

THE ENERGY INDUSTRY TIMES

March 2016 • Volume 9 • No 1 • Published monthly • ISSN 1757-7365

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Halt on US Clean Power Plan may have wider implications

Todd Stern, the US climate envoy, is set to discuss the decision in Brussels



Uncertainty surrounding the US' Clean Power Plan may undermine global climate change efforts. Junior Isles

The implications of the US Supreme Court's decision to freeze President Barack Obama's climate change policy may extend beyond the US.

In February, the court ruled that the Obama administration could no longer enforce deadlines for complying with its proposed Clean Power Plan (CPP). The new regulations for limiting carbon dioxide emissions from electricity generation are central to Obama's climate strategy.

The court's decision will lift a September 6 deadline for states to submit plans to the federal Environmental Protection Agency (EPA) showing how they would comply with new limits on their carbon dioxide emissions.

Under the proposed CPP, the EPA was empowered to force coal fired power stations to cut carbon dioxide emissions by 32 per cent from 2005 levels by 2030.

The new rules, which have been years in the making, in the face of opposition from a number of states and businesses, mark the first nationwide limit on CO₂ from fossil fuel power generation in the US.

The Supreme Court decision, however, means the regulations can make no further progress while legal challenges are heard first by the DC circuit court.

The Supreme Court ruling suggests it is very likely to hear the case brought against the CPP by 29 states and state

agencies, led by the Republican attorneys-general of West Virginia and Texas, with support from coal companies and some utilities.

Oral arguments are expected to take place in early June, with the US Supreme Court revisiting the Plan in spring 2017.

While many international politicians, businesses and campaigners remained positive that the delay would not affect the global climate change agreement, there is evidence of some concern.

Miguel Arias Canete, EU Energy Commissioner, said: "We have confidence in all countries to deliver on what they promised," adding that he would meet Todd Stern, the US

climate envoy, in Brussels "to better understand the potential implications of the Supreme Court's decision".

The US Chamber of Commerce, the USA's main business lobby, called the Supreme Court decision "a stunning rebuke" to the Obama administration, and called into further question US ability to deliver on the climate promises made in Paris.

"The implications of this decision are likely to extend well beyond the United States and call into question the durability of the Obama administration's pledge to the United Nations to slash US net greenhouse gas emissions 26-28 per cent by 2025 from the

Continued on Page 2

Renewables show fastest growth but shale is here to stay

BP's latest energy outlook forecasts renewable energy as the fastest growing fuel over the next 20 years but maintains that the use of oil and gas in primary energy consumption will remain fairly constant.

The 'BP Energy Outlook 2016' report, which outlines the 'most likely' path for the global energy landscape to 2035, states that renewable energy will grow rapidly at 6.6 per cent per year, causing its share in primary energy to rise from around 3 per cent today to 9 per cent by 2035.

In terms of electricity generation,

renewables are predicted to account for over a third of the growth in power generation by 2035, causing their share of global power to increase to 16 per cent.

According to the report, the growth in renewables will largely be at the expense of coal. This view is echoed in a report by Goldman Sachs, which said the demand for thermal coal is declining, a trend that appears to be "irreversible".

BP forecasts that fossil fuels will remain the dominant form of energy but lists gas as the fastest growing

fossil fuel with a predicted increase of 1.8 per cent a year.

The report also predicts that shale oil is here to stay. BP believes that any Saudi-led attempt to drive US shale producers out of business is bound to fail. Instead, the report argues, US tight oil and shale gas producers have repeatedly proved stronger than expected, with innovation and successive gains in productivity leading them to revise the outlook higher.

Meanwhile, a separate report entitled 'Unconventional gas, a global phenomenon', released by the World

Energy Council, says the growth of unconventional gas is spreading across the world with major implications over many years for markets and prices.

The study, developed with project partner Accenture Strategy, claims that despite an uncertain price environment, the magnitude and speed of change is not only influencing the US market, but also other markets including countries such as China, Argentina and Algeria which have similar potential as the US in shale gas production.

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2005 level," a blog post from the Chamber's think-tank said.

"We estimate that the shortfall would expand from the current range of 45-49 per cent to a range of 60-63 per cent – that's more of a chasm than a gap. At the Paris climate talks in December, administration officials, who should have known better, spent considerable energy assuring anyone who would listen that the Clean Power Plan was legally unassailable."

Eminent climate change economist Lord Stern warned: "We have to recognise that delay is dangerous and faltering by the US risks being amplified elsewhere. While this is a setback, it does not change the profound attractiveness to the United States of the transition to low-carbon economic growth, and a world that is cleaner, safer and more prosperous."

Many observers blamed vested corporate interests and Republicans hostile to climate action for the setback.

Five conservative justices – including Antonin Scalia – voted for a stay, while the four liberal justices dissented.

William Bumpers, who chairs the environmental practice for law firm Baker Botts in Washington, notes, however, that with Justice Scalia's passing soon after the stay was decided, the CPP may yet have a chance.

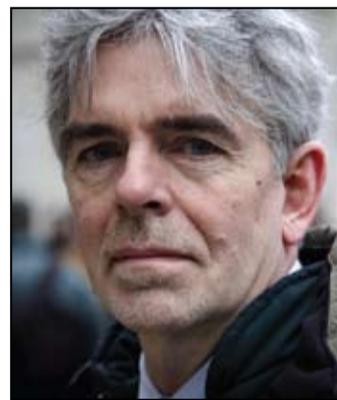
"The EPA will likely face better odds than it did with Scalia on the bench, and more so if Obama is able to get a liberal justice confirmed by the Republican-controlled Senate," said Bumpers.

Regardless of the outcome, many believe the shift to a clean energy landscape is unavoidable.

Jonathan Adler, a professor at Case Western University School of Law, said: "This isn't going to stop, even if the court's final ruling is negative. The shift away from high-carbon fuels towards cleaner energy and efficiency is unstoppable."

John Sauven, executive director of Greenpeace UK, said: "The hard-line climate sceptic Republicans and their corporate backers on the big utilities will use all their power and money to try to thwart Obama's attempts to kick start a renewable energy revolution. We can only hope this is a last desperate throw of the dice as coal continues to slide down the power league table."

The Economist Intelligence Unit said coal fired generation will still face several market challenges



Sauven hopes this is a "last desperate throw of the dice" as coal slides down the table

going forward, whether or not the CPP is eventually implemented. This is due to competition from cheap natural gas, fuelled by the shale boom, and continued growth in renewables capacity, which will be helped by the recent continuation of tax credits for wind and solar power.

EU pushes to turn COP21 climate deal into reality

At a recent energy summit in Brussels, the EU outlined its plans on how it intends to make the international climate agreement secured in Paris a reality. **Vic Wyman reports.**

European Union policymakers have insisted that they have not put their feet up since the COP21 international climate change agreement in Paris last December.

To turn the deal into reality in order to halt climate change, the European Commission has been pushing out energy and climate policy proposals, with more to come.

Speaking at the recent 2nd EU Energy Summit in Brussels, Miguel Arias Cañete, the EU's Climate Action and Energy Commissioner said "COP21 was a challenge for all the parties", pointing to the need for large investments and greater attention to renewables and energy efficiency. "We will have a more coordinated approach. There is a major shift," he said.

As well as reducing the EU's greenhouse gas emissions by at least 40 per

cent by 2030, proposals must fit in with the EU's energy roadmap 2050. The Commission's thinking was made clearer in Brussels.

It has, for example, proposed changes to the stumbling carbon market, the Emissions Trading System (ETS), partly to increase the carbon price to stimulate emissions cuts and energy saving. "Carbon pricing will be critical to the COP21 agreement," Cañete said.

