# THE ENERGY INDUSTRY TIMES

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**Special Project Supplement**

Mine control in Mexico improves supply reliability and reduces outage times.

**Shaping up for a decarbonised future**

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# Trump warned on risk of "ripping up" Paris agreement

Climate threat: US President-elect Donald Trump

The international community remains adamant that the election of Donald Trump as the next US President will not derail climate efforts. **Junior Isles**

US President-elect Donald Trump has been warned of the risks posed by his presidential campaign threat to "rip up" Paris.

Speaking to reporters at the COP22 climate change meeting in Marrakesh, Morocco, in November, Miguel Arias Cañete, EU climate and energy commissioner, said: "At the moment we are sending the Americans the message that it's in the interests of the US to deliver clean energy policies and ambitious climate change policies."

Cañete said he did not want to speculate on "worst-case scenarios" such as the US withdrawing from the Paris Agreement. "I prefer to be an optimist," he said.

In a sign of the frustration running through the meeting, Cañete added: "We are in a positive attitude, not a negative attitude – at the moment, under present circumstances."

During the run-up to the election Trump called climate change a "hoax" created by China and said he would pull the US out of the Paris accord as soon as possible. No single country can abolish the Paris deal and it is still too early to know exactly what a Trump presidency will mean for the accord.

Jonathan Pershing, US climate envoy, representing the outgoing Obama administration in Marrakesh, said it appeared that other governments were "holding judgment" on how to respond to the incoming Trump presidency.

China warned Trump that he would be defying the wishes of the entire planet if he acts on his vow to back away from Paris after he becomes President in January. Chinese negotiators in Marrakesh warned there was a clear consensus among the "whole global society" to back the Paris deal. "It is global society's will that all want to co-operate to combat climate change," a senior Beijing negotiator said in Marrakesh. The Chinese negotiators added that "any movement by the new US government" would not affect their transition towards becoming a greener economy.

Countries were adamant that the US election result should not interfere with the Marrakesh meeting.

Russia's lead negotiator, Oleg Shamanov said: "We're talking about the big challenge of climate change. This issue is bigger than life. This is a long-term issue, longer than any mandate of any president of country X or Z, even if that country is a big one."

Pershing told reporters in Morocco he does not know what Trump's "outlook" on climate policy will be. However, he said his Chinese counterpart, Xie Zhenhua, told him that China intends to move ahead regardless.

"Of course they are going to move forward," he said. "I'm hearing the same from the Europeans. I'm hearing

*Continued on Page 2*

# IEA says renewables and gas are big winners in energy transformation

As a result of major transformations in the global energy system that take place over the next decades, renewables and natural gas are the big winners in the race to meet energy demand growth until 2040, according to the latest edition of the *World Energy Outlook* (WEO), the International Energy Agency's flagship publication.

"We see clear winners for the next 25 years – natural gas but especially wind and solar – replacing the champion of the previous 25 years, coal," said Dr Fatih Birol, the IEA's Executive Director. "But there is no single story about the future of global energy: in practice, government policies will determine where we go from here."

Renewables will account for 37 per cent of global electricity generation in 2040, according to the main scenario in WEO 2016. In its 450 scenario consistent with limiting the global increase in temperature to 2°C, a much higher percentage, almost 60 per cent, of the power generated in 2040 is expected to come from renewables. Almost half of that will be from wind and photovoltaics (PV). Currently, the share of renewables in power generation is 23 per cent.

The IEA also noted that although renewables "make very large strides" in the coming decades, their gains remain largely confined to electricity generation.

Dr Birol said: "The next frontier for the renewable story is to expand their use in the industrial, building and transportation sectors where enormous potential for growth exists."

The gas market is also set for change, with the share of LNG overtaking pipelines and growing to more than half of the global long-distance gas trade.

Birol said: "We have seen the shale gas revolution in the US, which was first announced by the *World Energy Outlook* in 2009. Now we are giving you a heads-up that a second gas revolution is coming through. This time it will be driven by LNG.

"A huge amount of LNG is coming in the market in the next few years from the US and Australia, followed by a second wave from Mozambique, Tanzania and Canada."

The IEA said gas provides "the story of continuity" between the last two and a half decades and the next two and a half decades. It said natural gas is the fuel that sees growth in nearly all countries because it is being used across a number of different sectors. "It is very versatile at supplying a large number of energy services," said Laura Cozzi, Deputy Head at the Office of the Chief Economist at the IEA.

In its 450 Scenario, low carbon energy sources dominate the generation mix. Hydro generates 20 per cent, nuclear 18 per cent, wind 18 per cent and solar PV 9 per cent. Fossil fuel generation declines sharply, with gas supplying 16 per cent, coal 9 per cent and oil 1 per cent. The remaining 9 per cent is supplied by a range of other low carbon sources.


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the same from the Brazilians. I'm hearing the same from Mexico, and from Canada, and from smaller nations like Costa Rica and from Colombia." Saudi Arabia also said it will press ahead with its pledges, even if Trump pulls the US out of the global deal.

Under the Paris accord, countries have volunteered nationally determined contributions. They are not legally obliged to meet any emissions targets in their plans but they do have to update them every five years so that, ultimately, global temperature rises are kept "well below" 2°C compared to pre-industrial revolution levels, and 1.5°C if possible.

**Sauven: "Trump is a climate menace, no doubt about it"**

The US, for instance, has proposed an emissions cut of up to 28 per cent on 2005 levels by 2025, while the EU is planning a 40 per cent cut from 1990 levels by 2030. China has no goal for an outright cut at all, but instead says its emissions will peak by 2030.

Because the Paris agreement came into force sooner than expected, every country ratifying the pact is now legally bound by its terms – including the US for the moment.

To pull out would take four years, unless Trump chose to take the US out of the accord's parent treaty, the 1992 UN Framework Convention on Climate Change, in which case it could only take a year.

That would be a highly provocative move, said international climate law expert, Farhana Yamin. "It would escalate non-cooperation to the highest level possible."

The Paris agreement reached at the UN climate change conference last November was, according to US law, an executive agreement rather than a treaty. Legal experts from US environmental organisations point out that under "customary international law" the country is bound to respect international executive agreements that are not treaties ratified by the Senate. Trump, however, can withdraw from an executive agreement.

India warns that Trump's appointment would force countries to reassess the accord hailed as an end to the fossil fuel era.

"Everyone will rethink how this whole process is going to unfold," India's chief negotiator, Ravi Prasad, told the *Financial Times*. He feared the Paris accord could suffer "a contagious disease that spreads" if the US withdrew.

Commenting on the implications of Trump's election for climate and energy policy, Greenpeace UK executive director John Sauven said: "Donald Trump is a climate menace, no doubt about it. He wants to pull out of the Paris Climate Agreement, stop funding clean energy research and drill for extreme oil. But together we are more powerful than he is. And we need to be."

# Marrakesh looks to maintain climate change momentum

Following ratification of the Paris Agreement on November 4th, climate leaders met in Marrakesh, Morocco, to start the process of converting the goals of the agreement into concrete actions. **Junior Isles**

Climate change leaders, who met in Marrakesh, Morocco, for the COP22 climate change summit in November, have stressed that the achievements of the last year cannot be a short-lived success.

Following the ratification of the Paris Climate Agreement just 11 months after the accord was reached in December 2015, government ministers in Marrakesh were keen to maintain the considerable momentum that has been built by converting the goals of the agreement into concrete actions.

EU Commissioner for Climate Action and Energy, Miguel Arias Cañete said: "We need to do more and go much further if we want to keep global warming well below 2°C and avoid the most dangerous effects of climate change. The EU's ambition is to be in the driving seat of the clean energy transition, but we know that leadership must be followed by concrete actions."

With ambitions to lead the clean energy transition, Arias Cañete announced a package of measures to boost EU's energy system.

"Later this month we will be launching our Smart and Clean Energy Package to put energy efficiency first, make the EU number one in renewables and to do so in a cost-effective way that delivers a fair deal to consumers."

The package of measures expected late November will cover energy efficiency, renewables, a new electricity market design, and ways to boost consumer involvement in the energy transition, according to European Commission (EC).

Preliminary estimates show that emissions across the European Union in 2015 were 22 per cent lower than 1990 levels, despite a slight increase compared to 2014, according to new reports from the European Environment Agency (EEA). The reports confirm that the EU is well on course to meet its greenhouse gas emission target set for 2020.

In another important development, 19 nations that are part of the UN-sponsored Climate and Clean Air Coalition (CCAC) recognised methane reductions as "the next big climate opportunity" and agreed to implement policies to minimise emissions of this powerful pollutant from their oil and gas sectors.

Mark Brownstein, Vice President, Climate and Energy, Environmental Defense Fund said: "Methane pollution is driving about 25 per cent of the warming our planet is experiencing today, and reducing oil and gas methane emissions is the fastest, cheapest, most impactful way to address this. It will take a combination of government policy and industry action to fully realise this opportunity."

Meanwhile, business and subnational leaders called on governments to start planning for long-term climate strategies now in order to unlock the investments needed for the transition to a zero carbon economy. At a press briefing organised by The Prince of Wales's Corporate Leaders Group and 'We Mean Business' at COP22, they highlighted the importance for countries to develop plans with a 2050 horizon as a necessary complement to their nationally determined contributions (NDCs).

These new, science-based, longer term national strategies will give business a clear framework on which to plan future investments. Thomas Lingard, Climate Advocacy & Sustainability Strategy Director at Unilever, a member of The Prince of Wales's Corporate Leaders group, said: "Business needs a long term pathway to fully embrace the opportunities offered by a low-carbon world. Unilever understands the business case for climate action and, as part of our Sustainable Living Plan, we have committed to become carbon positive in our operations by 2030, supporting the generation of more renewable energy than we consume."

The Under2 Coalition – an ambitious network of states, regions and cities committed to limit their GHG emissions by 80-95 per cent on 1990 levels or to 2 metric tons $CO_2$-equivalent per capita by 2050 – is leading efforts to promote long-term decarbonisation at the sub-national level.

Ken Alex, Senior Advisor to Governor Brown of California, who initiated the Under2 Coalition, said: "The Under2 Coalition now represents over 165 sub-national jurisdictions around the world across all continents, and 35 per cent of world GDP. A key area of our work is to support each other in developing decarbonisation pathways to 2050.

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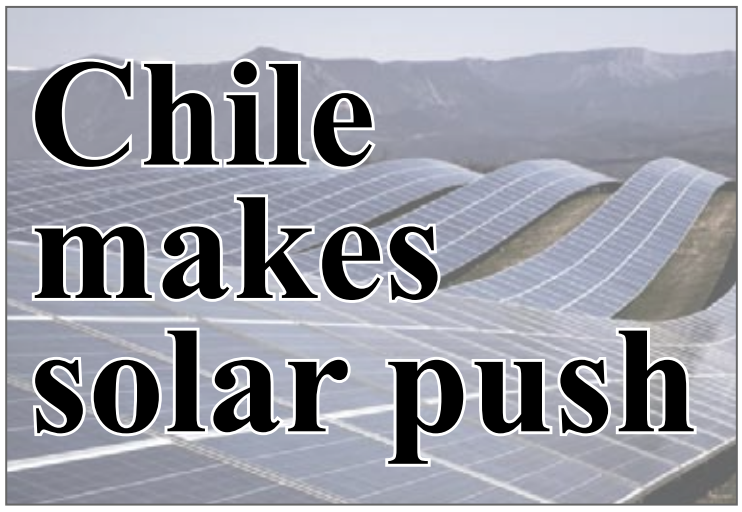


# Chile makes solar push

Chile wants to further expand solar power generating capacity in order to help it reduce emissions and build a domestic solar industry.

Chilean environment minister Pablo Badenier said at COP22 in Marrakesh last month that renewable energy and storage could play a larger role in the country's energy mix.

He announced plans for the development of a solar energy complex of up to 1000 MW in Atacama to supply energy to the country's mining sector. There are also plans to establish a solar technology centre in Antofagasta.

Renewables are becoming an increasingly important part of Chile's energy mix. Last month Acciona said it had connected Latin America's largest solar photovoltaic plant – El Romero – to the central SIC grid in Chile. Separately, Austrian Solar's plans for the 84 MW, $200 million La Huella solar photovoltaic plant in Chile's Coquimbo region have been approved.

Badenier said that the proposed Atacama solar complex would require an investment of around $4 billion. This, and other planned projects, would help Chile to reduce the costs of solar energy to below $20/MWh by 2025.

There are also plans to develop photovoltaic technologies that work well under Atacama conditions. Badenier said that around 100 companies could be active in the domestic supply chain by 2025.

According to Acciona, the 196 MW El Romero plant will provide 80 MW of energy to Google's datacentre in Santiago. Acciona also signed long term power purchase agreements for energy from the plant with Chilean power distributors in recent auctions.

# Renewable energy sector reflects on Trump election

US President-elect Donald Trump has appeared more moderate in the weeks since his election, but the US energy sector remains uncertain of policy proposals he will make next year and their impact on clean energy investment.

Siân Crampsie

The renewable energy industry in the US has expressed concerns over the potential impact of a Trump government on economic growth and green targets.

President-elect Donald Trump is known to be sceptical about climate change and made promises during his election campaign to reverse President Obama's Clean Energy Plan and other pledges around green targets.

He also vowed to "unleash an energy revolution" that will "unleash America's $50 trillion in untapped shale, oil and natural gas reserves, plus hundreds of years in clean coal reserves".

Following Trump's defeat of Hillary Clinton in November, shares in companies exposed to the USA's renewable energy market – including Vestas, SunPower and Suzlon – fell amid concerns over future energy policy and the incoming government's attitude to renewables and fossil fuels.

Trump has said little on energy policy and climate change in the weeks since the election, but there are fears he could attempt to repeal legislation providing support for wind and solar energy.

A recent report from analysts S&P Global Platts said that efforts to end incentives for alternative energy development would boost near-term demand for fossil fuels. "A potential cut in the Investment Tax Credit to ten per cent from the current 30 per cent would slash solar installation demand by 60 per cent," the report said.

"We urge President-elect Trump to take time to study the issue of climate change and hear a broad range of perspectives. He'll find that a majority of Americans across the political spectrum support stronger climate action," said Bob Perclasepe, President of the Center for Climate and Energy Solutions (C2ES). "Smart investments and technological innovation have started America on a clean-energy transition. Building on that momentum will protect communities from rising climate damages and will contribute to strong and sustained economic growth."

There are currently over 20 GW of wind energy under construction or in advanced stages of development in the USA, according to the American Wind Energy Association (AWEA). The US has 75 716 MW of cumulative installed wind capacity and wind provided 5.36 per cent of the nation's electricity for the 12 months ending in July.

AWEA believes that the wind sector has been able to rapidly scale up thanks to the falling cost of wind power and policy certainty. In the wake of the US election, it said that it is "ready to work with President-elect Donald Trump and his administration to assure that wind power continues to be a vibrant part of the US economy."

The US wind sector employs 88 000 jobs, AWEA said, while the Danish Wind Energy Association has cited a Vestas survey indicating that 80 per cent of Trump supporters are in favour of the expansion of wind power.

