of renewables to happen even more quickly."

Engie has been transforming its company in line with the changing market. In March it sold its British shale gas interests to petrochemicals firm Ineos. It is all part of a move to reduce its exposure to oil, gas and power prices, which have tumbled in recent years. The plan is to reinvest the €15 billion it expects to raise from the divestment into energy services, renewable power and gas pipelines where revenue is regulated or more predictable.

Others, like Dong, RWE and E.On, have been making similar moves. Just last month (May) Dong agreed to sell its upstream oil and gas business to Ineos for $1.1 billion as it continues to exit the fossil fuel arena. Meanwhile, both the big German utilities have restructured their businesses, hiving off conventional generation into separate companies.

Also speaking at the conference, Johannes Teyssen, CEO, E.On said: "There has been a fundamental change. Even if you look back just a few years, there was not a consensus that we were living in the midst of a transition. It took us a while to accept that it's not just German politics that is fundamentally driven by technology and customer desire. Whilst we embraced it, we thought again it's not that important how fast it would go, [but that] it will continue.

"So we will see a distinction between the system-based world – driven by centralised facilities that are needed to keep the lights on – and the customer-centric business, which is greener and much more decentralised. We decided we could not be in both worlds and thus split the company."

The speed of the transition has certainly taken most by surprise but the pace at which it will continue and its ultimate extent is a question that divides the industry.

Lord Adair Turner is Chairman of the Institute for New Economic Thinking and Chair of the Energy Transitions Commission. Notably he was the first Chair of the UK Climate Change Committee (CCC). Speaking on a panel addressing the energy revolution, Lord Turner recalled: "When I look back at the cost estimates we were making during the first year of the work of the CCC in 2008, frankly, I'm just embarrassed because we completely failed to predict that wind costs would come down by 60-65 per cent and solar would be down by 85 per cent."

As costs continue to plummet, there is a growing question of whether it is possible to build a near 100 per cent renewables electricity system at a reasonable cost. "The answer we're getting is definitively, yes," said Lord Turner. "Even with just storage and gas plants for peaking, by 2035 at the very latest you could get the cost of a near 90 per cent renewable power system down below 7¢/kWh; that's the cost of everything – [with] the backup, the flexibility.

"And having developed those figures by autumn last year, my worry now, is that in 10 years time, I'm going to be embarrassed by how pessimistic those assumptions were as I am by those assumptions in 2008."

One school of thought is that the rapid fall in costs for renewables and storage, and the emergence of new technologies, will see the economic case – never mind the environmental argument – for fossil fuelled power generation dwindle.

Others argue, however that we should be cautious about predicting the end of the hydrocarbon era.

Professor Jason Bordoff, Founding Director, Center on Global Energy Policy, School of International and Public Affairs, Columbia University, said: "We've been talking about energy transitions for quite a long time, yet fossil fuels continue to supply more than 80 per cent of the global energy mix. I think that's important because two things can both be true and sometimes they get conflated.

"Renewables will without question be, by far, the fastest growing form of energy in the world. That can be true and the world 20 or 30 years from now can still be overwhelmingly powered by hydrocarbons."

Considering the overall growth in energy demand and the difficulty in decarbonising sectors such as aviation, steel and cement, this is entirely possible.

Spencer Dale, Group Chief Economist at BP, essentially backed this thinking. "Our central guess is that energy demand will rise by around a third over the next 20 years – all of this comes from developing countries. We are absolutely seeing an energy transition but the nature of that transition will be coloured by the nature of this increasing energy demand."

Dale made his second point by looking at history, noting that "energy transitions take a very long time". He said it took 45 years for oil to rise from 1 per cent to 10 per cent in the global energy mix, more than 50 years for gas, while nuclear represented 1 per cent in 1974 and still has not achieved 10 per cent.

"Renewable energy – wind, solar and biofuels – is around 7 or 8 years into its clock," said Dale. "BP's central guess is that it achieves 10 per cent by 2035. That will be a quicker transition than any fuel has ever seen in history but it will meet only 10 per cent of the world's energy needs in 2035.

Yet we should be careful of using the past to predict the future.

Juliet Davenport, Founder and CEO of green energy company, Good Energy, made a very telling observation, at least for the electricity sector. She explained: "This transition includes a lot more people than ever before. If you look at the transition in gas and oil, most of that is done from one end of the pipe to the other end; it has been delivered from the industry to the consumer. This is the first time the consumer is looking down the pipe and putting something back the other way. This is the first time we've seen this transition in a two-way energy market.

"This approach of looking at the energy market from completely the other way around is why potentially we could see a transition that is much faster than historical transitions. It's not going to obey any of the laws we have seen before because suddenly we've got consumers in the market as well and they will shape things in a completely different way to what we have seen before."