Charlotte Wolff-Bye, vice-president for sustainability at Norwegian oil company Statoil, said that "a suitably ambitious level" of carbon pricing was needed to incentivise consumers and the gas industry.

Cañete also admitted that the electricity market needed to be changed: "It is not giving the right signals." He added that investment, particularly to

cope with more renewables, was also not enough.

Much of the Commission's focus is on gas, including security of supply and gas as a backup for renewables. Mechthild Wörnsdörfer, the energy policy director in the Commission's energy directorate, was less worried about the high level of gas imports than about some countries having single suppliers.

Under its energy security package, the Commission wants countries to have at least three gas sources, gas hubs to the EU's south and east, more cooperation with countries such as Norway, Canada and the USA and more infrastructure, including storage for better market balancing.

It wants the power to approve EU government energy deals with other governments that last more than a year

and account for more than 40 per cent of annual national consumption. It also proposed strategies for liquefied natural gas (LNG) and for more energy saving in heating and cooling.

Emmanuel Haton, director of European affairs at oil and gas firm BP, echoed others' view that gas would increasingly become an LNG market, with more competition for pipeline supplies and prices, particularly for Russian gas.

The Commission will soon update its future gas market scenarios and by the end of 2016 will publish an energy efficiency package, which will include buildings performance. Vera Brenzel, head of political affairs at the utility E.On, said that consumers received a confusing mixture of efficiency information. She noted: "We have to address efficiency from the demand-side."

European Commission moves on energy security

The European Commission's adoption of a package of energy security measures will equip the EU for the global energy transition and address possible energy supply interruptions. Energy security is one of the cornerstones of the Energy Union Strategy, a key political priority of the Juncker Commission.

The package adopted in mid-February sets out a wide range of measures to strengthen the EU's resilience to gas supply disruptions. These measures include moderating energy demand, increasing energy production in Europe (including from renewables), further developing a well-functioning and fully integrated internal energy market, as well as diversification of energy sources, suppliers and routes. Further, the proposals bring more transparency to the European energy market and create more solidarity between the Member States.

The Commission said the energy security package was adopted in the light of the global agreement on climate

change, agreed by world leaders in December 2015 in Paris.

Commenting on the security package, Vice-President responsible for Energy Union, Maroš Šefčovič said: "The Energy Union Strategy, launched one year ago, promised to provide all Europeans with energy which is secure, sustainable, and competitive. Today's package focuses on the security of our supply, but touches upon all three overarching goals. By reducing our energy demand, and better managing our supply from external sources we are delivering on our promise and enhancing the stability of Europe's energy market."

Commissioner for Climate Action and Energy, Miguel Arias Cañete said: "After the gas crises of 2006 and 2009 that left many millions out in the cold, we said: 'Never again'. But the stress tests of 2014 showed we are still far too vulnerable to major disruption of gas supplies. And the political tensions on our borders are a sharp reminder that this problem will not just go away."

Speaking at a conference organised by the International Energy Agency (IEA) just ahead of the launch of the energy package, Šefčovič noted that due to a lack of gas infrastructure and the dominant position of "a supplier" in the market, countries of central and eastern Europe paid 23 per cent more for gas in 2014 than their Western partners.

"This is proof we need more liquid markets, better interconnectors and we need to diversify our supplies to make sure competition can really play a role," he said.

The energy security package is widely seen as a move to reduce the EU's dependence on Russia, although both Šefčovič and Cañete were quick to play this down.

Šefčovič said Russia would continue to play an important role in the EU's energy sector in the future, but said that the Commission wanted the relationship to be based on "transparent rules and full respect for European law".

Cañete said that the strategy was

meant to deal with any kind of supply interruptions, not just a political decision to stop gas flows. He added that the specific proposal that the Commission has the power to examine commercial contracts (in cases where one company has more than 40 per cent market share) would apply to all suppliers, not just Gazprom.

Eurelectric, the organisation representing Europe's electric utilities, was positive about the energy security package, pointing out that the proposals "certainly point in the right direction", even if there are "a few areas of concern".

It commented: "We also welcome the proposed inclusion of the needs of gas-fired power plants in the risk assessments and in both Preventive and Emergency Plans, as emergencies declared in a gas market could result in load shedding being imposed on gas fired power stations. In this context, Eurelectric appeals for strong cooperation between gas and electricity TSOs."

European utilities on negative watch

Credit ratings agency Moody's has put 10 European utility companies on negative watch, amid plummeting commodity prices and low wholesale power prices.

In a report entitled 'European Unregulated Utilities and Power Companies: Falling commodity prices put earnings and ratings under pressure', Moody's said that electricity, oil and gas prices have fallen sharply since

last autumn, which will weigh on cash flows across the European unregulated utility and power companies.

"We have conducted a review of the sector's exposure, and on 12 and 13 February 2016 affirmed the ratings of nineteen groups and placed those of ten others, representing almost half the European sector's rated debt, on review for downgrade. We also downgraded one group," it stated.

Moody's said that since mid-2015, European gas, coal, and carbon prices have fallen by around 35 per cent and electricity prices by between 15 per cent and 40 per cent. It also said there would be downward pressure on earnings and cash flows across the sector as existing hedges roll off.

Utilities placed on review for downgrade are Centrica, CEZ, DONG Energy, EDF, E.On, Eesti Energia, En-

gie, RWE, Vattenfall and Verbund.

EDP, EnBW, Enel and Fortum were among the 19 companies that had their ratings reaffirmed. According to Moody's the reaffirmations primarily reflect companies' business mix and moderate exposure to commodity-linked earnings. It also factors in their financial flexibility, which will likely allow them to absorb the negative impact of low power prices.

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Obama fights for climate change action through final budget

- Obama reaffirms Mission Innovation pledge
- \$5.85 billion for DOE clean energy R&D

President Barack Obama is using his final budget request to push for action on climate change.

Obama's final budget proposal for fiscal year 2017 includes a request for \$7.7 billion for clean energy R&D, and reaffirms the President's commitment to Mission Innovation, an agreement made by the USA and 19 other countries at COP21 in Paris last year to double clean energy R&D over five years.

"Rather than subsidise the past, we should invest in the future," Obama said in his weekly address in early February. "That's why the budget I will send to Congress... will double funding for clean energy research and development by 2020."

Obama's budget request includes \$5.85 billion in discretionary funding

for clean energy R&D at the Department of Energy (DOE), a 21 per cent increase from FY 2016. It also includes \$2.89 billion for funding energy efficiency and renewable energy programmes, an increase of \$829 million from FY 2016. Some \$621 million is reserved for renewable energy generation technologies.

"The President's budget request would accelerate American energy innovation, increase our energy and national security, and expand our commitment to science and research," said Energy Secretary Ernest Moniz.

To complement a national R&D effort, the budget proposes new 'Regional Clean Energy Innovation Partnerships', creating up to 10 centres that will engage universities, industries, investors, labs and others to

work toward technology-neutral clean energy breakthroughs that support regional needs.

The budget also proposes the creation of the ARPA-E Trust, which creates the necessary funding to allow ARPA-E to expand its scope to address larger scale, more complex energy challenges than can be currently supported under its programme. The proposed trust would provide \$150 million in FY 2017 and a total of \$1.85 billion over five years to ARPA-E.

Obama's budget also proposes \$878 million for the Office of Fossil Energy (FE), \$564 million of which will support Mission Innovation. Key areas of research will include carbon capture and storage (CCS) and advanced energy systems such as gasification, advanced turbines and fuel cells.

Energy ministers agree low carbon collaboration

Energy ministers from across North America have signed an agreement to promote cooperation in the fields of climate change and low carbon energy technologies.