# Alberta commits to renewables targets

The Alberta government says that committing to targets for renewable energy will help to stimulate the economy.

The Canadian province has announced plans to set clear timelines for developing renewable energy capacity and says that it will develop a competitive bidding process to control costs.

The Renewable Electricity Programme will add 5000 MW of renewables capacity to Alberta's grid by 2030, putting the province on a path to achieve its target of 30 per cent renewable electricity by that date.

The competitive bidding process will be administered by AESO, the system operator. Successful projects will be privately funded and will result in new investment of at least C$10.5 billion into the Alberta economy, the province's government said.

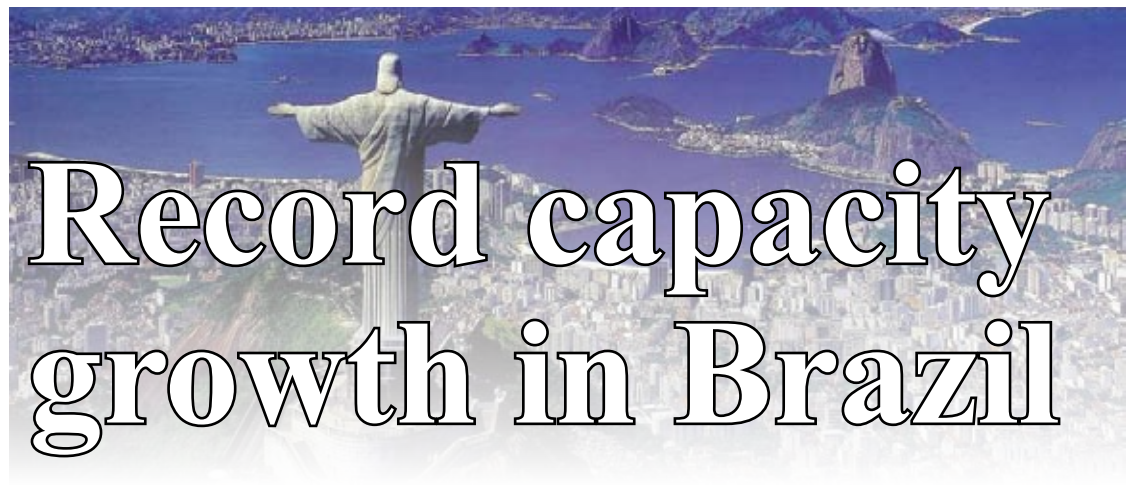
AESO began the process for procuring the first 400 MW of capacity last month by gathering feedback from industry on draft commercial terms. The first competition is due to take place in 2017.

"As the AESO built our recommendations for government, we were keenly aware of ensuring that competitive outcomes drive the best result for the province," said David Erickson, President and Chief Executive Officer, AESO.

"Reaching 5000 MW of new renewable generation is a complex task, but we are confident we can reliably integrate this much renewable energy into the electricity system in a cost-effective manner by accessing the benefits of robust competition."

The Canadian Wind Energy Association (CanWEA) said it applauded Alberta's policy. "Alberta's renewable energy target is ambitious and achievable and enshrining the target in legislation makes it clear to investors that Alberta will be Canada's largest market for new wind energy investment for at least the next decade," said Robert Hornung, CanWEA President.

"[The] announcement of key details around Alberta's plans for procuring new renewable energy will convert the significant investor interest in the Alberta market into investor action – ensuring an extremely competitive procurement process that will reduce costs for consumers and maximise value for Albertans."



# Record capacity growth in Brazil

Economic recession and dwindling demand for electricity have failed to stifle investor appetite in Brazil's power sector.

The country's government says that a record 8.6 GW of generating capacity was brought online in 2016, beating a previous high of 7.5 GW in 2014. The mines and energy ministry reported that the risk of an energy deficiency for the remainder of 2016 was near zero, and around one per cent in 2017.

Brazil has encouraged the development of new generating capacity over the past few years to help overcome power shortages experienced in drought years. Renewable energy and thermal power plants have been a particular focus in order to reduce the country's reliance on hydropower.

According to government figures, installed wind power in September 2016 grew by 43.4 per cent year-on-year, reaching 9507 MW. Solar grew 8.3 per cent to 23 MW and biomass by 5.3 per cent to 13 845 MW. Hydropower capacity in Brazil now stands at 13 845 MW, up five per cent from a year ago.

Installed capacity in Brazil is just over 148 GW and is set to continue growing thanks to a number of large projects in the pipeline as well as a large number of smaller renewable energy projects contracted in recent auctions.

In October GE said it had secured an order worth over $900 million for the turnkey execution of the 1.5 GW Porto de Sergipe power plant, Latin America's largest gas power plant. Meanwhile the Norte Energia consortium said that the third turbine at the Belo Monte hydropower plant has started operating, bringing the output of the project to over 2 GW.

GE said that it will equip the Porto de Sergipe power plant with three HA gas turbines as well as a high voltage step-up substation at the power plant, transmission lines and a bay at an existing substation to connect the new plant to the grid.

Once complete, the combined cycle plant, located at Barra dos Coqueiros, will account for around 15 per cent of northeast energy demand in Brazil. It will also play an important role in enabling a quick response to fluctuations in supply caused by growing levels of renewable energy on the grid.

The plant's first operation is scheduled for January 2020 as part of the Governador Marcelo Déda power generation complex.

# Vietnam to invest $40 billion by 2020

- Mainstream to build 940 MW of wind power
- Renewables to represent nearly 11 per cent of generation

Syed Ali

Vietnam may need to invest about VND859 trillion ($38 billion) in electricity generation, transmission and distribution infrastructure between now and 2020 to meet domestic demand, the government said in a new report. The country is also shifting attention to renewable energy to meet the needs of the economy.

According to the report, about 75 per cent of the investment will go to generation, with the remaining 25 per cent to upgrade, repair and expand the national transmission and distribution system.

The country's electricity demand is expected to continue to grow 13 per cent annually in the next four years to match the economy, which is forecast to grow by 6.5-7 per cent a year over the next four years.

The government recently revised down the target for electricity generation from coal from 56.4 per cent of the total electricity generation to 53.2 per cent by 2030.

Vietnam says it will be more focused on renewable energy, particularly solar and wind energy, targeting a renewable energy share of 10.7 per cent by 2030. At present, wind and solar power capacity is estimated to account for only 0.8 per cent and 0.5 per cent, respectively, of total electricity generation by 2020.

In November, global wind and solar developer, Mainstream Renewable Power, said it will develop, build and operate, together with local and international developers, three wind projects with a combined capacity of about 940 MW. The projects represent an investment of over $2.2 billion.

# Philippines consultations on new energy plan

The Philippines Department of Energy (DOE) recently conducted a series of stakeholders' consultations nationwide in line with its mandate to formulate a comprehensive energy plan for the country. Through its Energy Policy and Planning Bureau (EPPB), the DOE is finalising the Philippine Energy Plan (PEP) 2016 to 2030.

Energy Secretary Alfonso G. Cusi said the DOE is currently formulating a 15-year energy plan, and a more comprehensive one until 2040, that entails a series of studies factoring in gross domestic product (GDP) and population growth, among others.

Consultations have already been held in several cities. The DOE said the sectoral roadmaps are a result of the review exercises done by the DOE on the effectiveness of the current agenda and the identification of implementation gaps in the programme. It said each of the roadmaps is complemented by programmes of action, which are broken down into short, medium, and long term targets guided by the overall 2030 objectives.

"The PEP formulation paved the way for the development of sectoral energy roadmaps that are critical to ensure energy security and increased energy access. We have conducted a series of consultations with various stakeholders – local government units, electric cooperatives, non-government organisations, civil society organisations, academia, renewable energy developers, oil industry players, generation companies, chambers of commerce and industries, financial institutions and development partners – to present the plan and generate inputs for its enhancement," Cusi said.

■ Meralco Powergen Corp. (MGen), Manila Electric Co.'s power generating arm, will select the contractor for its 2x600 MW coal-fired power plant in Atimonan, Quezon, before the end of the year. Three of the four original bidders are still in the running for the project, which will start construction by mid-2017. The Atimonan project is one of the coal-fired power plants MGen is working on to meet its 3000 MW capacity target.

# India rethink on emissions deadline

India looks likely to push back its deadline to meet new standards for cutting emissions from coal fired plant by one year to December 2017.

Amid pressure from generators who say it is too difficult to implement the $37 billion reforms, S.D. Dubey, chairman of the Central Electricity Authority, and head of the panel drafting the road map for generators to meet the guidelines, said the goals may now be implemented "in a phased manner".

Prime Minister Narendra Modi's government proposed the limits on toxic emissions in December 2015. Limiting emissions would take longer than the government's original two-year deadline and cost as much as Rs2.5 trillion ($37.4 billion) according to the Association of Power Producers.

Sachin Mehta, an analyst at Mumbai-based Centrum Broking Ltd. said: "The emission norms require capital expenditure, which will lead to an increase in tariffs and burden the already weak financials of state power retailers. The plan is fraught with challenges. It is impossible to meet the current deadline."

Commenting on the possible phased approach Dubey said: "Particulate matter emissions should be addressed in the first phase. The next step would be sulphur dioxide emissions and later on oxides of nitrogen. That's the direction we are moving in."

India must first establish monitoring systems at all plants to establish an emissions baseline, determine what technologies will be appropriate and then install them at the plants, said Leslie Sloss, an analyst with the IEA Clean Coal Centre, a technology cooperation programme of the Paris-based International Energy Agency.

"The time frame for the new norms is extremely challenging and probably not possible in practice," Sloss said. "The new norms equate to India complying with emissions standards within a few years that Western economies have worked up to over decades. "

Coal fired power plants contribute to the release of about 60 per cent of India's industrial particulate matter, as much as half of the sulphur dioxide and 30 per cent of nitrous oxides, according to the New Delhi-based Centre for Science and Environment.



# Thailand renewable FITs to remain unchanged

The feed-in tariff (FIT), which Thailand's government pays to private power producers, will be mostly kept unchanged for the next two years, says the Energy Policy and Planning Office (Eppo).

Wattanapong Kurovat, director of the Power Policy Bureau, said the FIT rate for biomass power would remain in the range of 4.2-5.3 baht/kWh, while the rate for waste-to-power would stay at 5.0-6.3 baht/kWh. However, the FIT rate for solar farms would drop to 4.12 baht/kWh, down from 5.66 baht/kWh the previous year due to falling production costs, Eppo said.

Wattanapong Kurovat, director of the Power Policy Bureau, said up to 1054 MW of renewable power is due to be open for bidding next year.

Of the total, 514 MW would be from solar under the ownership of state agencies and agriculture cooperatives, while 400 MW would be from biomass and 140 MW from waste-to-power projects.

"The technology to generate power from biomass and waste is about to develop, so we kept their rates static to allow these sectors to form," said Mr Wattanapong. He said the costs of solar modules and systems have dropped substantially over the past two years because of technology, leading Eppo to reduce the FIT for that energy source.

# China makes biggest acquisition in Pakistan in 10 years

Dubai-based Abraaj Group has entered into a definitive agreement to divest its 66.4 per cent stake in Karachi-based power generation and distribution company K-Electric to China's Shanghai Electric Power (SEP). When completed, the $1.77 billion deal will be the biggest M&A in Pakistan in a decade.

SEP announced its intention to bid for the stake in August.

Commenting on the deal, Wang Yundan, Shanghai Electric Power's CEO, said: "The K-Electric transaction only marks the beginning of SEP's cooperation with Abraaj and we look forward to further collaboration between the two parties in many other areas in the future."

Chinese companies' interest in Pakistan is growing after China announced energy and infrastructure projects worth $46 billion in the South Asian nation last year.

# UK plans next CFD auctions

■ Falls in EY renewables index ■ Coal phase-out consultation

Siân Crampsie

The UK government is hoping that recent policy moves will send clear signals to potential investors that the country is committed to a clean energy pathway.

Last month it announced further details of the next contracts for difference (CFD) auction, and launched a consultation on proposals to phase out unabated coal fired generation by 2025.

The UK has also ratified the Paris climate agreement.

The government's moves have been widely praised in the energy sector, but the country has continued to lose its appeal in the eyes of investors, according to EY.

In its latest table of the world's most attractive renewable energy markets, the UK has dropped to a new all-time low, EY said, citing uncertainty caused by Brexit, the dismantling of the government's Department for Energy and Climate Change (DECC) and the approval of the Hinkley Point C power station as reasons.

The UK now ranks 14th on the index. "Continued uncertainty around the government's energy policy has created a confusing picture for investors seeking a low-risk return," said EY's Ben Warren. "In addition to radical changes to its structure, the government has decided to press ahead with investment in forms of energy that either don't seem to have the public's backing, such as shale gas, or have been deemed costly."

Last month the government announced that less advanced renewable energy technologies – including tidal stream, offshore wind, wave, geothermal, advanced conversion technologies, anaerobic digestion and biomass – would be eligible to compete for CFDs in the next auction. Some £290 million annually will be available in the next auction round for projects to be delivered in 2021/22 or 2022/23.

RenewableUK said it was disappointed that there was no minimum level of deployment set for wave and tidal energy. "These ground-breaking technologies can replicate the cost reduction we're seeing in offshore wind and deliver industrial benefits to Britain," said Hugh McNeal, RenewableUK's Chief Executive. "We can't risk falling behind and handing our global lead to other countries."

UK Business and Energy Secretary Greg Clark said that the CFD auction and consultation on coal plant phase-out were "essential elements of the government's plan to upgrade the UK's energy infrastructure, lower our carbon emissions and spur on the growth of large scale, low-carbon energy".

The UK announced plans to phase out coal-fired generation in late 2015. Some 8.4 GW of coal-fired capacity has closed since 2010 and it now accounts for just nine per cent of generation, down from 43 per cent in 2012.

However the UK still has ten operating coal fired power plants with a capacity close to 15 GW.

# Decentralisation continues to drive digitalisation

Junior Isles

Digitalisation is becoming an increasingly important aspect of the transmission and distribution business as grids adapt to accommodate a growing amount of distributed generation, according to European technology solution providers.

As renewables penetration grows and consumers look to also become electricity producers, this is calling for greater intelligence in transmission and distribution networks and greater digitalisation.

Speaking at European Utility Week (EUW) in Barcelona, Spain, Ralf Christian, CEO, Siemens Energy Management Division, said 57 per cent of consumers are considering some form of self-sufficiency.

Distribution System Operators (DSOs) are therefore being urged to take up new roles to be the platform provider as power systems become more complex.

Christian said: "Digitalisation will be a big driver for cost savings. DSOs should take up the role as platform operators and matchmakers. The question is to what extent DSOs and utilities start to pick up this opportunity."

Although the high cost of completely disconnecting from the grid means there will always be a role for traditional power supply from utilities, Christian noted: "We believe in the decentralised world, that's why we are investing heavily and have strong positions in transmission and distribution grids, on the prosumer side, commercial and industrial consumers, etc. So we are really driving technology in these fields."