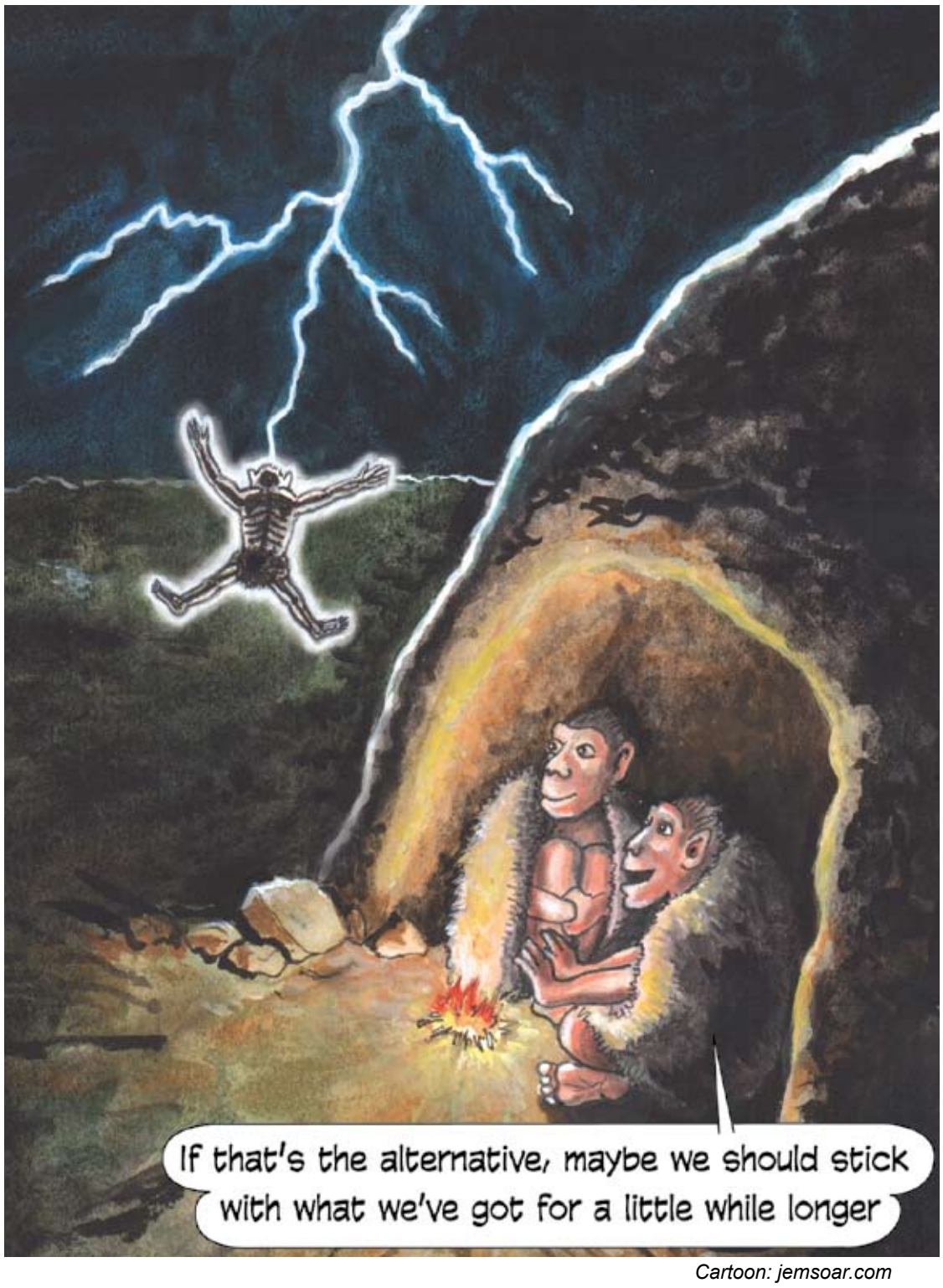
It was Kingsmill Bond, New Energy Strategist at TS Lombard, however, who perhaps made the strongest statement on the pace of the transition. While he said the question of whether the industry could get to 80 or 90 per cent of renewables was "inappropriate" at this stage, he stressed that the widely held view that transitions take a very long time was a "completely wrong understanding of history".

He explained that there are two types of energy transition. Using financial markets as an example he said: "There is systemic change, which takes a very long time but is actually irrelevant in financial markets, and there is marginal change, which is what drives financial markets."

For example, out of nearly 100 million cars sold last year, only 1 million were electric, yet this has not stopped car companies making the shift to electric vehicles. Lighting is another example: demand for gas for lighting peaked in 1914 when electricity was just 3 per cent of the market. The point is that old technology can peak when new technology is still in its infancy.

"You can get very radical change taking place when the new technologies are tiny," said Bond. If India is anything to go by, he could well be right. India's solar ambitions, once seen as implausible, demonstrate how dramatically change can occur.

In this transition, innovation and consumers will dictate the pace and those who base their strategy on history could be left in a cold, dark place.



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