The memorandum of understanding was signed at the North American Energy Ministers Meeting hosted by Canada last month. Canadian Minister of Natural Resources Jim Carr said that the agreement would help the region to build its energy security and sustainability.

"The MoU... reflects our governments' shared vision for a future where an expanding clean energy sector, a sustainable environment and a strong economy go hand in hand," said Carr.

The agreement was signed by Can-

ada, the USA and Mexico and will enable the three countries to collaborate and share information on six key areas such as low-carbon electricity; clean energy technologies; energy efficiency; carbon capture, use and storage; climate change adaptation; and reducing emissions from the oil and gas sector, including from methane.

The Ministers also launched a web platform detailing information on North America's energy resources and infrastructure. It features a suite of static and interactive North American energy infrastructure maps, a combined North American energy outlook, and data tables and methodological guides to enable the comparison of energy trade between the three countries.



Peru attracts international investment

Sustained economic growth is helping Peru to become a key investment market for energy companies targeting emerging markets.

An international consortium comprising the Abu Dhabi Investment Authority (ADIA), Chile's Colbún and Sigma Capital has acquired power generation firm Fenix Power Peru, while Italy's Enel Green Power (EGP) has entered the Peruvian market after winning bids for three renewable energy projects.

Peru's economic stability is seen as an attractive prospect for investors.

Average annual gross domestic product over the last 15 years has been 5.3 per cent. "Utilities and infrastructure are sectors in Peru that continue to gain the attention of international investors," said Alvaro Silva-Santesteban, Director of the Trade and Investment Office of Peru in the UAE. "We enjoy a consolidated advantage in energy costs on a regional level because of our high utilisation of gas and hydro energy."

Blue Bolt, a subsidiary of ADIA, will own 36 per cent of Fenix, while Colbún will own 51 per cent. Sigma

will own the remaining 13 per cent of Fenix, a Lima-based company that owns a 570 MW combined cycle power plant in the district of Chilca.

The consortium's transaction is valued at \$786 million, ADIA said.

"The Peruvian power sector has a well established regulatory framework and is a competitive market," said Thomas Keller, Colbún's CEO. "This transaction represents a very important milestone for Colbún and it allows us to improve the company's diversification in terms of revenue streams, generation technology and

markets."

Enel last month said it had won a tender held by Peruvian energy regulator Osinermin to build 126 MW of wind power, 180 MW of solar PV and 20 MW of hydro capacity.

"With 326 MW awarded in the tender, EGP will become by 2018 the main renewable player in Peru and the only company operating plants of three different renewable technologies in the country," the Rome-based company said.

EGP will invest almost \$400 million to build the power plants, which will

start operating by 2018. They will comprise the Nazca wind project in the southern Peruvian region of Ica, the Rubi solar PV plant in Moquegua, and the Ayanunga hydropower plant in Huanuco.

The company said in a statement that Peru "has a vast renewable potential which is still largely unexploited". CEO Francesco Venturini said that the results of the tender "illustrate how renewable energy can be competitive with traditional generation even in geographies where its development is still in the early stages".

Dominion makes offer for Questar

Dominion Resources has made an offer to take over smaller rival Questar as consolidation in the electricity and gas sectors continues amid low fossil fuel prices.

Dominion, a mid-sized US electricity and gas distributor, said it would buy Utah-based Questar for \$4.4 billion. The purchase would expand Dominion's geographic reach in the US beyond its operations in the mid-Atlantic region.

The combined company would serve about 2.5 million electric utility customers and 2.3 million gas utility customers in seven states. It also would operate more than 25 000 km of natural gas transmission, gathering and storage pipelines, one of the nation's largest natural gas storage systems, and about 24 300 MW of generating capacity.

Dong expands offshore portfolio

Dong Energy is taking on a second 1000 MW lease off the east coast of the USA in a bid to expand beyond European waters.

| Siân Crampsie

Dong Energy is targeting the US offshore wind energy market with the acquisition of a second lease in the country.

The firm has sealed an agreement with RES America Developments Inc to take over the rights to an offshore wind development lease off the coast of New Jersey.

Subject to final approval by the US

Department of Interiors Bureau of Ocean Energy Management (BOEM), Dong will take over the lease area and draw on RES for project development support.

The lease area could accommodate the development of up to 1000 MW after 2020, RES said.

"The US is an interesting market for offshore wind with the potential to become a significant area for future development," said Samuel Leopold,

Dong's Executive Vice President for Wind Power. "With the transfer of the offshore wind development projects in the US, we are broadening our international scope."

"The site conditions are quite similar to those we currently work with in North-Western Europe which means that the project could be developed using well-known technology."

The New Jersey lease has a total size of 64 944 ha and is located about

18 km offshore. The average water depth is approximately 24 m.

In 2014, RES and Dong Energy agreed to cooperate on offshore wind projects in the USA. Under that agreement Dong took on the lease rights to the Bay State Wind project off the coast of Massachusetts, with a potential capacity of 1000 MW.

Bay State Wind lies 24 km off the coast of Martha's Vineyard and in water depths of 40-50 m.





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Government solar spending may be constrained in 2016-17

- Industry should not expect any significant funding support
- Tender for 4431 MW expected in February-March period

| Syed Ali

The road ahead for India's solar sector may not be very smooth this year due to the government's difficult fiscal position, according to experts.

In mid-February Vinay Rustagi, managing director of Bridge To India, a consulting and knowledge service provider in the renewable power sector said: "The Indian government is expected to table the budget for 2016-17 on 29 February. Due to severe constraints on the government's fiscal position, room for new expenditure including spending on solar sector seems limited."

While battling for intelligent use of the available fiscal resources, Rustagi said the budget was likely to approve funding for schemes that have already been announced.

"Overall, the solar industry should not expect any significant funding support from the budget. If the government can rationalise the overall taxation structure and provide long-term visibility and certainty, that will be a major positive," Rustagi added.

With an eye on its ambitious target of 100 000 MW of solar power by 2022, the Central government is expected to tender solar power projects worth 4431 MW across India in the February-March period.

According to state-owned Indian Renewable Energy Development Agency (IREDA) solar and wind projects in the country would attract \$20 billion of investment each year from next fiscal until 2018-19.

"US\$20 billion of investment is anticipated from fiscal 2016-17 for harnessing the potential of solar and wind

energy in India from leading financial agencies [the] world over... for the next three years to enable it to add solar and wind capacities to an estimated level of between 10 000 MW to 12 000 MW each year by 2019," PHD Chamber of Commerce and Industry said in a statement quoting K S Popli, Chairman and Managing Director of the Indian Renewable Energy Development Agency Ltd.

In early February the government approved a 'viability gap funding' (VGF) of Rs5050 crore (\$935.2 million) for setting up over 5000 MW of grid linked solar projects under the Jawaharlal Nehru National Solar Mission.

"The Cabinet Committee on Economic Affairs has given its approval for setting up over 5000 MW of grid-connected solar PV power projects on a build, own and operate basis," an

official statement said.

As part of efforts to boost the solar sector, the government will soon come out with a new policy for setting up solar zones in the country to give further stimulus to renewable energy projects and manufacturing of equipment. Each solar zone will be spread over 100 km² and 25 per cent of the area will be reserved for the small and medium industries.

■ India has confirmed the first 20 cities to receive funding for a sustainability makeover as part of the government's 100 smart cities project. The cities will be provided with secure access power and water supplies, proper sanitation and public transport in a \$7.5 billion makeover. The aim of the project is to convert the cities into smart cities with living standards comparable to Europe.