Others are also investing in technology aimed at DSOs. Speaking on the sidelines of European Utility Week (EUW), Vincent Petit, Senior Vice President Energy Automation at Schneider Electric said: "We believe the DSO will be the enabler of the transition."

Schneider Electric, the global specialist in energy management and automation, showcased its newly launched EcoStruxure Grid at EUW. EcoStruxure Grid is designed to provide an integrated framework for utilities to tackle the increasing complexity of grid operations and to optimise asset management.

**Christian: DSOs should take up the role as platform operators and matchmakers**

Based on the open and inter-operable EcoStruxure system architecture and platform for the Internet of Things (IoT), and tailored for the grid market, EcoStruxure Grid enables distribution utilities to make the most of the new opportunities created by utility digitisation.

## White paper warns of "rocky ride" for winter energy

Energy traders should prepare for a "rocky ride" over the coming winter, a white paper from ICIS has warned.

The market intelligence firm says that the winter period is likely to be volatile thanks to a series of supply shocks that will expose how fragile Europe's wholesale energy markets are in the low-carbon transition.

Fewer coal plants are now operating around the continent and there is greater reliance on combined cycle gas turbines. Greater volumes of renewable energy require backing up bay gas, resulting in greater volatility, ICIS said.

For some years, regulators and grid operators have been warning that fundamental risks, hinging around the pace of fossil-fuelled power plant closures, awaited the markets during the winters stretching from 2015 towards the end of the decade.

In September, record-high prices on western Europe's short-term power markets coincided with record lows at some gas hubs. Such events have reminded the market of just how daunting the scale of the energy transition really is, and just how quickly the risk associated with a wholesale industrial transformation can rear its head.

ICIS's white paper notes that much risk this winter has already been priced into the first half of the season, and could well extend into the second.

# Commission mulls priority dispatch reform

The European Commission could remove priority dispatch rules for new renewable energy projects, it has been reported.

UK newspaper *The Guardian* reported in early November that a leaked EU impact document it had seen modelled four scenarios under which wind and solar energy plants lost their priority dispatch privileges.

It showed that paring back the priority dispatch system could increase carbon emissions by up to ten per cent, the paper reported.

*Reuters* reported later in November that the European Commission is planning to limit priority dispatch for renewables, but would stop short of scrapping the system altogether.

The priority dispatch system has been a cornerstone for the establishment of a robust and growing renewable energy market in Europe as it gives wind and solar plants priority over other types of power plants in the electricity system. Reforming it could affect investment in renewable energy, and even impact revenue streams of existing projects, if applied retroactively.

*Reuters* reported that the Commission would publish at the end of November proposals to maintain priority dispatch for existing renewable energy facilities, but end it in EU nations where renewables account for more than 15 per cent of energy production.

In addition, the Commission proposes limiting priority dispatch to installations smaller than 250 kW from 2026. It proposes that member states could still apply to have a priority dispatch system if "substantial problems" for renewable energy installations would occur otherwise.

Trade group WindEurope commented that removing or paring back priority dispatch would be at odds with plans to decarbonise and increase renewables penetration in Europe in the coming years.

However, it is thought that the European Commission sees reform of the priority dispatch system as a step forward in the creation of a truly level playing field for all technologies in the power sector.

Fossil fuel generators also argue that ending priority dispatch would bring an end to "negative prices" on the system, when supply exceeds demand.

EU ProSun said that paring back priority dispatch would make achieving climate goals and Paris commitments impossible.

"The priority dispatch is a central pillar of the energy revolution," said Milan Nitzschke, President of EU ProSun. "If this priority were to be scrapped, coal and nuclear power could block the grid and access of solar and wind power.

"By prioritising fossil fuel power plants, we will lose any possibility of achieving climate goals in Europe and globally. The EU is effectively axing its energy and climate goals by choosing to cut the priority dispatch for renewable energies."

# Morocco sets up exchange task force

■ Roadmap for energy exchange planned ■ NOOR PV1 takes shape

Siân Crampsie

Four EU nations say they plan to sign an agreement with Morocco at COP23 in Asia next year on the exchange of renewable electricity between Europe and the African country.

Germany, France, Spain and Portugal last month inked a non-binding statement with Morocco outlining plans to establish a roadmap for establishing power links and energy exchange.

The statement was signed at COP22 in Marrakesh and will enable the five nations to examine in more detail issues surrounding the economic, legal, regulatory and technical aspects of energy exchange.

The Moroccan Agency for Solar Energy (Masen) was appointed Secretary of the Steering Committee of the project, known as the SET roadmap.

Renewable energy is a key element of Morocco's energy policy, and the ability to exchange power with Europe will provide the nation with a greater degree of energy security.

It will also help the four EU nations to meet renewable energy targets.

Last month Masen announced it had selected the developer of the 170 MW NOOR PV 1 solar photovoltaic plant and had also signed contracts that complete the financing of the project.

NOOR PV 1 is an integral part of Morocco's NOOR solar projects, which will help the country to achieve its ambitious renewable energy target. NOOR PV 1 will be developed by ACWA Power and Chint.

The combined rate per kWh for the NOOR PV I project comes out to 0.46 dirhams (4.22 eurocents), one of the lowest on a global scale, Masen said.

NOOR PV 1 comprises three solar PV plants:

- NOOR Ouarzazate IV, with a maximum capacity of 70 MW, located in the Masen complex, NOOR Ouarzazate
- NOOR Laayoune, with a maximum capacity of 80 MW
- NOOR Boujdour, with a maximum capacity of 20 MW.

"With these three solar plants, Masen continues to expand its portfolio of multi-technology projects," said Masen President Mr. Mustapha Bakkoury. "This is also the consolidation of long-standing partnerships, both with the KfW, which is financing the fourth and last phase of the Ouarzazate complex, and with Acwa Power, and it assures us that we will develop projects meeting international standards at Ouarzazate, Laayoune, and Boujdour."

Construction of the three plants is due to start in early 2017 and will take 12 months.

■ IFC has agreed to a $20 million equity investment in ACWA Power Ouarzazate, which developed the 160 MW NOORo 1 concentrated solar power parabolic trough plant with three-hour storage near Ouarzazate, Morocco.

# Hassyan sets new benchmark on price

The UAE will benefit from the economic and reliable energy provided by the Hassyan ultra-supercritical coal fired power plant when it comes online in 2020, the Dubai Electricity and Water Authority (DEWA) has said.

Construction of the $1.8 billion power plant has started. It will ultimately generate 2.4 GW of electricity by 2023 and will provide a 12.5 per cent boost to Dubai's current generating capacity.

According to DEWA, Hassyan will supply electricity at a price of US4.241 ¢/kWh under a 25-year power purchase agreement, one of the cheapest rates globally for coal. Dubai will import some 6 million tonnes of the fuel annually.

Hassyan will also play a key role in the UAE's efforts to diversify its energy mix. The first 600 MW unit will start operating in March 2020, DEWA said.

A consortium consisting of Saudi Arabia's Acwa Power, Harbin Electric of China, the GE-acquired Alstom and US-based NRG Energy is building Hassyan and recently closed financing on the first 1.2 GW phase of the project.

DEWA is also planning to develop a hydropower plant in the emirate to boost power supplies.

DEWA has proposed construction of a 250 MW pumped storage hydropower plant in the Hatta area that would use water stored in the mountains next to Al Hattawi dam. Solar energy could be used to pump water from the lower reservoir to the upper reservoir, DEWA said.

■ Abu Dhabi has revised its electricity and water tariffs with effect from January 1, 2017. The amended tariff will reflect the actual cost of supplying water and electricity to all categories of customers in line with the emirate's natural resources conservation policy, according to an announcement made by the Abu Dhabi Water and Electricity Authority (ADWEA) along with Abu Dhabi Distribution Company (ADDC) and Al Ain Distribution Company (AADC).

**DEWA: diversifying its energy mix and cutting power price**

# Banks turn backs on coal

Two French banks have become the latest in a growing list of financial institutions to cease financing for coal-fired power plants.

Crédit Agricole and Société Generale both said in the run-up to COP22 in Morocco that they would no longer provide finance for new coal-fired power plants.

Their moves follow that of other international financial institutions, including JPMorgan and Bank of America, who have also ceased coal plant finance. Banks are increasingly concerned about the growing risks associated with investments in fossil fuel industries as the global push to reduce carbon emissions gathers pace.

Société Generale said in a statement that it would no longer finance coal-fired plants or related infrastructure anywhere in the world, with effect from January 2017. Credit Agricole said it would "stop financing new coal-fired power plants or extensions".

Société Generale said that it will also scale back its outstanding loans to the coal industry, with a goal of reducing the proportion of coal-fuelled share in power production financed by the bank to 19 per cent by 2020, in line with the International Energy Agency's 2°C scenario.

Société Generale said that the shift in the energy mix it supports will also result from increased financing for renewable energies, where the bank is continuing to ramp up project financing. In 2015, the banks announced it was doubling project financing in the renewable energy sector, with a €10 billion of funding allocated to the renewable energy sector by 2020. In 2016 Société Generale maintained its position among the world leaders in this area, it said.

Severin Cabannes, Deputy Chief Executive Officer of Société Generale said that the pledge marked "a new step forward for the bank" and that it intended to become "a major financer of the energy transition".

# NERSA to investigate Eskom on PPAs

South Africa's National Energy Regulator (NERSA) is to investigate Eskom over its refusal to sign power purchase agreements with renewable energy projects.

The South African Wind Energy Association (SAWEA) said it had lodged an official complaint with NERSA over Eskom's "failure to comply with ministerial determinations". It has asked NERSA to impose the maximum legislated penalty on Eskom if the national utility is found guilty.

Eskom has delayed the signing of PPAs with preferred bidders from the South African government's renewable energy independent power producer programme (REIPPP). It says that the move is due to grid issues, but SAWEA believes that Eskom is abusing its position as the operator of the national grid in order to favour its own investment in new power plants.

Since 2011, the REIPPP has awarded 6590 MW of renewable energy capacity to 102 independent power producers, of which at least 44 are already operational. In all, the programme will attract new private sector investment worth R194 billion ($13.75 billion) in predominantly rural areas.

Successive capacity bidding rounds have seen tariffs fall to the point that renewables are now the cheapest form of electricity generation available to the country, SAWEA said.

"SAWEA believes that Eskom is acting in direct contravention with government's policy to diversify the country's energy mix," said Johan van den Berg, CEO of SAWEA. "Eskom's current stance is incompatible with government policy, the law of the land, and its own licence conditions."

# Fins look to Iran for opportunities

Finland's government has called on Finnish firms to invest in Iran's electricity sector after the two nations signed a cooperation agreement.

Iranian Energy Minister Hamid Chitchian and Finnish Minister for Foreign Trade and Development Kai Mykkänen signed the agreement in Tehran and noted that Iran plans to add 26 500 MW of capacity to its power system in the next five years.

Currently Iran's nominal and actual power generation capacity stand at 76 GW and 59 GW, respectively. Of the 26 500 MW it plans to add, 5000 MW will be renewable energy.

Less than one per cent of Iran's current installed capacity is renewable.

Chitchian told an energy conference in Tehran at the end of October that the country is currently building 10 830 MW of capacity, including thermal, hydropower and renewable energy plants.

The country needs $25 billion of investment in its generation, transmission and distribution sectors by 2021, Chitchian added.

Distribution losses in the country have fallen from 15 to 11 per cent.

# Mine control in Mexico

A copper mine in Mexico has implemented a microgrid that will not only greatly improve the reliability of its power supply but will also reduce network outage times and enable it to better manage its processes, thus making it more economically competitive. **Junior Isles**

**Grupo México's Buenavista del Cobre mine**

Like many industrial operations, copper mining is one that requires a highly reliable power supply. Avoiding power outages is top priority, and when outages do occur, it is of utmost importance to re-connect supply to the mining operation in the shortest possible time.

This was the overarching driver behind a project that saw Mexican conglomerate Grupo México turn to Siemens for the installation of an industrial microgrid at its newly expanded "Buenavista del Cobre" copper mine in Cananea, in the state of Sonora, Mexico.

Mining is the principal activity of Grupo México, whose subsidiaries together hold the world's largest copper reserves. It is the fourth largest copper producer in the world and is among the most important companies in Mexico, Peru and the US.

In 2010 Grupo México took the decision to expand the Buenavista del Cobre mine to increase its processing capacity to 188 000 tonnes/year – an expansion that would make the site the third largest copper mine in the world and the largest in Latin America.

Copper mining is an energy intensive process that requires large amounts of power. However, the mine is located in a region where there is a lack of generating capacity and an unreliable supply from the utility. With plans for expansion on the horizon Grupo México decided to build its own power plant in an effort to not only secure sufficient power to run its mining operations but also to lower the cost of energy.

Following the commissioning of a 500 MW plant, powered by two Siemens combined cycle units in 2014, the company then embarked on constructing a new high voltage electrical network inside the mine. Seven substations, several of which were built by Siemens, were installed to form the backbone of a microgrid.

Two years ago, Grupo México began thinking of how it could improve the control of its operations to ultimately become more competitive by reducing downtime. The challenge was to find a way to automate data acquisition and create a more proactive maintenance approach. Essentially, the primary goal was to use the microgrid to reduce the occurrence of operating errors and major maintenance outages, which would in turn reduce maintenance costs.

Already familiar with Siemens and its equipment, Grupo México again turned to Siemens for a solution.

Tomas Reyes Sanchez, Business Manager of Siemens' Grid Control Business in Mexico recalled: "We had our first meeting with them two years ago. We discussed the challenge of managing a network like this, which is complicated, and decided to implement a new control centre."

Explaining the challenges of managing the network, Reyes Sanchez said: "The load configuration inside a mine is complicated; it generates trips into the network. These trips are costly to the operator because they have to reset the entire process. This involves first finding out where the trip is, restoring it and then restarting the production process."

The mine, however, is huge – almost the size of Paris. Following a trip, a large crew had to be dispatched to locate the fault. "Everyone was communicating by walkie-talkie radio and it could take one or two days to find the fault. In the best case, they did a fast restoration in three hours," said Reyes Sanchez.

Trips had been causing the owner to lose as much as one month a year in downtime. When considering the manpower and downtime, for a mine this represents a huge cost. "We explained to them," said Reyes Sanchez, "that by having a new control centre, fault restoration would be very fast and much cheaper. Reducing the number of people and having them work more efficiently was the key sales argument for the new microgrid solution.

"Also, with a maintenance outage planned for October 2015, they realised that if the new control centre was in operation by then, it would pay for itself during this outage alone. The mine is stopped for maintenance once a year, at which time they have to change the load from one source to another. The new control system would allow this to be done in an hour, whereas it would normally take three hours."

Reyes Sanchez gave an idea of the economic impact of this. "In Mexico the cost of a kilowatt hour is about US10 cents; a mine could have an average consumption of 250 MW per hour. If we do the maths, this means about $18 million is spent each month on energy consumption alone. By reducing downtime by 80 hours a year the system can pay for itself just from electrical network operation savings. If we include the man-hours and human risk, the benefit is even higher."