Japan set for return to coal

In what appears to be a reversal in environmental policy, Japan's Environment Ministry has given the go-ahead for the construction of new coal fired power plants.

The Environment Ministry has not, however, given a free pass for power companies to increase emissions. In exchange, power companies and the Ministry of Economy, Trade and Industry (METI) must take tougher measures to reduce global warming emissions.

Announcing the policy reversal, Minister Tamayo Marukawa said officials will review each plan and "check whether it is consistent with the government's targets".

The Environment Ministry and METI will request all utilities to report how much carbon dioxide they have emitted in generating electricity after the Japanese power market is fully liberalized in April.

METI will also set standards for coal fired power generation efficiency while requiring utilities to bring the ratio of renewable energy and nuclear power combined to at least 44 per cent. It will issue instructions or recommendations if it finds the utilities' efforts are insufficient.

World Wildlife Fund (WWF) Japan issued a statement opposing the move, saying it could result in coal fired power plants operating into the latter half of this century while impeding the country's counter-emission measures for an extensive period.

"Japan should be at a stage where it strengthens measures against global warming," the statement said, while noting that coal is the highest carbon dioxide emitting fossil fuel.

"Tolerating the increase of coal fired plants gives the wrong message to society, (it says) that it is still OK to use coal," WWF Japan said.

China continues to spread its wings

China is using its financial muscle to expand its global footprint in the power sector.

The Bank of China Ltd. and China Export & Credit Insurance Corp recently signed a non-binding framework credit line financing agreement with Enel SpA aimed at involving Chinese firms in worldwide projects being developed by the Italian utility.

In a statement, Enel said the accord with Bank of China will provide it and its subsidiaries with a financing credit line of up to \$1 billion backed by China Export & Credit Insurance Corp.

The accord, which was signed in Beijing, lasts five years and can be extended if the parties involved agree. It seeks to promote Chinese companies as contractors or suppliers in Enel's energy projects across the globe.

China is becoming increasingly active in all areas of the global power sector – from large thermal power plants to distributed renewable projects. Notably, late last year it became a partner in EDF's proposed Hinkley Point C nuclear power station in the UK.

At the same time Chinese solar companies are looking for opportunities in the solar segment specifically, as over-production in solar manufacturing has

exposed Chinese solar manufacturers to vast overcapacity.

As a result, Chinese manufacturers are increasingly looking to alternative markets for growth, with neighbouring emerging Asian renewables markets set to offer significant opportunities to capitalise on.

China accounted for 66 per cent of Indian imports of solar power panels during April-June of 2015. In December power minister Piyush Goyal informed the Lok Sabha, the lower house of India's Parliament, that more than 29 million of the 44 million imported solar power panels came from China during the period.

Meanwhile, BMI Research recently highlighted Thailand as an alternative growth destination to China, where the renewable power market has reached saturation point.

BMI identified Thailand as one of the key outperformers for solar power, particularly for Southeast Asia, as the country's ambitious renewable targets and supportive policy environment encourage investors into the market.

The trend continues to play out, with several Chinese solar manufacturers committing investment and setting up module production facilities in the rapidly expanding Thai solar industry over the last year.

New power tariff policy will boost investment

India's revised power tariff policy looks set to attract investment to the country's power sector, writes Syed Ali

India's recent revision of its tariff policy for the power sector could provide an important boost to investment and clean energy.

The Cabinet recently approved several changes, with the broad objectives of promoting renewable energy, incentivising exchange-based power trading and shielding the producers from fluctuations in fuel and tax costs due to government decisions.

Notably, power plants will be allowed to sell their unsolicited capacity – which has been abandoned by the procurer despite existing power purchase agreements – on the open market through power exchanges.

The profit thus earned would be equally split between the generator and the procurer.

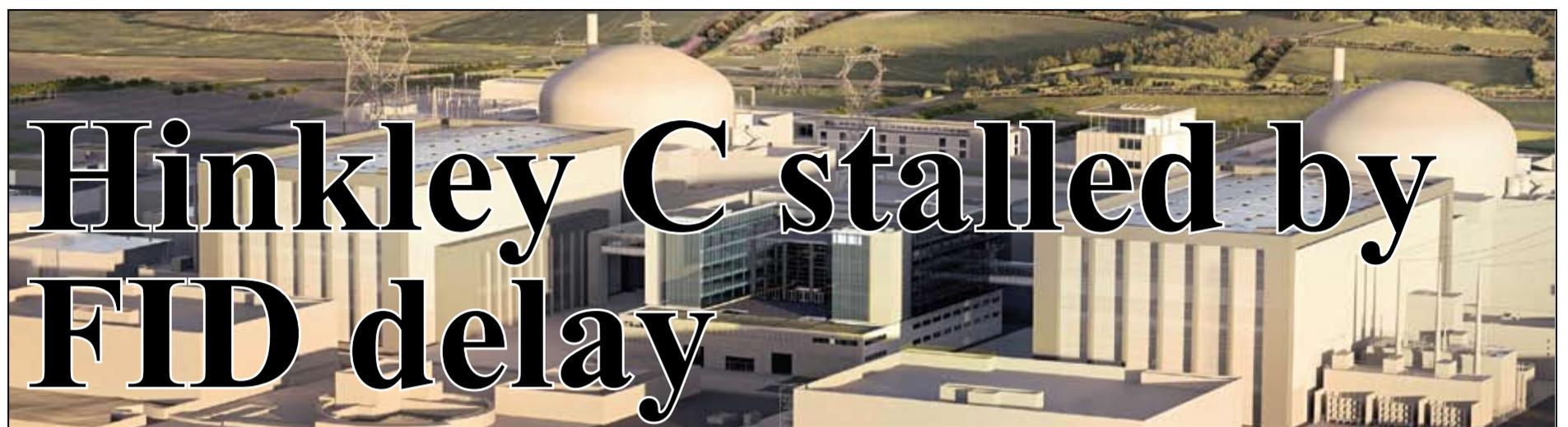
The new tariff policy also requires future thermal power plants to set up renewable capacity corresponding to a percentage of planned thermal capacity. However, the policy has left the mandated renewable capacity to the discretion of electricity regulators.

Moreover, the policy has imposed an obligation on power distribution companies to procure solar energy amounting to a minimum of 8 per cent of energy requirement by 2022. The policy has also exempted solar and wind power from inter-state transmission

charges to ensure affordability.

General Electric (GE) said the revised policy offered new opportunities. Banmali Agrawala, President and CEO of GE South Asia called the tariff policy a "fairly comprehensive" power policy that "inspires confidence" in the sector.

He added: "The biggest challenge in the industry – losses of electricity boards and distribution companies – is already being addressed by a bold debt restructuring scheme. The tariff policy addresses all the other aspects the industry has been asking for, right from time-of-the-day tariffs to mainstreaming of renewable energy projects."



Hinkley C stalled by FID delay

EDF's reluctance to make a final investment decision (FID) on Hinkley Point C has led to concerns over the energy firm's ability to finance the proposed nuclear power project.

Siân Crampsie

French utility EDF has insisted that it will make a final investment decision on the proposed Hinkley Point C nuclear power plant "soon" in spite of concerns over financing and other project risks.

EDF Chief Executive Vincent de Rivaz told UK lawmakers in early February that "EDF will deliver" on the £18 billion project in Somerset, southwest England.

"I can tell you that I am absolutely confident that Hinkley Point C will be reaching a final investment decision soon," de Rivaz told a Parliamentary group on energy.

His comments came days after EDF postponed plans to make the final investment decision on Hinkley at a

January board meeting. An anti-Hinkley campaign group said that the firm took the decision off the agenda for the meeting because of pressure from private investors and unions.

The decision on Hinkley did not make the agenda of the firm's February board meeting either.

EDF has since announced plans to extend the life of four nuclear reactors in the UK, a move some analysts believe has been in part driven by uncertainty over the Hinkley project.

EDF said that it plans to extend operations at the Heysham 1 and Hartlepool nuclear power plants by five years to 2024. It will extend operations at Heysham 2 and Torness by seven years to 2030, it added.

EDF said the decision followed "extensive technical and safety reviews". "Our continuing investment, our

expertise and the professional relationship we have with the safety regulator means we can safely prolong the operating life of our nuclear power stations," said de Rivaz. "Their excellent output shows that reliability is improving whilst their safety and environmental performance is higher than ever."

Fred Dahlmann, an Assistant Professor of Global Energy at Warwick Business School said that extending the four units' operating lives was an "obvious choice to provide some sort of income stability" but "casts serious doubt over EDF's ability and intention to seal the deal on" Hinkley. Dahlmann added: "EDF's decision to extend the lifetime of four of its eight nuclear power plants in the UK reflects the continuing political and economic uncertainties surrounding the development of new large-scale power generation assets."

Under current plans, Hinkley Point is due to be completed by 2025, after which it will provide seven per cent of Britain's electricity. EDF has sealed a deal with the UK government for a guaranteed price of energy from Hinkley C once it becomes operational, and has also brought China General Nuclear Power Corporation (CGN) on board to help finance the project.

Nevertheless EDF's apparent inability to make a FID indicates that the firm is unsure it can finance the project, according to reports.

French newspaper *Les Echos* reported in February that the delay on the final investment decision was due to funding concerns. EDF has debts of €37 billion and its falling share price values the company at €21 billion. EDF needs to invest some €49 billion in its French nuclear fleet, and

is likely to seal a €2.1 billion deal to buy Areva's ailing nuclear power plant business, putting further pressure on its balance sheet.

According to the Stop Hinkley Campaign group, the EDF board has been unable to make the final investment decision because concerns about the project and its impact on EDF's finances have been expressed by the managers' union CFE-CGC, which has a seat on EDF's board.

Delays to Hinkley Point C could threaten the UK's planned nuclear new build programme and will lead to concerns about the country's looming supply gap.

The UK government has pledged to close all coal fired power plants by 2025 and wants new gas fired capacity, new nuclear and offshore wind to meet demand.

Next-generation technologies ready to boost offshore wind growth

- Siemens, GE bring new tech to market
- Denmark approves interconnector

New large-scale offshore wind technologies are poised to help the European offshore sector grow.

Siemens announced last month that its 7 MW-class direct drive wind turbine has successfully passed final type certification, while GE has completed the manufacture of its first serial permanent magnet generator (PMG) in its offshore wind factory in Saint-Nazaire, France.

Siemens said that field testing of the SWT-7.0-154 has been extended to a second prototype in Østerild, Denmark, and that grid performance, quality and safety are currently being tested on both units.

First orders for the SWT-7.0-154 are already in place, including the Walney Extension East project in the UK. "The development of our SWT-7.0-154 has reached the final stage and we are well on track," said Morten Rasmussen, Head of Technology at Siemens Wind Power and Renewables Division. "Serial production will be ramped up in

autumn 2017."

GE's Saint-Nazaire factory will manufacture 100 generators per year and will help GE to serve the French and wider European offshore wind markets. The 6 MW PMG is one of the world's largest generators ever built and the first unit will be installed in Denmark, GE said.

In February Nissum Bredning Vindmøllelaug won a tender held by the Danish Energy Agency calling for the construction of a test-bed for new offshore wind technologies. The project will include testing of four SWT-7.0-154 wind turbines and new gravity jacket foundations off Rønland in Denmark.

Separately, Denmark's Ministry for Energy, Utilities and Climate has approved Energinet.dk's application for a €320 million investment in a new 400 MW interconnection between one Danish and two German offshore wind farms in the Baltic Sea.

The interconnector will serve to link

the 600 MW Danish offshore wind farm Kriegers Flak via submarine cables which run from the German side to the two German offshore wind farms: the 48.3 MW Baltic 1 and the 288 MW Baltic 2.

The connection is a joint project between Energinet.dk and the German transmission system operator 50Hertz. It is the world's first interconnection between two countries that also connects two countries' offshore wind farms.

According to the European Wind Energy Association (EWEA), offshore wind investments in Europe doubled in 2015 to €13.3 billion.

EWEA's latest report shows that 3019 MW of new offshore capacity came on-line in 2015, bringing Europe's cumulative installed offshore capacity to 11 027 MW. An additional 3034 MW of capacity – spread across ten projects – reached final investment decision last year, a two-fold increase on 2014.

Aker starts carbon capture test project

- Technology first on WTE
- UK criticised for CCS stance

Aker Solutions has started a pioneering carbon capture project at a waste-to-energy (WTE) plant in Oslo, Norway.

The five-month test programme at the Klemetsrud plant is the first of its kind in the world for a WTE plant and comes after Aker signed a contract with the city government in December.

The project will test Aker's amine-based CO₂ capture technology and its application to the WTE sector. "We see potential in this market across the world," said Valborg Lundegaard, head of Aker Solutions' engineering business.

The project will use Aker Solutions' mobile test unit for carbon capture. The gas released from Klemetsrud contains about ten per cent CO₂ and is treated in several steps before it enters the mobile unit. Klemetsrud gets most of its feedstock from biomass and emits about 300 000 tons of CO₂ per year.

"We expect to capture up to 90 per cent of the CO₂," said Oscar Graff, Head of CCS at Aker Solutions. "The tests will verify important operating parameters such as energy consumption, solvent degradation, losses and required solvent make-up."

In the UK, a panel of lawmakers

have said that the government's decision to unexpectedly pull funding for carbon capture and storage (CCS) development was damaging to the relationship between government and industry and to investment in the UK.

The House of Commons Energy and Climate Change Committee published a report criticising the government's move, and warned that it would be challenging for the UK to meet its climate change commitments without using CCS on gas fired capacity.

"The Treasury's decision to renege on its promised CCS support is damaging for investor confidence and undermines the government's promise to tackle climate change as cheaply as possible," said Richard Black, director of the Energy and Climate Intelligence Unit (ECIU). "Although it may look a bit pricey up-front, CCS can play a very significant role in solving the energy 'trilemma' – decarbonising, allowing flexible gas fired power stations to keep running for years which aids energy security, and doing so cost-effectively."

"Cancelling it shows the folly of basing energy policy on short-term concerns about affordability – especially at a time when energy bills are falling."

Morocco connects first phase of Noor

■ \$3.9 billion NOORo I inaugurated ■ New report outlines role for solar thermal technology

| Siân Crampsie

The first phase of what is set to become the largest solar complex in the world has been completed.

Sener, Acciona and ACWA Power have formally inaugurated the 160 MWe NOORo I solar thermal power plant in Ouarzazate, Morocco. The plant is a key element of Morocco's ambitions to generate 52 per cent of its electricity needs from renewable sources by 2030.

NOORo I was constructed at a cost of \$3.9 billion and employs Sener's parabolic trough solar collectors

combined with a molten salt storage system that provides 3.5 hours of thermal energy storage.

Further phases of the \$8 billion NOOR project will bring its total capacity to 2 GW by 2020. The next two phases will comprise 350 MW solar thermal plants and will be operational by 2018.

The Noor project has been financed by a range of organisations including the World Bank and the Clean Technology Fund which both provided €150 million, and the African Development Bank which has contributed €168 million.

The European Investment Bank, Germany's KfW, and the French Development Agency have each contributed €100 million.