Siemens' contract saw it supply, install and commission a microgrid control system that includes the Spectrum Power 5 network control system, SICAM PAS (Power Automation System), remote terminal units RTUs) and the communication and protection system for the entire mine.

Although other suppliers had offerings, Grupo México's decision to opt for this solution was made easier by the fact that Siemens had provided the control centre for the local power utility. It had also delivered all the protection and communications for the substations on the network.

"We had installed the SICAM PAS in three substations so they were

# **Special Project** Supplement

already familiar with the Siemens solution," said Reyes Sanchez. "Also, Siemens was able to supply the capacitor bank and associated controller, which is a utility requirement for the control of reactive power. So we were able to provide the two solutions under one contract. "

The new control centre has been built in an area inside a substation. "Grupo México asked us to design the entire room – with air-conditioning, lighting, security, power supply network, illumination, Videowall, everything," noted Reyes Sanchez.

The communication network provides access to every substation inside the mine. All the information is collected in the control centre and the entire power network is viewed in the control centre, so that the mine owner can view everything that is happening in the mine in real-time.

There is also a remote connection to the mine, whereby the Siemens team in Mexico City can support the mine operators in case of emergency or as required.

At the heart of the Buenavista del Cobre microgrid solution is the Siemens Spectrum Power 5-based control centre. Spectrum Power 5 is a Windows-based network control system designed for the automation of power supply networks in industry and for gas, water, district heating, and power supply grids operated by public utilities. The platform can also be used for energy production planning. The network control platform enables components to be integrated for specific applications and other IT systems can be linked easily.

With Spectrum Power 5, system solutions for network control centres of any size can be implemented. It enables the automation platforms to be used for energy management in simple to highly complex networks.

Customized network control technology solutions can be combined using a modular approach from a large number of applications. Specific components can be integrated in the network control platforms for specific applications, including analysis functions for distribution or transmission grids, forecasting and optimisation applications, as well as energy production planning and energy market management.

The Spectrum Power platform is based on international standards that are globally applicable as key standards for viable smart grid solutions. These include IEC 61968, IEC 61850, and the Common Information Model (CIM) The CIM is a standard developed by the electric power industry that has been officially adopted by the International Electrotechnical Commission (IEC). It enables application software to exchange information about an electrical network.

As the platform works with CIM source-data management, it can import transaction-secure incremental data changes into all systems in the computer network. In addition, vulnerability assessments analyses are implemented regularly for optimal IT security. The Spectrum Power Security Service, which also includes services for patch management, creates an even higher level of security.

Spectrum Power 5 is a redundant distributed network control centre, meaning that there is a main and backup for every device.

With this platform's service-oriented architecture (SOA), it is possible to use services and data from other IT systems in the network control system via Spectrum Power 5: for example, geographical data from geographic information systems, load profiles from meter data management systems, and information about network operating resources.

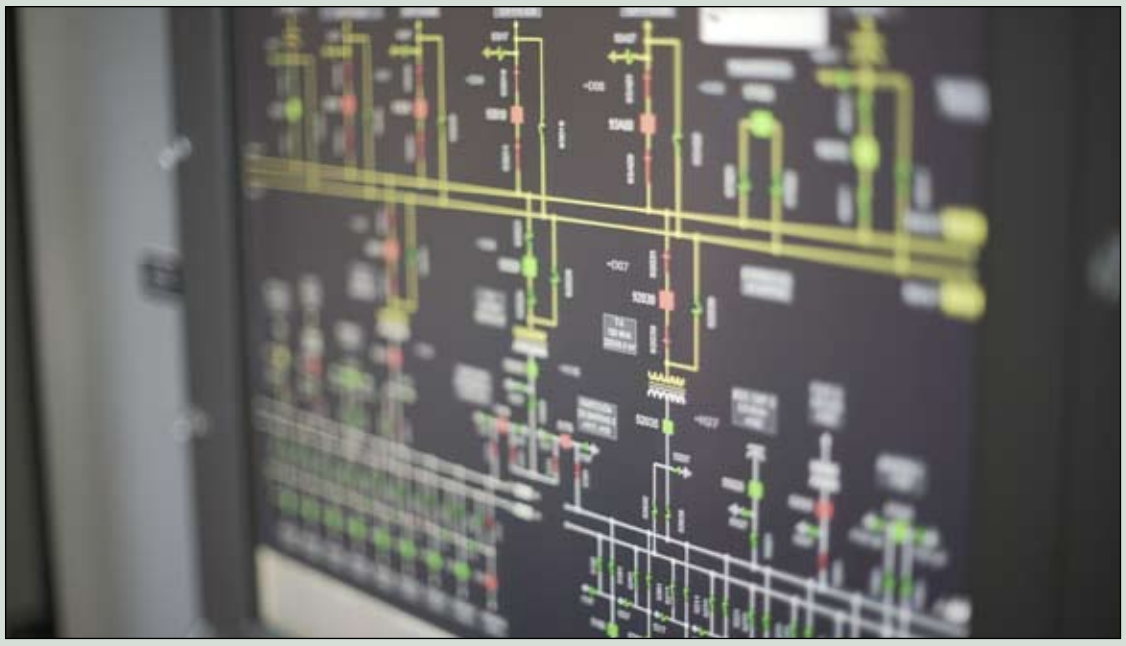
Other IT systems can also access the network control system's services and data. Examples include information about downtimes in the case of faults for customer information systems and work orders and switching jobs for the workforce management system. The SOA permits the exchange of data between the systems and ensures that the platforms can be integrated in the user's IT systems and work processes.

Crucially, the Spectrum Power suite gives operators a fast and precise overview of their grid. This means they can quickly assess its status and swiftly reach the right decisions – avoiding cost-intensive faults.

The system at the Buenavista del Cobre mine has several functions that are particularly useful to operators. One such function is known as 'Dynamic Colouring'. Here the colour of the single line diagram changes according to the real-time situation. For example, if a breaker is open, that portion of the network on the diagram automatically illuminates in white.

Another useful feature is 'Historian', which gives operators access to up to five years of historical data. At the mine, the Historian generates energy consumption reports for each production plant. "This gives the operator details on how much energy each process consumes; he can immediately see what is the biggest consumer at any instant," said Reyes Sanchez. "They can then associate the cost of production to that process."

Siemens configured SICAM PAS solutions on all the substations. SICAM PAS is an energy automation solution suitable for operating a substation not only from one single station level computer, but also in combination with further SICAM PAS or other station control units. It offers a large number of commercially available communication protocols for recording data from various devices and through differing communication channels.



**Single line diagram view from the Videowall display**

Four small and compact RTUs were delivered as part of the SICAM PAS solution. These will also be able to provide supervision of some of the mining processes in the future.

Following award of the contract, project execution kicked off in March 2014. With the next official outage planned for October 2015, there was little time to complete the project. Any error during construction, point-to-point testing or commissioning of the system had to be avoided. It was a high-pressure situation.

Reyes recalled: "The project manager in Mexico City is a very important man in Grupo México – he told me: "you cannot fail here". We could not make a single mistake; if we failed here, we would have been talking about millions of dollars. We were under a lot of pressure."

With the intention of performing the annual maintenance using the control centre, Siemens had just seven months to have everything up and running. It was a task made more difficult by the mine environment.

"This was a little bit challenging because although we had the personnel, we didn't have a full knowledge of the security aspects [of a mine]," noted Reyes Sanchez. "Being inside a mine means you need to have someone who knows about security, who is always present to supervise. He may not actually be involved in the control centre operations but had to be there purely for security reasons."

Siemens implemented its 'Zero Harm' culture during project execution. This called for an emergency plan to be in place, which all personnel had to be familiar with.

"Reyes explained: "They had to know things like important phone numbers and emergency services such as the nearest hospital and police station. They had to know the location of the pumping station and so on."

In addition, a meeting was held at the start of each day to discuss security with all personnel working on the project. "We always had to remember we were inside a mine and therefore had to be very, very careful," said

**Substation at the Buenavista del Cobre mine**

**Protection, control and measurement cabinet inside the substation at the Buenavista del Cobre mine**

**Substation main protection, control and measurement room. The new network control system has seen a 60 per cent reduction in downtime**

Reyes Sanchez.

The project started with procurement of all the devices that would take the longest time to deliver. At the same time Siemens engineers began configuring the project scheme at its offices in Mexico City. It was able to do this before hardware arrived using information that was already available from the substations, which it had previously implemented.

"This was key to having the shortest possible delivery time," noted Reyes Sanchez. "It meant we were ready to push the configuration straight into the hardware when it arrived."

Also, in parallel with the procurement, Siemens carried out all the planning and civil works for the control room. "Everything was ready so there was no waiting time between the despatch [of equipment] from the factory and the mine side. The site and control centre had to be finished and ready so that the devices could be installed on arrival."

All work had to be completed within the scope of the annual major maintenance shutdown, scheduled for October 2015. Despite the challenging time schedule and tricky environment Siemens did not fail. The project was completed in October last year, and the control centre has now been in operation for just over one year.

According to Reyes Sanchez, the customer is more than satisfied with the outcome. "They are really happy to have the control centre, because prior to its installation, they had to send an engineer to make inspections in the field, which is also a security issue. So the control centre, is also a tool to keep staff safer – they only have to go into the field if it's absolutely necessary, said Reyes Sanchez.

He also noted that because all information is now available in real-time, the mine operator can now be confident in the accuracy of its energy use and therefore charges for electricity. Reyes Sanchez explained: "When they received their electricity bill there was always a conflict, or confusion in relating the costs to the processes. Now with the control centre there are no doubts."

So far there have been no failures or emergencies. Reyes Sanchez also notes that the system has responded very well even when operators have made small errors.

Most importantly, the reliability of the system has been greatly improved. The introduction of the new control room has seen a 60 per cent reduction in downtime – key for a copper mine that aims to operate 24/7.

It also puts Grupo México in "a better technological position" than its competitors. A 50 per cent reduction in costs was achieved as a result of the automated consumption reports, generated in real-time. "They now have the lowest copper production costs in the world," said Reyes Sanchez.

"Being able to identify areas that can be improved has allowed them to reduce consumption," he said. "When you are able to look at historical data, you can see if trends are different to the past. This allows you to investigate why consumption is different, and therefore improve the process."

Grupo México, for example has been able to identify its biggest load and make adjustments. Reyes Sanchez explained the economic impacts. "If your biggest load represents 80 per cent of your consumption and you can reduce this to one or two per cent of your consumption, this is a big economic saving."

He noted that there are penalties for having low power factor (PF). Power factor is related to the consumption of non-linear loads. Ideally, power factor should be 1. Reyes said: "There is a penalty or bonus depending on how close the PF is to 1. When the PF is less than 90 per cent, a penalty is applied and if it is more than 90 per cent a bonus is applied." This number can be monitored in the control centre and the reactive power adjusted to push this figure to its ideal.

Ultimately, the central generation of reports has allowed mine personnel to devote themselves to more productive work and tasks, new technical capacities, or to creating effective new cost reduction alternatives and activities to increase energy efficiency. And simplified standardisation now allows personnel to easily assess the quality of the energy delivered by the Federal Electricity Commission.

Looking to the future, the scalability of Spectrum Power 5 means that there is room to grow, providing capability of expansion to cover the medium and low voltage network and other processes. Siemens says the Spectrum Power 5 is powerful enough to handle all of the mine's future requirements.

Reyes Sanchez says several projects are already under way that will be facilitated by the control centre. "They are looking to map the entire low voltage network in the control centre. Right now the high voltage network is mapped but inside the mine there are something like 200 low voltage substations. They want them all in the control centre. They have seen the benefits and want to also find savings at the lower voltage."


**Switchgear at the mine's substation. The network control centre will reduce outage time and is a tool to keep staff safer – they only have to go into the field if it is absolutely necessary**

**The new control centre has been built in an area inside a substation**

Mapping the LV network would involve installing more RTUs and expanding the database in the control centre.

Mapping the LV network would shorten the restoration time for trips on the network, which will further reduce operating cost. Reyes Sanchez notes that having more "granular information" on consumption will enable the mine owner to dig deeper and see which sub-processes are the biggest energy consumers.

He said: "If they can see this, they can develop a more comprehensive strategy, which might involve putting in local generation to supply that subprocess. This might be cheaper than buying power from the grid."

It is already planned that the system will be expanded in the future to supervise processes such as water pumping and discharges to the environment. Reyes Sanchez summed up: "Although not confirmed, at some point in the future there could be distributed generation for some secondary processes in the mine, and the control centre would be used to control this generation."

Indeed these are exciting times for Grupo México; and the microgrid project is a key development that not only improves the company's already strong position in the mining industry but also sets it up well for the future.

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# A reliable grid can move mountains

## Uncover buried potential with Siemens control technology

Siemens control systems are reshaping industries across the globe. Like Mexico's Buenavista del Cobre copper mine, which has achieved a 60% reduction in down time and significant cost savings thanks to automated data acquisition and more proactive maintenance. Find out how these same systems can improve the effectiveness and efficiency of your operational processes. Because with the right technology, no mountain is too tall.

**siemens.com/buenavistacobre**

# EDF confirms Areva NP stake

■ EDF targets 51 per cent stake ■ Areva set to refocus

Siân Crampsie

The French government's plan to shore up its nuclear energy industry has taken a step forward with the signing of a contract by EDF and Areva for the sale of Areva's nuclear business.

The contract follows a memorandum of understanding between the two French energy firms earlier this year and paves the way for Areva to raise new capital and restructure its struggling business.

The deal will see EDF buy up to 75 per cent in New NP, a new entity combining Areva Group's activities relating to design and equipment manufacturing of nuclear reactors, and fuel design and assembly manufacturing and services to the nuclear installed base.

The deal values New NP at €2.5 billion, Areva said.

Contracts and liabilities relating to the Olkiluoto 3 EPR project in Finland, and to a number of other French nuclear power plants, are excluded from the sale, which is expected to be concluded in late 2017.

Jean-Bernard Lévy, EDF Group's Chairman and Chief Executive Officer said that the deal would enable the French nuclear industry to move forward and to be more efficient in the execution of major projects, such as the 'Grand Carénage' of the French fleet.

The Grand Carénage is a project to extend the operating lives of France's extensive nuclear fleet and build new nuclear units.

Philippe Knoche, Areva Group's Chief Executive Officer, said: "We are delighted with these agreements, which give Areva NP activities a long term vision of a strategic share structure conducive to their development.

"This signature marks an important stage in the refocusing of Areva on fuel cycle activities, our core business. The conclusion of these agreements strengthens our resolve to continue to implement our action plan."

EDF is already in discussions with potential strategic partners in the sale. The utility is aiming to ultimately reduce its stake to 51 per cent. Areva New Co – the holding company that is to take Areva SA's fuel cycle assets – will own 15 per cent.

The sale is dependent on regulatory authorities as well as on favourable conclusions from French regulator ASN concerning the outcome of tests on the primary circuit of the Flamanville 3 EPR under construction. Satisfactory conclusions of quality audits at the Le Creusot, Saint-Marcel and Jeumont nuclear plants are also key to the deal.