The European Union and Germany's Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety have also helped to finance the project with contributions of €30 million and €15 million, respectively.

A new report launched last month said that solar thermal electricity (STE) could supply as much as 12 per cent of the world's power needs by 2050.

The report, 'Solar Thermal Electricity Global Outlook 2016', released by Greenpeace International, SolarPACES and the European Solar Thermal Electricity Association (Estela), states that STE will be key to achieving a world powered by 100 per cent renewable energy by 2050.

"The importance of STE is its ability to harness the sun to provide round-the-clock energy, even when the sun isn't shining," said Dr Luis Crespo, President of Estela. "It unlocks a future of emission-free energy in sun-belt countries around the planet."

According to the report, the annual

market volume for STE hit the \$1 billion mark in 2009. Whilst the installed capacity of STE in 2006 was only 0.5 GW, it has increased by a factor of 10 to almost 5 GW today.

The STE sector is heading towards double digit GW capacity within the next five years, say the report's authors, who also highlighted the importance of the NOORo I project.

"Noor I isn't just a showcase for STE technology," said M. Bial, Estela Secretary General. "It shows that countries like Morocco can be leaders in renewable energy, setting the country on a path that Europe should follow."

ACWA seeks Middle East expansion

ACWA Power is planning to explore opportunities in power project development in the United Arab Emirates, Egypt and across the Middle East through a new venture with Silk Road Fund Co.

The two companies have signed a memorandum of understanding aimed at seeking opportunities for investment in power generation projects such as the 1200 MW Hassyan clean coal power plant in the UAE and the 2250 MW Dairut combined cycle power plant in Egypt.

ACWA Power will be responsible for the successful implementation and

development of the projects through to financial close, whilst Silk Road Fund will make equity investments in the projects, and provide the necessary debt financing.

"The Middle East and North Africa is one of the fastest growing in the world, so we see it as vitally important to support its sustainable economic development by increasing and improving its access to energy," said Wang Yanzhi, President, Silk Road Fund. "We believe that this partnership can continue to grow, increasing the future participation of Chinese companies in the region."

Investors have clear signal for green growth, says UN

The United Nations has called on the private sector to help mobilise billions of dollars of investment needed in clean energy.

UN Secretary-General Ban Ki-moon said last month that clean energy investment should double to \$660 billion by 2020 in order to catalyse a shift to a low-carbon green economy and build on the momentum generated at the recent Paris Climate summit.

At a meeting organised by Ceres, the UN Foundation and the UN Office for Partnerships in New York, Ban addressed more than 500 global investors and said: "Markets now have the clear signal they need to unleash the full

force of human ingenuity and scale up investments that can generate low-emissions resilient growth.

"The world now counts on you to act at the speed and scale needed to transform the global economy. To keep global temperature rise well below 2 degrees, and even 1.5 degrees, we must begin the shift away from fossil fuels immediately.

"We need a massive scaling up of investments in clean energy and energy efficiency."

"Investors are better positioned than ever before to address climate risks and seize the economic opportunities presented by clean energy," said Mindy Lubber, president of Ceres and

director of its Investor Network on Climate Risk (INCR). "Ultimately, global investment portfolios need to shift far more capital to low-carbon business activity and away from risky high carbon sectors that may perform poorly in the years ahead."

Lubber called on all investors globally to set ambitious clean energy investment commitments; establish clear goals for reducing carbon risk exposure in their portfolios; encourage regulators worldwide to implement mandatory climate risk disclosure requirements; and to continue advocating for policies such as economically meaningful carbon pricing and ending fossil fuel subsidies.

US pledges support for electrifying Africa

US lawmakers have passed a bill known as the Electrify Africa Act that aims to improve access to electricity in sub-Saharan countries.

The bill was last month sent to President Barack Obama for his signature. It provides a framework for public-private partnership between the United States and Sub-Saharan African countries, through which about 600 million people on the continent will have access to affordable and reliable

electricity.

The bill directs the president to establish a multi-year strategy to assist countries in sub-Saharan Africa in implementing national power strategies with a mix of energy solutions, including renewable energy sources. It will help to make the goals outlined in Obama's Power Africa initiative a reality by providing a framework for companies to invest in promoting energy solutions in Africa.

Egypt boosts capacity

Egypt is preparing to install the first gas turbines at the 4.8 GW Beni Suef power plant.

Siemens said that the two H-class gas turbines have started their journey to Egypt from Germany and are due to be installed in mid-May at the Beni Suef site, approximately 110 km south of Cairo.

The German firm is installing a total of eight SGT5-8000H gas turbines at Beni Suef in several phases. The power plant will initially be operated as a simple cycle gas fired power plant before being expanded to combined cycle operation.

"We expect the plant in Beni Suef to feed electricity into the Egyptian power grid as early as the winter of 2016/2017," said Willi Meixner, CEO

of Siemens Power and Gas Division.

Beni Suef is one of three gas fired power plants that Siemens will build in Egypt with a combined capacity of 14.4 GW. Financing for the projects will be provided by Deutsche Bank AG, HSBC Germany, and KfW Group.

Siemens has also sealed a number of deals to expand the country's wind energy sector.

"We see great potential for wind energy as a significant source of electricity generation in the Middle East," Emad Ghaly, Siemens Middle East's senior executive vice president of wind and renewables said at the World Future Energy Summit in Abu Dhabi. "Egypt, Morocco and Jordan are currently driving this development."

Siemens has signed around €8 billion of deals to build 12 wind farms in Egypt, which is aiming to become a regional hub for wind energy expertise. The German firm is planning to build a rotor blade manufacturing facility in Ain Sukhna, Egypt, while GE is also building a \$200 million wind energy manufacturing and training facility in the country.

Egypt has set a target of 2 GW of installed wind energy capacity by 2022 as well as 2 GW of solar and some 300 MW of hydropower.

In January, China agreed to provide \$3 million of financing to Egypt to support the development of renewable energy plants, including biomass facilities fuelled by agricultural waste.

Abengoa sets out plans for survival

Abengoa's latest business plan has been well received but the firm must convince its creditors of its viability if it is to avoid bankruptcy.

Siân Crampsie

Troubled Spanish renewable energy technology firm Abengoa has laid out its plans for the future.

The company has published an 'industrial viability' plan and says that it will soon publish a financial restructuring plan in a bid to avoid all-out insolvency.

Abengoa says that it needs €826 million this year and €304 million next year in addition to any cash it generates from asset sales. Its plans have been given a vote of confidence by ratings agency Moody's, which believes that Abengoa's underlying business is still viable.

Abengoa says that its business is worth seven times its liquidation value and that it intends to take key actions to reduce cash outflows, including the

disposal of non-core assets, reducing its cost base and exiting projects with higher cash requirements.

Abengoa is also planning to focus its business in the near-term on completing projects in its portfolio that will maximise value and carrying out turnkey projects for third parties. It is expecting to generate a cash flow of around €700 million by 2020.

Moody's, however, noted in February that "further sizeable liquidity injections" are needed to keep the business afloat. If Abengoa were forced to declare bankruptcy, it would be the largest in Spanish history.

Moody's said the company's plans support its view that "Abengoa's underlying operating business is viable" but the agency is maintaining a negative outlook because discussions over a debt restructuring "might not be suc-

cessful and the company might end up in a formal insolvency process".

Abengoa sought creditor protection in November through a Spanish pre-insolvency process, which is expected to last until the end of March. The firm's financial problems date back to Spain's 2013 energy reforms, which cut subsidies for renewable energy providers.

Last month Abengoa sold its 20 per cent stake in the Shams 1 solar energy project in the United Arab Emirates as part of its plans to cut debt.