Areva has suffered financial losses in recent years because of a decline in demand for nuclear power plants and strong competition from other nuclear engineering firms.

It will receive a €5 billion injection from the French government and has also confirmed plans to sell other parts of its business.

# Oil and gas firms put more focus on clean energy

Major oil firms from around the world have pledged millions of dollars of investment in clean technology development through the Oil and Gas Climate Initiative (OGCI).

OGCI has announced plans to spend $1 billion over the next ten years in developing and accelerating the commercial deployment of innovative low emissions technologies.

Its ten members include Saudi Aramco, BP, Eni and Repsol, each pledging investments of $100 million. In a joint statement the heads of the ten member companies said: "The creation of OGCI Climate Investments shows our collective determination to deliver technology on a large-scale that will create a step change to help tackle the climate challenge.

"We are personally committed to ensuring that by working with others, our companies play a key role in reducing the emissions of greenhouse gases, while still providing the energy the world needs."

OGCI Climate Investments (OGCI CI) will aim to deploy successfully developed new technologies among member companies and further afield. It will also identify ways to cut the energy intensity of both transport and industry.

OGCI said the initiative represented "an unprecedented level of oil and gas industry collaboration and resource sharing".

The news comes as DONG Energy, the Danish wind farm developer with large UK operations, announced it would exit its oil and gas business to focus solely on offshore wind power.

The company said that it would manage its oil and gas business for cash, and that future cash flows from the oil and gas business would be used to fund further investments in renewable energy.

Last month the company inaugurated a new office in Taipei and at the same time revealed its ambition to develop four offshore wind farms in the Changhua area in Taiwan.

# Mainstream launches capital arm

Mainstream Renewable Power is aiming to raise finance for its growing renewable energy project pipeline through a new business unit.

Mainstream Renewable Capital will create custom-made opportunities for investors to gain exposure to the company's wind and solar energy projects around the world. It will be headed by veteran energy banker and investor James P. McGinnis and will help to address the "vacuum" in the finance market for good quality renewable energy projects.

"Forming our own financing and investment arm has been in the planning for some time now," said Mainstream CEO Eddie O'Connor. "Given our recent major government tender win in Chile and our new agreement with GE in Vietnam, now is the optimum time to get this off the ground.

"Over the next five years we have very substantial capital funding requirements to support our build-out programme and significant opportunities for the creation of new investment vehicles for dedicated renewable energy investors."

Mainstream said in a statement that its diverse, global, 9 GW portfolio of wind and solar generation projects at different stages of development would give investors "rich possibilities to find the investment opportunity that best suits their risk appetite and term preferences".

Mainstream recently announced plans to build 2 GW of wind capacity in Chile and Vietnam. It is also pursuing "high growth" markets in southeast Asia, Latin America and Africa.

# E.On aims to boost agility

■ Phoenix project designed to decentralise
■ Firm gains clarity over nuclear charge

E.On says it is committed to further restructuring its business in order to make it competitive in the demanding trading environment of the energy sector.

E.On's CEO Dr. Johannes Teyssen announced last month that increasingly fierce competition requires that the company becomes closer to its customers as well as "leaner and more agile". It has launched a new project – known as Phoenix – designed to restructure E.On's complex, centralised business model and give employees that are closest to customers more decision-making authority.

The project will also review corporate functions and reduce costs by €400 million, E.On said.

The plans were announced as E.On reported third-quarter results that were dominated by a €6 billion write-down associated with the spin off of Uniper earlier this year.

The charge resulted in a widened net loss of €9.3 billion in the first nine months of the year, compared to a loss of €5.3 billion for the same period last year. Teyssen said that underlying performance in E.On's core business units were strong, however, with adjusted earnings before interest and taxes in networks, renewables and customer services up 13 per cent year on year to €1.9 billion.

E.On says that the increase in Uniper's share price since its listing reflected the fact that it was well positioned for growth in the future. It also believes that it has more clarity around the contentious issue of Germany's nuclear phase-out thanks to an agreement to adopt proposals made by the Commission for Organizing and Financing the Nuclear Energy Phaseout.

The proposals include plans for utilities to pay for the dismantling of nuclear reactors while the state takes responsibility for storing radioactive waste. E.On expects to pay around €10 billion into a fund for the clean-up.

"We're prepared to pay a considerable amount… to contribute to the success of this consensus," Teyssen said in a letter to shareholders. "In return, the German state will assume responsibility for the intermediate and final storage of the country's nuclear waste. E.On has sufficient financing flexibility to make available the necessary funds. There is therefore no need to take action in the immediate future."

# ACWA launches new clean energy company

ACWA Power is aiming to accelerate the growth of its renewable energy portfolio with the creation of a new company.

ACWA Power RenewCo will group the firm's existing renewable energy portfolio and act as a platform to capitalise on the potential for renewable energy in emerging markets.

Chris Ehlers, currently Chief Operating Office – Renewables at ACWA Power, will head the new entity. "Given our commitment to renewable energy and the ambition of the region in which we are focused, I see enormous potential to increase our renewables portfolio," said Ehlers.

ACWA Power's current renewable energy portfolio stands at over 1 GW and includes wind, solar photovoltaic (PV) and concentrated solar power (CSP) plants. It recently signed an agreement to develop and operate a 170 MW PV facility in Morocco, known as NOOR PV1, and won IFC financing for its NOORo 1 CSP plant in Morocco.

## Americas

### Exelon, GE reach deal

Exelon and GE have announced an enterprise-wide software agreement that will see the US utility deploy GE's Predix software across its entire US generation fleet.

The agreement is part of a wider strategy by Exelon to partner with technology companies to accelerate its digital transformation. GE's Predix software will help Exelon to improve power plant reliability and the performance of its 32 GW fleet.

"This agreement allows for enhanced collaboration between GE and Exelon to develop solutions to complex industry challenges and accelerate the adoption of new, digital technologies across our industry," said Chris Crane, President and CEO of Exelon.

Both companies also announced a collaboration to co-develop, test and build next-generation software as a service (SaaS) applications built on the Predix platform for future market opportunities.

## Asia-Pacific

### Vestas success down under

Vestas has signed an engineering, procurement and construction contract with Windlab Limited for a 30 MW wind farm in southeast Australia.

The Kiata wind farm, in Victoria state, will include Vestas V126-3.45 MW wind turbines.

Vestas' contract includes a five-year Active Output Management 4000 service contract and a SCADA system for data-driven monitoring and preventive maintenance.

### Chinese milestone for Gamesa

Gamesa is to install 18 of its G132-5.0 MW wind turbines at a wind complex being developed in China by Sinohydro, the firm has announced.

The G132-5.0 MW is a new product and also Gamesa's largest turbine. The contract represents the debut order for the supply of turbines from the 5 MW platform in Asia, and "marks an important strategic landmark for Gamesa", the company said.

The turbines will be installed at the 90 MW Nangang wind complex in Tianjin in late 2017, with commissioning scheduled for the first quarter of 2018.

### Vietnam signs Nghi Son 2 BOT deal

Vietnam's Ministry of Industry and Trade has signed an agreement with Marubeni Company and Kepco for the Nghi Son 2 thermal power plant.

The 1200 MW build-operate-transfer power plant has been approved by the Vietnamese government, which selected the two companies as investors following an international competitive auction process.

Located in the central province of Thanh Hoa's Nghi Sơn Industrial Zone, the project will use imported coal for power generation. It is expected to supply electricity for the economic development of the northern region while ensuring national energy security.

### MHPS wins Soma contract

Mitsubishi Hitachi Power Systems has received an order from Fukushima Gas Power Co., Ltd. for two power trains for the Soma Power natural gas fired power plant in Japan.

The 1180 MW power plant will be built in Shinchi, Soma District, Fukushima Prefecture, and is scheduled to start operating in the spring of 2020. MHPS's contract also includes a long term maintenance agreement and an operations and daily maintenance contract.

MHPS will supply two M701F gas turbines and steam turbines as well as large auxiliary machines, which are the main facilities of the power plant, and construct the combined cycle plant under an EPC (engineering, procurement and construction) contract. Mitsubishi Electric will supply the generators.

### Sri Lanka awards power line contract

A consortium of three companies is to install a new power transmission line between Habarana and Veyangoda in Sri Lanka.

Mitsubishi Corporation, J-Power Systems Corporation and Ceylex Engineering will supply and install the overhead lines. The 6 billion yen ($53.4 million) project is a key part of efforts to expand and modernise the country's transmission grid, Mitsubishi said.

Mitsubishi and J-Power will supply the cables, while Sri Lankan firm Ceylex will be in charge of the supply of the remaining equipment as well as installation and construction works.

## Europe

### Amec FW secures deal with EDF

Amec Foster Wheeler has secured a framework agreement to provide engineering consultancy services to EDF Energy's Coal, Gas and Renewables (CGR) division to support its fleet of coal- and gas-fired power stations and gas storage sites.

The CGR framework has a broad spectrum that covers operations and maintenance, outage support, technical services, plant modifications and enhancements, new build and decommissioning. It also covers EDF Energy Renewables' UK wind farms, Amec Foster Wheeler said.

Under the framework, Amec Foster Wheeler is one of two companies supporting EDF Energy at a strategic level under a Technical Support Alliance Agreement.

The technical programmes covered by the agreement include: pressure systems management; steam turbines and turbo alternator plant; electrical plant management; civil engineering requirements; gas turbine plant; control efficiency, performance and reliability management; gas storage and gas supply systems; wind turbines and wind farm management; as well as project management.

### Siem nets Borkum contract

Siem Offshore Contractors GmbH (SOC) has been awarded a contract for a turnkey supply and installation of the inner array grid cable system for the Trianel Windpark Borkum Phase II (TWB-II) offshore wind farm in the German part of the North Sea.

The TWB-II offshore wind farm is located 40 km north of the island of Borkum, within the German Bight sector of the North Sea. It will feature 32 monopile-mounted Senvion 6.33 MW wind turbines.

Under its contract with Trianel Windkraftwerk Borkum II, SOC will supply and install 33 kV medium voltage alternating current submarine composite cables with a total length of up to 61 km to interconnect the turbines. SOC will also provide associated materials and services including the supply of the submarine composite cables, cable protection systems and related accessories as well as post-installation termination, trenching and testing services.

The project engineering works will commence immediately.

### Viesgo installs EnergyIP

Spanish power utility Viesgo has installed a smart grid application platform that will manage the power consumption data of smart meters installed on its network. Siemens' EnergyIP platform will replace Viesgo's existing data acquisition system. It will gather, process and analyse electricity consumption data, providing Viesgo with information that can be used to develop business strategy and improve service to its 700 000 customers.

In addition to various other applications, EnergyIP will allow Viesgo to expand its low-voltage load management while reducing recurring costs and improving the efficiency of task management, infrastructure, and further development of the grid. It will also provide a foundation for Viesgo's future business developments – for example in the areas of smart home, distributed power generation, energy efficiency, and prepaid procedures.

### Ideal enters German storage market

Ideal Power Inc. has won a 0.5 MW order for its 30 kW Power Conversion Systems (PCS) in Germany.

The order has come after the successful deployment of an initial demonstration project at a commercial facility in Germany. "We are pleased to expand into Germany, which has a mature residential storage market and burgeoning demand for commercial and industrial (C&I) storage," said Dan Brdar, CEO of Ideal Power. "The pilot commercial installation was a successful case study and shows that our products combined with distributed energy storage have value beyond the US demand charge application."

Ideal Power's patented PPSA-based PCS are smaller and lighter than traditional technology without the efficiency losses associated with conventional power converters. The grid resilient 30 kW PCS offers customers a solution for integrating energy storage at C&I facilities where space can be limited.

### Amec FW to upgrade Estonian plant

Enefit Energy has placed a contract with Amec Foster Wheeler for the delivery of a boiler technology upgrade project.

Under the contract, Amec Foster Wheeler will modify an existing 100 MWe circulating fluidised bed (CFB) boiler at a power plant in Estonia to increase its retort gas combustion capacity.

Today, retort gas is burned in small amounts in the boilers of Enefit´s power plants. Once the project is complete, Enefit will be able to burn almost the entire volume of gas generated in the modified boiler plant which should result in higher efficiency and improve environmental conditions.

### Vattenfall bags Kriegers Flak

Vattenfall has won the contract to build the 600 MW Kriegers Flak offshore wind farm in the Baltic Sea.

The Swedish firm won the tender for Kriegers Flak with a bid of €49.9/MWh. The wind farm will be Denmark's largest and is a key part of the country's strategy to become fossil fuel-free by 2050.

Vattenfall will invest €1.1-1.3 billion in Kriegers Flak, pending a final investment decision. The firm has also won Denmark's other two most recent offshore wind tenders – Horns Rev 3 and Danish Near Shore.

## International

### Uzbekenergo launches tender

Uzbekenergo JSC has announced a tender for the supply of power transmission equipment for the Turakurgan thermal power plant project in Namangan region.

The Uzbek company is seeking suppliers of transmission lines and 220 kV substations, it said. In total, eight lots for the supply of metal poles for 220 kV lines, high voltage equipment, transformers, protective devices and other equipment are included in the tender.

The deadline for submission of the tender bids is December 28, 2016.

### International firms to build Rusumo plant

A consortium of two Chinese firms and an Austrian engineering company has been selected to build the 80 MW Rusumo hydropower station, which is being jointly developed by Rwanda, Tanzania and Burundi.

The Rwanda Energy Group (REG) said China Geo-Engineering Corporation, Jianxi Water and Hydro Construction Ltd. and Austria's Andritz Hydro will carry out civil, electronic and mechanical works on the power plant, which is expected to be commissioned in 2019.

Construction of the $340 million facility is due to start in 2017.

### GE powers up Qatar smart city

GE has won a contract to support the power supply of Qatar's future smart city. L&T has awarded GE Energy Connections' Grid Solutions business the contract to support seven 66/11 kV substations in the Lusail City mega-development with advanced protection and automation systems.

The project will support the electricity needs of nearly 450 000 people who are expected to take up residence in Lusail City, which is envisaged to have marinas, residential districts, island resorts, commercial districts, luxury shopping, leisure and entertainment centers and a golf course community in the man-made islands.