Abu Dhabi-based Masdar has purchased Abengoa's share in the concentrating solar power plant project, bringing its stake to 80 per cent. France's Total continues to own the remaining 20 per cent stake.

In September, Abengoa's gross debt stood at €8.9 billion.



If Abengoa is forced to declare bankruptcy, it would be the largest in Spanish history

RWE sinks into the red

German utility RWE has suspended dividend payments to ordinary shareholders in a bid to strengthen the company's finances.

In an announcement in mid-February, the energy giant said that the earnings prospects of its conventional electricity generation business had further deteriorated and that it had achieved its operating earnings goals for 2015 despite the difficult conditions in the energy sector.

RWE said that its renewable energy division more than doubled its earnings in 2015 compared to 2014, but that €3 billion in write-downs and impairments resulted in the firm posting a €200 million net loss for the year, which the company described as "unusually weak".

Based on unaudited pro-forma figures, RWE posted an operating result of €3.8 billion, as well as €1.1 billion adjusted net income. The posted figures are within the ranges forecast by the company in March 2015.

At €7 billion, the company's EBITDA was much higher than expected due to special items.

The improved results from the utility's Renewables Division helped cushion the financial blow caused by deteriorating results in conventional power generation segments, where margins have deteriorated because of low energy prices.

In a statement, RWE said the continued collapse of wholesale electricity

prices "came to bear, leading to an erosion of power plant margins".

RWE is taking steps to reorganise its business, pooling the renewables, grids and supply units into a new subsidiary that will be listed on the stock exchange. The firm said it would increase this new company's capital by around ten per cent by the end of 2016 by issuing new shares, and use the proceeds to finance further growth.

This, and other moves, would equip the company "for difficult times while tapping into new business prospects at the same time," said Peter Terium, CEO of RWE AG. He added that the decision on dividend payments had "not come easily" but was "necessary in order to strengthen our company".

Terium recently said that he had decided to make innovation a priority of his leadership and announced the start of a range of collaborative projects with technology start-ups in the USA.

RWE New Ventures LLC, based in Silicon Valley, USA, has expanded its existing collaboration with KnGrid to gain a foothold in the US infrastructure market for EV charging points. It has also inked collaborations with Mach 49, Bidgely, and STEM.

RWE Group has announced that Arndt Neuhaus will step down as CEO and from other positions within the group. Dr Neuhaus's duties will be assumed by Bernd Boddeling, CFO of RWE Deutschland AG, until further notice.

Vattenfall, Statoil look to renewables investment

■ Statoil seeds venture fund ■ Vattenfall boosts wind prospects

Statoil says it will invest up to \$200 million in renewable energy projects over the next four to seven years through a new fund.

Statoil Energy Ventures plans to invest in offshore and onshore wind, solar energy, energy storage, transportation, energy efficiency and smart grids, and will form part of Statoil's new business area, known as New Energy Solutions.

The fund will take direct positions primarily as a minority shareholder in growth companies, preferably as a co-investor with other venture firms.

Investment in selected funds will also be considered to gain a wider footprint, Statoil said.

"Statoil Energy Ventures aims to be an attractive partner for growth companies," said Gareth Burns, vice president in Statoil and managing director of Statoil Energy Ventures.

Last month Vattenfall said that it had earmarked €1.5 billion for investment in renewable energy in the next two years.

The Swedish state-owned utility announced that the funds would help it to achieve its goal of adding 2300 MW

of installed wind capacity by 2020.

Renewable energy will account for 93 per cent of Vattenfall's growth investments over the next two years and will be financed in part through partnerships such as the one Vattenfall recently signed with the Swedish pension group AMF.

Vattenfall's wind segment generated 5.1 TWh of electricity in FY 2015, a 41.5 per cent increase compared to 4.1 TWh generated in FY 2014. The company's installed renewable capacity increased by a total of 445 MW in 2015.

Areva, EDF finalise negotiations

Areva moved a step closer to resolving its financial difficulties after its board of directors gave its CEO a mandate to finalise negotiations with EDF for the sale of majority interest in Areva NP.

EDF's board has agreed to take a controlling stake in Areva NP, a move it has made at the behest of the French state. EDF's offer values Areva NP, the reactor business of Areva, at €2.5 billion.

Areva also announced a €5 billion

capital increase that would be backed by the French state and would restore the firm's balance sheet.

Areva added that it would once again have a net loss in fiscal 2015 due to a number of provisions including its restructuring, costs related to the Olkiluoto 3 nuclear power plant in Finland, costs related to renewables contracts and an additional write-down of mining assets.

The company said, however, that its efforts in cost reduction and cash

management had improved its cash flow position and it had been able to postpone until early January 2016 the drawdown of back-up lines of credit of €2 billion that was initially planned for the third quarter of 2015.

Analysts have expressed concerns about the financial impact of the deal for EDF, which is attempting to secure financing for the construction of a new nuclear power plant at Hinkley Point in the UK.



Silicon Valley: RWE is focusing on innovation

10 | Tenders, Bids & Contracts

Americas

Holland Energy Park orders LV, MV equipment

Siemens has been chosen to supply low- and medium-voltage electrical equipment and power transformers for the new Holland Energy Park power plant in Holland, Michigan.

Siemens will install its SPPA-T3000 Distributed Control System technology, integrated with its medium- and low-voltage switchgear and low-voltage motor control centre for centralised monitoring and operation for the entire electrical system. The technology will include the latest arc-resistant switchgear, which allows workers to safely operate the electrical equipment.

The combined cycle power plant will replace an ageing coal fired power plant. Last year Siemens was chosen to supply two gas turbines and one steam turbine for the project.

Santo Domingo converts

Termochilca SA has placed an order with Siemens to upgrade the Santo Domingo de los Olleros power plant from simple cycle to combined cycle.

The conversion will add 100 MW to the output of the plant, which is located near Lima, Peru. Siemens will be responsible for full turnkey supply of the upgrade and will supply one SST-900 steam turbine, one SGen6-100A generator, a three-pressure heat recovery steam generator, and an air-cooled condenser.

Siemens handed over the Santo Domingo de los Olleros simple cycle plant in 2013, after a construction time of just 19 months. The plant is equipped with an SGT6-5000F gas turbine and currently has an overall installed rating of 200 MW.

The upgraded plant is scheduled to start commercial operations in 2018.

Nexans to provide cables for urban electric grid

Nexans is to supply a medium voltage high temperature superconducting (HTS) cable for American Superconductor (AMSC) for the firm's Resilient Electric Grid project in Chicago, USA.

Nexans will design and supply the cable, including terminations and a splice. Following the successful completion of this qualification cable, the project plan envisions the connection of substations in downtown Chicago by HTS cables in order to improve resiliency of the electrical grid against extreme weather or other catastrophic events.

This project is part of the US Department of Homeland Security's Resilient Electric Grid Program.

All necessary cable tests will be performed in the Nexans facility in Hannover, Germany, which is specially equipped to perform tests on superconducting systems for power grids.

Asia-Pacific

ZTT to supply offshore cables

Jiangsu Zhongtian Technology (ZTT) has won a contract to supply subsea cables for the 300 MW Huaneng Rudong offshore wind farm in China.

Under a €33 million contract with Huaneng Tendering, ZTT will supply 35 kV and 110 kV subsea cables for the wind farm, which is being developed in the East China Sea, off the coast of Jiangsu Province.

The wind farm will comprise fifty 4 MW and twenty 5 MW turbines. It

is being developed and is owned by China Huaneng Group.

Gamesa secures India contract

Gamesa has secured its first orders for its G114-2.0 MW turbine in India.