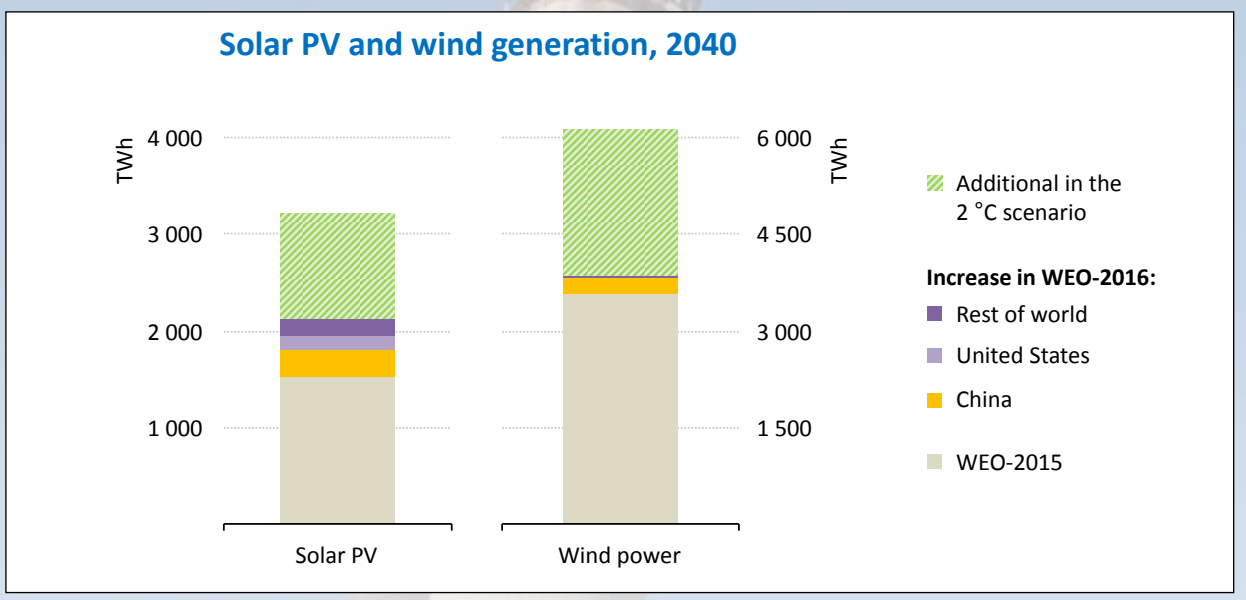
### Wärtsilä to supply Sierra Leone power plant

CECA SL Generation Ltd., a Sierra Leone company co-owned by CEC Africa Investments and TCQ Power, has awarded Wärtsilä an engineering, procurement and construction (EPC) contract to build a 57 MW power plant. The order includes six Wärtsilä 32 engines running on heavy fuel oil. Wärtsilä's will also build 1.3 km of fuel pipeline from a jetty to the site, and 8 km of overhead power lines.

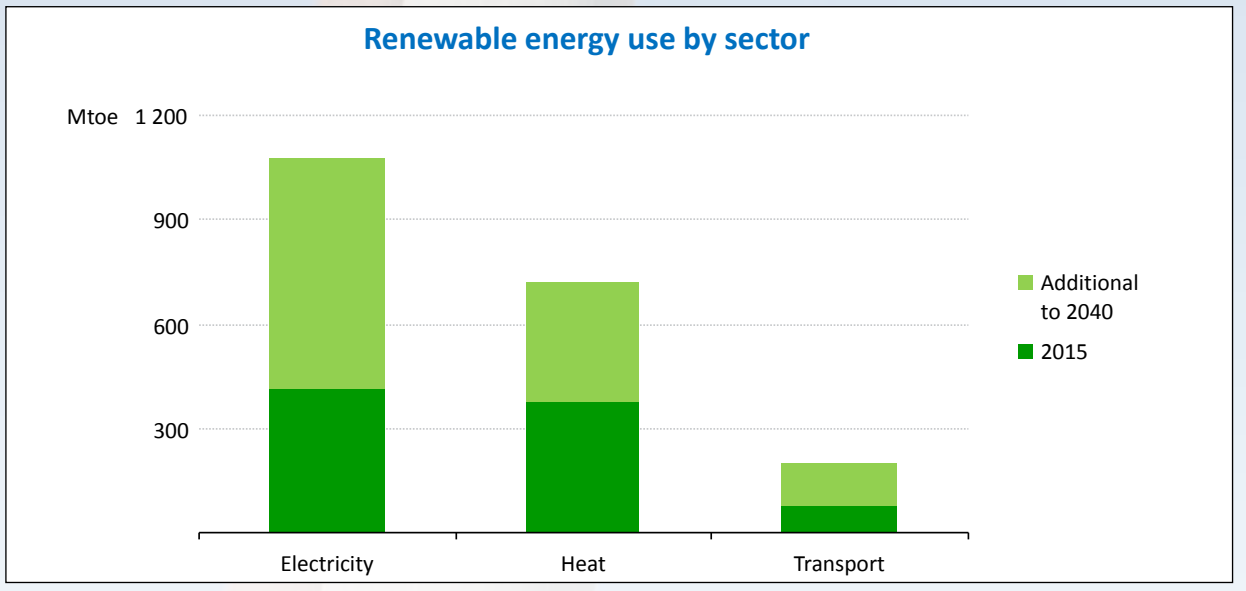
The plant is expected to be operational within 18 months.

The project will have a "significant impact" on the development of Sierra Leone's power system, Wärtsilä said. Electricity access in Sierra Leone is amongst the lowest in the world with less than 15 per cent of the population having access to the grid. The new power plant will increase the availability of energy in the country by 40 per cent.

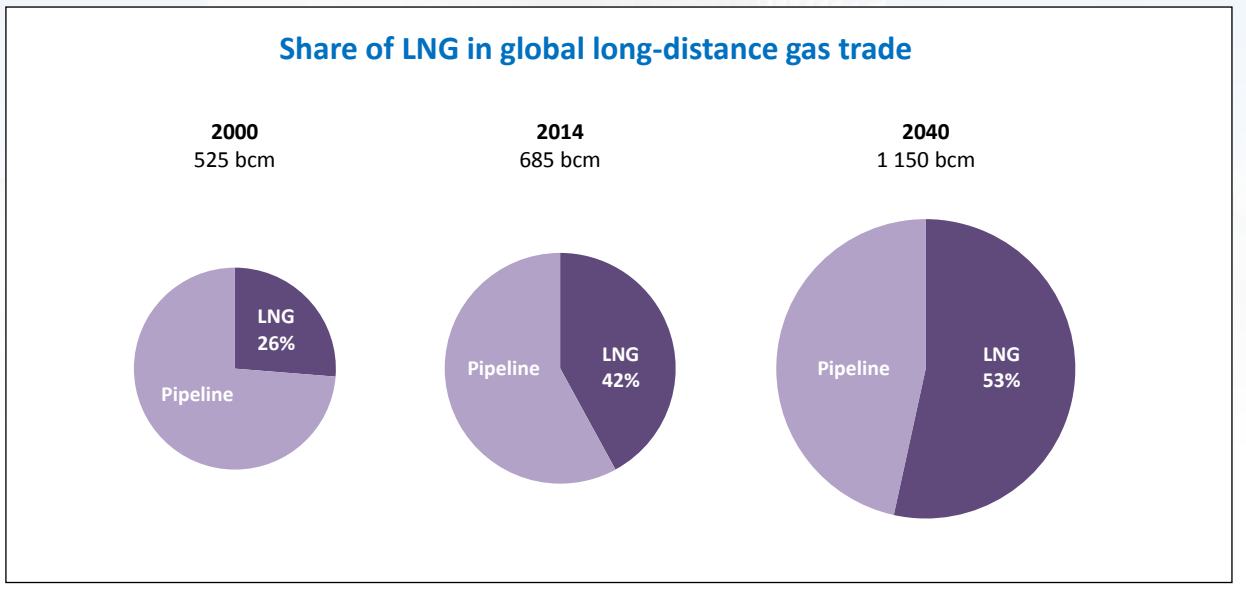
## Solar PV and wind generation, 2040. Stronger policies on solar PV and wind help renewables make up 37% of electricity generation in 2040 in the WEO 2016 main scenario – and nearly 60% in the 2°C scenario




## Renewable energy use by sector. Today renewables in electricity and heat use are nearly at par; by 2040, the largest untapped potential lies in heat and transport




## Share of LNG in global long-distance gas trade. A wave of LNG spurs a second natural gas revolution

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***Source: World Energy Outlook 2016 © IEA/OECD***

## Oil

# Opec struggles to get a grip on oversupply

- Record-breaking month as output rises by 230 000 b/d
- Low prices are holding back investment

David Gregory

Since Donald Trump's election to the office of US President on November 8, crude oil prices have remained in the mid-$40/b range, down from the low $50/b, high $40/b range during the last weeks of October.

The President-elect is now busy putting together an energy policy and speculation is rife about what impact it will have, first of all on the US economy, and also upon world oil prices. Trump appears confident that the US can solve its own energy needs and has expressed his determination to reduce US purchases of Opec oil, but at this point, it is impossible to know how his energy policy will affect world markets.

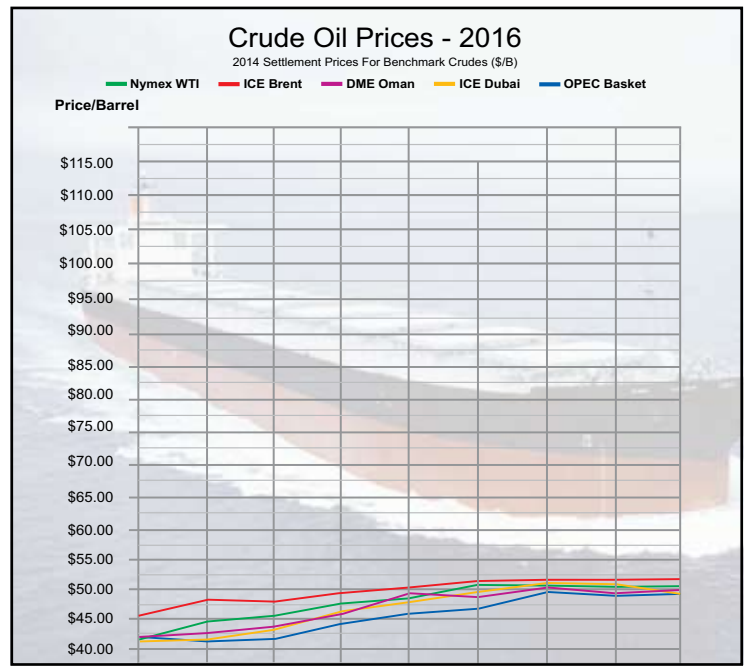
Most of the movement in the oil market has not so much been because of Trump, but because of speculation over what Opec might do at its next ministerial meeting in Vienna at the end of November. Depending on who says what from day-to-day, the market reacts accordingly, which has almost always been the case since the oil market became oversupplied two years ago.

Prior to the Opec meeting, and following months of discussion, the 14-member organisation was looking to arrange a freeze on production, which is already more than 33 million b/d, and which would not include Libya or Nigeria, and maybe not include Iran and Iraq, or even Indonesia, which means it could basically come down to Saudi Arabia again playing the role of swing producer.

The group also hopes to draw Russia into the arrangement, but there is strong belief among some analysts that if Opec should arrange a production freeze, higher crude prices will serve to trigger a return of the frackers in the US. They are already making a slow return.

The deal being discussed, advanced by Algeria, would entail a cut in production of 1.2 million b/d and then implementing the freeze. This is going to be a little like the children's story of 'The Little Red Hen'. None of the Opec members want to cut production, but all of them are happy to see higher oil prices. This would be the first time that the group attempted to cut production since 2008, and even during the days of quotas, there was not such strict adherence, so there is little history to bank on that such a scheme would work. It was frequently the case that a country's individual quota was set near its production capacity and Saudi Arabia levered Opec's total output.

Target total production is around 32.5-33.0 million b/d. Current output is estimated at 33.64 million b/d and in its October *Oil Market Report*, the International Energy Report (IEA) cited "another record-breaking month" with output rising 230 000 b/d to 33.83 million b/d. This is in the midst of a global supply glut, in which all Opec producers, and non-Opec producers like




Russia, are hurting from oil prices that are far below their budget targets. Global oil supply during October averaged 97.8 million b/d, an increase of 800 000 b/d.

For the month, the IEA reported that production was up in Nigeria, Libya, Iraq and Iraqi Kurdistan, Iran and Kuwait. Angola lost ground because of maintenance. "As of October, overall Opec output had risen for five straight months, led by major additions in Iraq and Saudi Arabia (supply from each is up about 300 000 b/d over the period). In October, Opec output was nearly 1.3 b/d above a year ago," the agency said.

On the other hand, global demand for the fourth quarter of 2016 was forecast at 97.1 million b/d and 96.3 million b/d for the year. In the US, stockpiles are growing and can be expected to continue to do so.

Meanwhile, low prices are holding back investment in new projects that could bring price repercussions in the future when and if demand picks up. The IEA, in its recently released World Energy Outlook (WEO) 2016 said that oil markets risk an acute supply shortage in the mid-2020s if investment in upstream projects do not recover. The IEA said a supply gap of 16 million b/d could appear by 2025 if reserves are not developed to replace declining conventional fields, and shale oil cannot be counted on to provide an adequate back-up.

The WEO made the point to remind the world that despite the growth of renewables and expanding use of natural gas, demand for oil will remain for some time and that the hydrocarbon age is far from over.

## Gas

# LNG moving into strong era, says IEA

According to the recently launched World Energy Outlook 2016, LNG will be the vanguard in an energy revolution, and global consumption is forecast to increase by at least 30 per cent in 2040 and possibly more.

Mark Goetz

Demand for natural gas, especially in the form of LNG, is going to rise and it promises to occupy a large slice of the energy pie by 2040, according to the International Energy Agency, which released its annual World Energy Outlook (WEO) in November.

"A 1.5 per cent annual rate of growth in natural gas demand to 2040 is healthy compared with the other fossil fuels," the Paris-based agency said in this year's WEO. "A more flexible global market, linked by a doubling of trade in liquefied natural gas (LNG), supports an expanded role for gas in the global mix."

This is good news for countries such as Australia, the US, Canada, and the East African states of Tanzania and Mozambique. Australia and the US are only at the start of their LNG careers, but the others are some years away. Furthermore, new natural gas sources can be expected to come into play, the East Mediterranean and West Africa is an example.

Oil and coal will lose market share to natural gas in the global energy mix, the IEA said, and renewables are due to see significant gains, but "the era of fossil fuels appears to be far from over and underscores the challenge of reaching more ambition climate goals," the WEO said in reference to global warming and the Paris accord on climate change.

Despite the fact that power generators have turned to cheaper coal in a current market that has plenty of gas in supply, the IEA sees no global upturn in demand for coal in sight.

"Some higher income economies, often with flat or declining overall energy needs, make large strides in displacing coal with lower-carbon alternatives," the report said. "Coal demand in the European Union and the United States (which together account for around one-sixth of today's global coal use) falls by over 60 per cent and 40 per cent, respectively, over the period to 2040.

"Meanwhile, lower income economies, notably India and countries in Southeast Asia, need to mobilize multiple sources of energy to meet fast growth in consumption; as such they cannot afford, for the moment, to neglect a low-cost source of energy even as they pursue the others in parallel," the report added.

The IEA's comment on coal's decline in the US strikes a note of discord with the election campaign promise of US President-elect Donald Trump to "bring back coal," in order to add jobs to the US economy. Whether that plays out in an economy where unconventional gas production can be expected to rise remains to be seen.

Meanwhile, LNG will be the vanguard in an energy revolution, and global consumption is forecast to increase by at least 30 per cent in 2040 and possibly more. LNG consumption could increase by as much as 50 per cent during the next 25 years, Tim Gould, IEA head of division, said during the unveiling of the WEO in London in November.

"Every revolution has a moment when it becomes clear that the old rules no longer apply but when it is also unclear what new rules apply. This is the point that LNG has reached today. But at the same time, we need clarity for new final investment decisions to go ahead," Gould said.

Gas transported by pipeline is also seen as giving way to international trade in LNG, according to the WEO. By 2040, LNG will make up the bulk of long-distance gas trades for the first time.

"Gas consumption increases almost everywhere, with the main exception of Japan where it falls back as nuclear power is reintroduced," the WEO said. "China (where consumption grows by more than 400 billion cubic metres) and the Middle East are the largest sources of growth.

But questions abound about how quickly a market currently awash with gas can rebalance, especially with another 130 bcm of liquefaction capacity under construction, primarily in the US and Australia."

The report goes on to forecast a change in the LNG market that strong fixed-term contracts between suppliers and customers to one of more competitive and flexible arrangements. This shift will be "catalyzed" by the increasing availability of "footloose" US LNG cargoes and the arrival in the 2020s of other new exporters and "the diversity brought to global supply by the continued, if uneven, spread of the unconventional gas revolution."

The global movement of natural gas in the form of LNG will establish a new sector within the hydrocarbon industry, based on the forecast of the IEA, and that sector will likely be encouraged by energy companies involved in gas production by identifying markets where none yet exist. Demand for floating storage and regasification units (FSRUs) is expected to rise significantly over the next 25 years in order to "unlock" newer and smaller markets for LNG.

# Shaping up for a decarbonised future

An intense debate is currently taking place in the EU on how to develop a future-proof wholesale electricity market design, with legislative proposals being expected for the end of the year.
**Hans ten Berge**

The economic environment of the electricity sector is driven by the low-carbon transition. This transition is unprecedented and its pace is difficult to foresee. It will bring about innovation and exciting opportunities as well as challenges. However, lots of questions still remain: How to design a new electricity market able to deliver decarbonisation and to function in a much more decentralised way? How to engage customers? How much flexibility will they provide? When will storage solutions be broadly implemented? When will existing power plants close and new investments happen? What will be the business models of the energy industry in the next 30 years?

To answer these questions efficiently, we need to tackle the critical challenges that the power sector will face in the short to medium term. Low-carbon technologies need to become increasingly competitive and the regulatory framework must allow for flexible solutions to develop. We should therefore ensure that the market provides price signals, which are adequate both for existing assets and new investments. Moreover security of supply must be ensured in a cost-efficient way.

Several elements of the upcoming legislative package of the European Commission need to be in tune to face these challenges.

First, consumers should reap the benefits of linking the wholesale and retail markets together. They need to be able to participate in the market by reacting to prices, on a level playing field with other flexibility resources such as generation and storage. This will be possible only with a bill that is clear to read and free of the burden of the costs of policy support.

Second, making the EU ETS stronger is a no-regret option to drive low-carbon investments. As we progress towards an integrated European electricity market, renewables must be laced on a level playing field with other technologies, including balancing responsibilities, and market-based rules for access and dispatch to the grid.

Third, in order to effectively make the market fit for renewables we must ensure the full integration of day-ahead, intraday and balancing markets, and implement shorter gate closure. Wholesale prices must also be allowed to adequately reflect scarcity, thus helping to provide investment signals that can be trusted by market participants. Another key element is to develop and implement market-based congestion management built on a common method. Last but not least, a more regional approach to electricity systems' operation and to system adequacy, including to capacity mechanisms, is the most sustainable path to follow.

It is time for the key energy actors to recognise the value of an increasingly regional approach to system adequacy and system operation. A truly integrated internal electricity market will need an optimised electricity system on a regional and European basis. This will require coordinating and ultimately integrating system operation and planning tasks relevant to cross-border trade at regional level, building on existing TSO coordination initiatives.

**Hans ten Berge: Regulatory and governance rules must be adapted to the needs of the moment**

To develop a more regional approach to security of supply, Member States should define system adequacy targets using homogeneous and transparent metrics to allow for a straightforward comparison between countries. Eurelectric fully supports the development of a European methodology for adequacy assessments and welcomes the improvement implemented by ENTSO-E in this field.

Such methodologies should also include an analysis of the firm capacity provided by all assets on both the supply side and the demand side, that is to say, including generation, demand response and storage assets available at national and cross-border level. To ensure security of supply in a cost-efficient way, capacity mechanisms must be market-based and allow for cross-border participation.

> One of the main issues in the electricity retail market is that policy support costs collected through electricity consumers' bills hamper electricity's competitiveness against other fuels

Decarbonisation of the power sector is essential to guarantee the long-term sustainability of the EU and global economy as there is currently no energy carrier that can decarbonise to the same extent and scale as electricity. In 2014, 56 per cent of electricity generated in the EU came from low carbon sources: 28 per cent was generated from renewable energy sources (RES) and 27 per cent from nuclear. Given our commitment to a carbon-neutral power sector by 2050 and to help electrify other sectors like transport, heating and cooling, we believe that a revived electricity market design is key.

As we progress slowly but steadily towards an integrated European electricity market, renewables must be increasingly exposed to competition and be placed on a level playing field with other technologies. Next to our decarbonisation objective, we are committed to a European binding objective to achieve at least 27 per cent of renewables by 2030. The post 2020 framework for renewables must therefore ensure a coherent approach that takes into account the contribution of all sectors – heating, cooling, electricity and transport.

In the transition phase, the EU ETS should be the main driver for RES investments in the electricity sector. It is an established, technology-neutral instrument that can bring an increasingly EU-wide approach to low-carbon technologies. Strengthening the EU ETS is therefore one of the best options to increase the competiveness of low-carbon technologies such as RES and nuclear, and encourage fuel switching to low-carbon sources.

It is nevertheless likely that some Member States will continue supporting RES after 2020 as the current market conditions and EU ETS price do not provide sufficient investment signals. Support schemes should be market-based, such as competitive tenders, ensure cost-efficiency, minimise distortions in the wholesale market and minimise the capital cost of investments.

Recently, some schemes have evolved from FiTs (feed-in tariffs) to FiPs (feed-in premiums) or CfD (contracts for difference) and elements of tendering are also being introduced for larger units, in line with the state aid guidelines. For instance, FiTs should be phased out, because they do not allow market integration.

Empowered customers will play a crucial role in the coming decades. Using the most modern technologies such as heat pumps, electric vehicles, home management systems and connected objects, customers will have unprecedented control over their energy use. The need to integrate increasing shares of variable renewable energy sources (RES) into the system makes demand side flexibility more and more relevant.

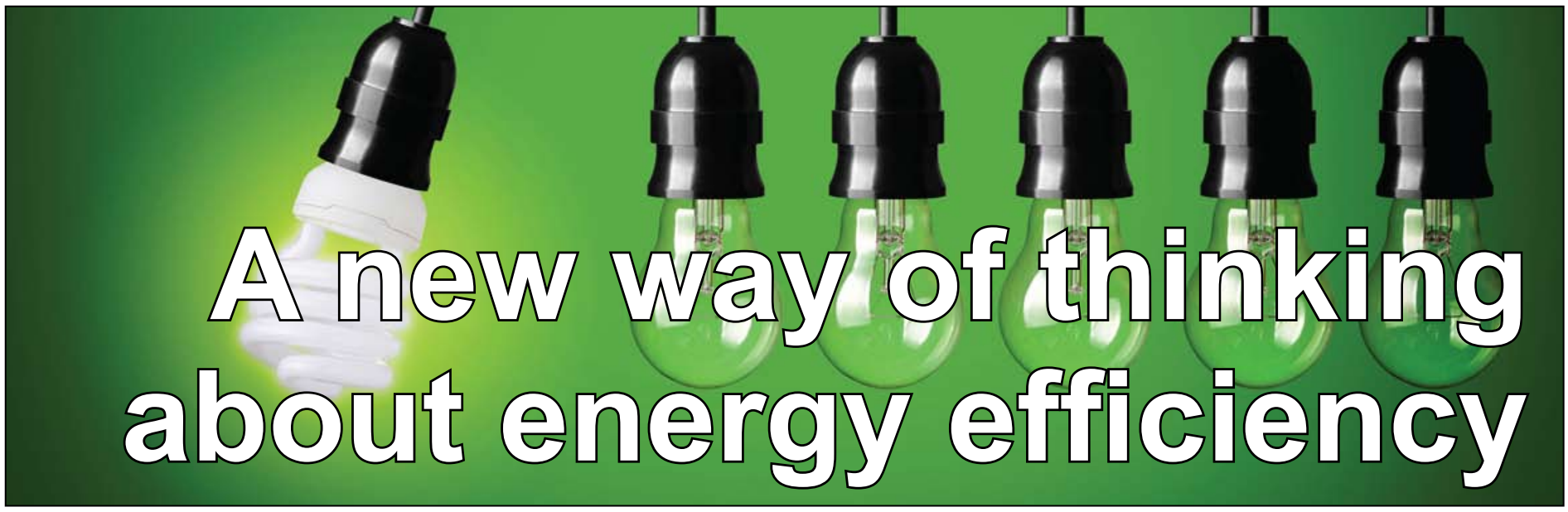
These developments require clear rules which enable the participation of customers in the market and a fair competition between all flexibility resources (generation, demand response, storage). For this purpose, retailers should be allowed to develop innovative products such as retail offers that incentivise customers to shift their consumption to hours with lower prices or higher renewables generation.

Today, one of the main issues in the electricity retail market is that policy support costs collected through electricity consumers' bills hamper electricity's competitiveness against other fuels, which slows down electrification. In addition, most of the regulated costs that are behind customers' bills, such as network costs and policy support charges, are fixed and thus do not depend on the volume of electricity consumed. Yet, due to regulatory requirements, they are mostly collected on a volumetric (€/kWh) basis.

This price structure leads to distorted investment signals (especially in self-generation) that result in increasing retail prices for all consumers who remain solely supplied via the grid. This could in the end lead to a "consumer divide" as the number of consumers connected to the grid continues to shrink and the unit price of electricity increases.

To carry out the energy revolution in the most cost-effective way, customers, energy companies and policy-makers all need to play a role in ensuring an effective and affordable energy transition to a low-carbon economy. Regulatory and governance rules must be adapted to current needs and be able to adjust to the challenges ahead. It is clear that market designs are not carved in stone and the upcoming review of the EU electricity market is crucial to putting the debate high on the European and national energy agendas.

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



# A new way of thinking about energy efficiency

Energy audits alone will not necessarily deliver a true culture change. The ISO 50001 energy management standard has a better chance of doing so because – when properly implemented – it explicitly targets changed thinking about energy efficiency.
**Ulrika Wising**

For Europe's policymakers, it is an intriguing thought experiment. From a policy perspective, what could be achieved if Europe's industrial sector were to improve its energy efficiency by 10-15 per cent? And if it were able to do so at very low cost – meaning that large-scale investment, and the rate-of-return hurdles associated with such investment, need not present a barrier?

It is not difficult to see. An improvement in energy efficiency on such a scale would obviously help to deliver greater energy security, reducing Europe's reliance on foreign imports, often from unstable geopolitical regions. Equally clearly, greater progress towards achieving Europe's decarbonisation and emissions targets would be another policy impact. Likewise, energy efficiency improvements on such a scale would obviously contribute significantly towards the objective of achieving Europe's Energy Union.

And just as importantly, greater energy efficiency on this scale – and at very low cost – serves Europe's industrial competitiveness agenda, because energy typically makes up 25-40 per cent of an energy intensive company's operating costs.

So at a time when Europe's industrial firms pay up to three times as much for their energy as do their equivalents in the United States, energy efficiency improvements of 10-15 per cent represent a significant levelling of the global playing field, helping to preserve European jobs and industries.

**Wising: box-ticking exercises are unlikely to deliver significant and auditable improvements in energy efficiency**

While energy competitiveness is a complex issue, it is a fact that some of Europe's largest industries are uncomfortably exposed to high energy costs, thanks to Europe's relative lack of cheaply exploitable energy resources. And high energy costs, as the European policy think-tank Bruegel has found, are negatively correlated with export prowess: simply put, countries with low energy prices are better at exporting energy-intensive products.

So as a thought experiment, an improvement in industrial energy efficiency of some 10-15 per cent has obvious appeal to policymakers. At a stroke it helps them to deliver on a number of significant policy objectives, ranging from job security to decarbonisation, and from energy security to international competitiveness. But how realistic is such an aspiration? What are the prospects of such an improvement in energy efficiency being achieved – not just as a thought experiment but in terms of actual energy consumed, and jobs preserved?

And here, there is good news, and even better news. So let's start with the good news.

The simple fact is that this 10-15 per cent energy efficiency improvement – at very low cost, don't forget – requires cultural changes among a fairly tightly focused group of energy-intensive industries. In fact, according to one EU-sponsored study, just eight energy intensive industry sectors account for 98 per cent of European industrial energy use.

The industries in question are: industrial staples such as iron and steel, oil refining, the chemical and pharmaceutical industries, food and beverage manufacturing, industrial machinery, and pulp and paper manufacture. Encourage a culture change in energy management within these eight industries, then, and the impact can be considerable.

But what sort of culture change, exactly? As governments know all too well as they try to prompt consumers to live more healthily, pay their taxes in full, and drive more carefully, there is no one simple answer, despite numerous initiatives having been tried. With energy management, however, it is perhaps more accurate to say that most of the work lies ahead.

Because in general, it is fair to say from a policy perspective at a pan-European level, there is a shortfall in policies aimed at driving or encouraging an energy culture change within industry. It is possible to point to national examples of best practice: energy-intensive industries in Belgium and the Netherlands are required to maintain and monitor an energy model, for instance. But at a pan-European level, such initiatives have yet to be replicated.

Yet, the broad outline of a greater corporate focus on corporate energy efficiency and corporate energy utilisation is not difficult to envisage.

Businesses should develop key energy-related performance indicators, for instance, and assign those performance indicators to specific individuals. They should then hold those individuals accountable for the indicators, just as they are held accountable for other production-oriented indicators. Subsequently, they need to ensure that those individuals have the tools and the authority they need in order to make a difference, as well as identify and promulgate good energy management practice, reward good behaviour, and so on. The potential is obvious.

And while it is difficult to precisely estimate the impact of such a culture change, a number of separate studies have suggested that Europe's energy-intensive industries could benefit from a 10-15 per cent improvement in energy efficiency from such low-investment initiatives.

Clearly, this is an improvement that would do much to deliver on a number of important energy-related policy aspirations, and one which would also do much to support employment levels and job security within some of Europe's most hard-pressed industries.

Even so, how realistic is this thought experiment? Where do such numbers come from? Again, there is reassurance for policymakers, as repeated analyses consistently throw up figures in the same broad range. Most recently, for instance, there's the in-depth 460-page study carried out for the European Commission by ICF Consulting, modelling the energy consumption and savings potential of those eight energy intensive industries (accounting for 98 per cent of European industrial energy use, remember) up to the year 2050.

And as its authors observe, traditional approaches to improving energy efficiency – and modelling the impact of such improvements – tend to under-estimate the impact of behavioural change on energy efficiency, relying instead on technology-based improvements.

In one context, this is understandable. A piece of equipment or production process that has been re-designed to operate more efficiently can reasonably be assumed to continue working at that enhanced level of energy efficiency. Cultural changes, in the jargon, are less 'sticky': actions that people take today are not necessarily the same as those they might take tomorrow. The problem is that as ordinary individuals and private citizens, we all know that resolutions to eat less and exercise more are easily forgotten or broken, no matter how well-intentioned.

But here again, there is good news. Businesses – especially the large-scale enterprises typifying the eight industries in question – are manifestly not ordinary individuals and private citizens.

Instead, they are corporate entities, and can be guided into particular modes of behaviour by laws, standards and regulations, as well as by education and training programmes highlighting and incentivising good practice. In a situation calling for cultural change, then, it is clear that enterprises are easier to influence than ordinary consumers.

To some observers, the expectation is that this influence will come through the European Energy Efficiency Directive, which is now mandatory (or about to be mandatory) in all 28 EU member states. Specifically, Article 8 of the Directive requires businesses above a certain size to carry out energy audits, with the intention of identifying opportunities to improve energy efficiency.

DNV GL takes a slightly different view. Energy audits on their own will not necessarily deliver a true culture change. Instead, we think that the ISO 50001 energy management standard has a better chance of doing so, because – when properly implemented – it explicitly targets changed thinking about energy efficiency.

Of course, the key phrase here is 'properly implemented.' And because implementing ISO 50001 serves to exempt companies from compliance with the European Energy Efficiency Directive, some companies will be tempted to see it as a 'box-ticking' exercise. And box-ticking exercises are unlikely to deliver the significant – and auditable – improvements in energy efficiency, which we at DNV GL have seen as a result of companies implementing ISO 50001 properly.

But with a growing number of EU countries putting in place schemes to encourage ISO 50001 adoption through tax credits – as the legislators drawing up the European Energy Efficiency Directive originally envisaged – the incentive to skimp on ISO 50001 implementation is gradually diminishing.

Roll it all together, in short, and it is clear that improvements in energy efficiency can do much to help Europe's policymakers meet their objectives across a wide set of policy agendas. From energy security to climate change, and from international competitiveness to job security, cultural changes have much to offer.

The stage is set. Will Europe's policymakers follow through?

*Ulrika Wising is Head of Department; Sustainable Energy Use Europe at DNV GL – Energy.*

# A heavenly stairway to zero carbon emissions

**With its unusual architecture, BIO4 is designed to reflect the plant's green credentials and sustainability**

Danish utility HOFOR has started work on what is believed to be the world's largest wood chip fired power plant – a move that will keep Copenhagen on its path to becoming the first zero carbon emissions capital city.

**Junior Isles**

In September this year, Valmet and Danish utility HOFOR Energiproduktion A/S signed a contract to install a new biomass-fired boiler plant at the Amagerværket heat and power plant in Copenhagen. The new facility is Valmet's biggest boiler plant order to date but more importantly it is a key part of Copenhagen's plan to become the first $CO_2$-neutral capital in the world by the year 2025.

Copenhagen's climate plan has been well publicised. The city launched its carbon-neutral scheme in 2009, when it hosted the UN Climate Change Conference. The first target was to reduce $CO_2$ emissions by 20 per cent by 2015 – a marker it has already surpassed – but a key period on the way to hitting the 2025 target is the 2016 to 2018 timeframe when its power stations will be converted from burning conventional fossil fuels.

Around three quarters of the emission cuts will come from switching to green energy. Out of the total reduction, 43 per cent will come from burning waste and biomass – mostly from wood – instead of coal in power plants. Another 42 per cent will come from adding more wind generation to the grid.

HOFOR's BIO4 Amagerværket CHP plant is one of the most important of these conversions. HOFOR is the largest utility company in Denmark, with more than one million customers in the greater Copenhagen area. The company pays special attention to sustainable deliveries and renewable energy in its operations.

In cooperation with a number of larger European energy companies, HOFOR participates in developing requirements regarding biomass acquisition under the Sustainable Biomass Partnership (SBP) collaboration. This is a voluntary agreement between Danish energy companies aimed at securing sustainable biomass use.

Commenting on the BIO4 project, Carsten Schneider, Project Director, HOFOR, said: "It represents an investment of around €600 million; it's a very important project for us as a company and in general. For Denmark, it's one of the largest power plant projects in terms of investment."

Copenhagen has one of the largest district heating networks in the world and, in addition to helping the city achieve its $CO_2$-neutral goal, BIO4 is central to HOFOR's strategy for securing the heat supply to its 500 000 district heating customers.

At 500 MWth, Schneider says BIO4 is the "largest and most interesting" of its ongoing projects. "To my knowledge, it is the largest wood chips-based biomass fired power plant in the world."

The unit will have a heat production of 415 MJ/s and a net electricity production of 150 MW, which can be adjusted by bypassing the steam turbine. It will replace a 600 MW unit at the Amagerværket site, which HOFOR bought from Vattenfall in January 2014.

Built in the 1970s, the Amagerværket plant provides the bulk of Copenhagen's district heating. It currently consists of two cogeneration blocks. Block 1 began operation in 1971. Originally fired by coal, it was converted to run on wood pellets in the 2004-2010 period. Block 3, which was commissioned in 1989, is a 250 MW coal fired unit that will be shut down when BIO4 begins operation.

Designed for pure base load district heating, BIO4 will meet approximately 25 per cent of the total heat demand for the greater Copenhagen area, while cutting $CO_2$ emissions from the site by 1.2 million t/year.

The new unit is expected to consume about 1.2 million t/year of wood chips. As biomass has a much larger volume than coal for an equivalent energy content, the harbour is being extended and two new harbour cranes installed.

The site's location, about 1-2 km east of the city centre, means that the plant's owner has to be conscious of the noise, environmental and visual impact of the facility.

Much of the emission mitigation will be through the use of the circulating fluidised bed (CFB) technology at the heart of the power plant. CFB technology was chosen instead of a grate fired system due to the size of the unit and the economic impact.

"A grate fired boiler has a maximum capacity of around 140 MWth, so we would have needed three of them," said Schneider. "An analysis was made and the investment favoured CFB technology."

The boiler will be supplied by way of a €150 million contract under which Valmet will deliver and install its CYMIC CFB boiler, as well as the wood chip conveyors and storage systems.

With CFB technology, the circulating bed material flows together with flue gas through the furnace, after which it is separated from the gas and returned back to the lower part of the furnace with cyclones.

This technology provides an even combustion temperature profile, which is optimal for handling a wide variety of fuel properties such as low heating value, high moisture and ash content, and a number of low melting point ash components. CFBs also ensure low primary emissions with high combustion efficiency and good utilisation of additives such as limestone for sulphur removal inside the furnace.

The key element in the CFB boiler is the cyclone. CYMIC boilers use high-efficiency cylindrical cyclones constructed of membrane walls covered by a light refractory for erosion protection. No hot expansion joints between the furnace and the cyclone are needed. High steam parameters are possible without severe corrosion, even with recovered fuels, thanks to fluidised bed heat exchangers located in the loop seal.

In addition to its ability to burn a wide range of solid fuels, including biomass, CFB technology inherently produces low levels of NOx. Emission control is essentially achieved due to the relatively low combustion temperature in the boiler – the BIO4 boiler will operate at about 800°C to produce steam at 560°C and 14 bar. NOx emissions in the boiler will be further reduced by selective non-catalytic NOx reduction (SNCR), where ammonia will be injected at optimised locations in the flue gas stream to reduce NOx levels to 20 mg/Nm$^3$.

Although the CFB boiler offers effective emission control, due to its close proximity to the city centre there is also an advanced backend flue gas cleanup system. This comprises a baghouse filter to remove dust, wastewater treatment equipment and a flue gas scrubber that uses the condensation heat from the flue gases – heat that is also fed to the district heating network to maximise plant efficiency.

While attention to emissions was important, the visual aspect was just as high on the agenda. Notably, the plant will be visible from both the historic Kastellet fortress and the Copenhagen Opera House. There was therefore a particular focus on its architecture. The brief was to develop a building that could become a landmark.

"When we first had a discussion with the planning authorities two years ago, all they asked was: 'what will it look like?' To get our planning approval, we had to address the visual aspect of the plant at a very early stage," recalled Schneider.

HOFOR launched an architecture competition, which was eventually won by Danish firm Gottlieb Paludan Architects.

The concept was to construct the plant inside a glass building surrounded by hanging logs – representing the fuel and sustainable energy production. There will be visitor observation points accessed by a visible wooden staircase running along the side of the building behind the tree-trunk façade.

"We call it the stairway to heaven," joked Schneider. "It goes up 45 m to a viewing platform from where visitors can look into the boiler, turbine hall etc., or you can have a view of Sweden or the whole city of Copenhagen."

Work has already begun on the masterpiece. Piling work began in September – there will be something like 5000 concrete piles – and the next milestone will be the start of equipment erection in May 2017. First supply of biomass is expected towards the end of 2018 and the plant will begin commercial operation in 2019.

When it fires up, BIO4 will accelerate Denmark further along the road to its 2025 target, showing how a country can utilise a range of sustainable energy resources to meet its zero carbon objective.

**A wooden staircase along the side of the plant will give visitors the opportunity to view the plant from a 45m-high platform**

# Who holds the trump card?

Junior Isles

Common sense usually trumps everything – at least that is the theory. But judging by his election campaign, common sense is something that US President-elect Donald Trump seems a little short on.

Yet while that may be the understandable reaction to many of the promises he made in what was the most divisive US presidential campaign in history, the hope is that much of the rhetoric was the usual political promises that never see light of day when a politician actually comes into office.

The international community is particularly concerned about Trump's stance on clean energy and climate change. Trump has promised to reverse President Obama's Clean Power Plan and pull out of the Paris Climate Agreement. In the past he has gone as far as to describe climate change as "a total hoax", "created by and for the Chinese".

Now Trump has actually won the election, the question is: whether the strong rhetoric was just public pandering to win votes or sincere proposals to which he is firmly committed. While it is hard to speculate, what is clear is that the energy industry will continue going through a transition.

A key issue is that, unlike President Obama, Trump's administration will have the support of Congress. With a Republican majority in both the Senate and the House of Representatives, Trump will be able to easily push through legislation and laws. Without the support of Congress, Obama was only able to sign executive orders, which are easily reversed by subsequent governments.

The Edison Electric Institute (EEI), the association that represents all US investor-owned electric companies, will provide recommendations to the incoming administration on what it thinks should be the way forward.

Dr. Lawrence Jones, Vice President of International Programs at the EEI gave his personal views on the sidelines of the *Economist Energy Summit* in London in November. "The biggest challenge facing the industry going forward is uncertainty. It is highly possible we will see some interesting changes. Some environmental regulation policies might be changed; there could be a reversal on some of the environmental restrictions. Will they happen? I don't know."

Whether they happen or not might indeed be a moot point. It may be the case that even if Trump does decide to reverse Obama's Clean Power Plan (CPP), it will have little impact on the path the country is already following and therefore limited effect on global climate change efforts.

"You have to remember that in the US most of the policies that affect utilities are state mandates. Nothing that happens in Washington is going to change the policy trajectory in, say, California," said Dr. Jones.

Trump will have the authority to order the Environmental Protection Agency (EPA) to request the US court of appeals to "remand" the CPP. Then it can be revised into a much weaker, almost ineffective policy, by the Trump EPA.

The CPP, a comprehensive set of regulations for cutting carbon emissions by electricity generators proposed by the EPA under Obama, was one of the principal means for the US to comply with its Paris obligations.

When speculating as to whether Trump would pull out of the climate change agreement, Dr. Jones said it was important to look at the ramifications for the Trump administration.

He explained: "Energy is a global industry and you have to look at it from the standpoint of job creation, especially in this environment where people are feeling left out and angry. So any energy policy agenda should start by asking the question: If you get rid of the agreement, who loses and who gains? If getting rid of it is going to result in massive job losses – will they do it? I don't know; I would be surprised [if they did]."

Demand drives the energy industry, and that is greatest in China and India. This will not change whether the US pulls out of the agreement or not and it could be a mistake for the US to disengage from clean energy. The new administration needs to examine the purpose of tearing up the agreement and more importantly, what might be the unintended consequences.

The solar industry could be a case in point. The growth of solar in India and China has eneabled manufacturers to reduce prices. If the US withdraws from the clean energy movement, US solar manufacturers will quickly become uncompetitive and unable to export to the biggest solar markets in the world.

Repealing orders may serve as a political victory but at what cost? The fundamental question facing the incoming administration is: if there is a reversal of policy on clean energy and climate change, what will the people currently in the sector do if the clean energy industry languishes? The new administration must ask: where are the new energy-related jobs?

Despite his campaign rhetoric, experts and industry players say Trump's proposed energy policies as President will come up against market realities.

Trump has made promises to coal miners, mining companies and coal-burning utilities that he would "rip up Paris". With many of his supporters in the Rust Belt, Trump has said that the region straddling the upper northeast, the Great Lakes, and the Midwest will be revitalised. But realistically, who will invest there?

Further, the economics in the energy sector increasingly favour renewable technologies such as solar and wind, which are reducing costs quickly. At the same time, increased fracking has produced natural gas at prices that are cheaper than coal.

Commenting on the prospects for solar under the new government, Tom Kimbis, interim president of the Solar Energy Industries Association, said he has been speaking with Trump's representatives and "they're very well-informed" about the pace of growth in the renewable energy sector.

This was echoed by Debbie Dooley, co-founder of the Atlanta Tea Party and national coordinator for the Tea Party Patriots, who helped with a multi-partisan coalition in Florida that defeated an anti-solar amendment pushed by the state's utilities. Dooley, a Trump supporter, said she believes that once he understands the benefits of solar and that it helps increase competition, he will embrace it.

Some believe it is a similar story for wind. The American Wind Power Association notes that wind and solar have become some of the cheapest energy options in many parts of the US. It added: "With over 80 per cent of all wind farms in Republican-held congressional districts, we envision that the Republican leadership in Congress and the White House will want to keep our industry growing." According to the organisation, wind power supports 88 000 American jobs currently.

Crucially, Mike Brune, Executive Director of the Sierra Club, the nation's largest and most influential grassroots environmental organisation, noted: "The one point of encouragement that we take solace in, is the fact that the market and the climate movement are aligned, which we haven't seen before."

Whatever Trump's views – whether purely contrived to garner public support or not – he could not have succeeded as a property tycoon without some level of business or commercial acumen. It should, therefore, logically follow that he will soon realise that the biggest opportunities for future job creation lie in the clean energy sector. Rescinding clean power policy will have little effect on US clean energy at the domestic level and attempting to withdraw from the Paris agreement will do little to alter the resolve of climate change negotiators or slow the momentum of the global energy transition.

The energy transition is under way and will not be reversed by any one man. Many fear that Trump has the hand that can change the course of the game but in reality common sense is the trump card.