The Spanish wind turbine company has won two contracts for a total of 92 of its class S units to be installed and commissioned in 2016.

The first contract, for an independent power producer, is for the installation and commissioning of 50 G114-2.0 units in Andhra Pradesh state. The second, for an Indian renewable energy developer, is for 42 G114-2.0 MW units in the state of Karnataka.

Since 2009 Gamesa has installed almost 2270 MW of wind energy capacity in India, and currently services over 2000 MW in the country under O&M agreements.

MAN engines head for Dhaka

MAN Diesel & Turbo has been selected to supply six diesel engines for a new power plant in Bangladesh that will provide baseload power for the capital city of Dhaka.

The power plant will have an installed capacity of 111 MW and will be based on six 18V 48/60TS engines. The project is MAN's second for its customer, Maisha Group.

The engines will be delivered and commissioned in 2016.

BHEL wins supercritical order

Bharat Heavy Electrical Limited (BHEL) has won an order for an 800 MW supercritical power plant in Tamil Nadu, India.

The Tamil Nadu Generation and Distribution Corporation (Tangedco) has awarded BHEL the main plant package for the North Chennai Supercritical TPS Stage III plant, which will be the first supercritical power project in the state.

The project will be commissioned by August 2019, BHEL said.

Substations strengthen Singapore grid

SPPowergrid has placed an order with ABB to supply four 66 kV gas-insulated switchgear substations for the Singapore grid.

The project is part of SP PowerGrid's continuous efforts to strengthen the efficiency and reliability of its transmission and distribution networks and to meet the growing demand for power in Singapore's industrial, commercial and residential sectors.

ABB will design, engineer, supply and install the GIS substations, which include control and protection systems as well as ancillary equipment. The scope also includes the replacement of aging equipment at two existing facilities to strengthen the national grid by increasing capacity and enhancing power reliability.

The contract is scheduled to be completed in 2018.

Europe

Saxlund wins order from B&W

Babcock & Wilcox Volund A/S has placed an order with Saxlund International GmbH for the delivery of a biomass handling system for a new renewable energy plant in Teesside, UK.

The scope of the order includes the design, manufacture, delivery and commissioning of two automatic fuel

handling systems, the equivalent of 125 MW of fuel input. Both systems shall be installed for fuel reception, fuel feeding and mixing of fuel in the fuel storage.

The entire fuel feeding system, including wood storage and conveyor systems will be designed for multi-fuel waste wood, designed for efficiency, minimum maintenance and high availability as well as low emission of dust and noise.

Gamesa repowers Debstedt wind farm

Energiekontor has placed an order with Gamesa for the repowering of the Debstedt wind farm in Lower Saxony, Germany.

Gamesa will supply three G128-4.5 MW wind turbines to replace the eleven 1 MW units currently installed at the site. The annual output of the wind farm will be doubled after the new units are installed, Gamesa said in a statement.

"This contract marks a milestone in our strategy for Northern Europe as it is the first order to supply the G128-4.5 MW in such a competitive market as Germany," said Martin G. Hake, Head of Sales for Gamesa in Germany.

Delivery of the turbines will begin in August 2016 and the refitted facility is slated for commissioning in December. Gamesa will also operate and maintain the facility for 18 years.

Senvion wind Freasdale order

Senvion has won a contract to supply the turbines for the Freasdale wind farm in Scotland.

The 22.55 MW project is being developed on the Kintyre peninsula on the west coast of Scotland by RES. The first turbines are scheduled for delivery in late 2016. Senvion's contract includes a five-year maintenance contract.

Impax orders Vestas units

Impax Asset Management has placed an order with Vestas for 11 wind turbines for a project in Ireland.

Vestas will supply its V112-3.3MW units for the Glanaruddery wind farm in County Kerry. It will also be responsible for delivery, installation and commissioning, and is providing a 12-year active output management service agreement.

Delivery and installation are expected in the third quarter of 2016 with commissioning expected in the fourth quarter of 2016.

Plutus awarded standby generation contracts

Plutus PowerGen (PPG) has been awarded two further management contracts for the construction and operation of 20 MW flexible standby by electricity plants, by SelectGen Limited and Reliance Generation Limited.

This agreement brings the total number of management contracts granted to PPG to nine, equivalent to 180 MW. Under the agreements, PPG will be paid £150 000 per annum by each company for these services in addition to an equity stake of 45 per cent in the capital of each company.

Tri-generation plant enters service

GE has announced that its Jenbacher J312 gas engine at Ramaplast S.p.A.'s tri-generation plant in Italy has started commercial operation.

The tri-generation plant, located in Castelnuovo Scrivia, in the Piemonte

region, provides heating, cooling and power for Ramaplast, which produces plastic boxes for uses such as pill containers. The plant can operate in backup power and island modes, with the gas engine supplying power to the main plant when disconnected from the national grid and with an import/export control known as the "scambio zero" feature.

This feature means that the gas engine can produce 50-100 per cent of the electrical power for the factory without using electricity from Italy's grid. It also is possible to sell the power to the national grid.

International

Siemens wins turnkey order for Azura-Edo

Independent power producer (IPP) Azura Power West Africa has placed a turnkey order with Siemens for the key components of the Azura-Edo power plant in southern Nigeria.

The 459 MW gas fired power plant, which will be located near the town of Benin City, will be built by Siemens in collaboration with local construction company Julius Berger Nigeria plc.

Siemens will supply three SGT5-2000E gas turbines, three SGen-100A generators as well as an SPPA-T3000 control system for the turbines.

Siemens will also provide maintenance and servicing for the plant under a 12-year contract.

Skytron chosen for SA solar plant

Skytron Energy has been selected to fit out one of the largest solar power plants in Africa with monitoring, control and supervision technology.

The 86.2 MWp Mulilo Sonnedix Prieska photovoltaic (PV) plant will be completed in July 2016 near Prieska, Northern Cape province.

Skytron will provide its PV Guard Scada software, the skycontrol power plant control system, an on-site skylog data logger system, the on-site data server skyserv, 600 ArrayGuard FH combiner boxes and several skyCONNI-Sun universal weather units.

Prieska is one of the utility-scale photovoltaic projects approved by South Africa's Renewable Energy Independent Power Producers Procurement Programme (REIPPPP), which calls for the development of 18 GW of renewable energy by 2030, 8.4 GW of which has been allocated to solar power.

LTSAs signed for Egyptian gas turbines

Siemens has signed an agreement to extend a long-term contract to provide service and maintenance, as well as component upgrades, at the Nubaria, Talkha and El Kureimat power stations in Egypt.

The 10-year extension calls for Siemens to continue providing service and maintenance for eight SGT5-4000F gas turbines and the associated generators.

In addition to long-term service and maintenance, the scope of the new agreement for the three power stations includes several modernisation and upgrade measures for the eight gas turbines in order to improve operational flexibility.

Siemens will also upgrade the gas turbine controls equipment to its SPPA-T3000 control system.

The upgrade will enable the plant operator to make faster, informed decisions in daily operation of the plant. A training programme for the power plant personnel is also part of this new agreement.



Fuel Watch

Oil

Crude price expected to hover in \$30/b range for near future

- Saudi confident production freeze will stick
- Market rebalance will begin in 2017

David Gregory

By late February the best that Brent crude was able to do was a little over \$34/b, and for the immediate future the price of oil is unlikely to go much higher.

Saudi Arabian Oil Minister Ali al-Naimi told a major oil and gas conference in Houston in late February that he was confident that a freeze on January production levels agreed by Saudi Arabia and Russia a week earlier would stick if other important oil producers follow suit. He said it was useless to ask producers to cut crude production or adhere to a production cut even if an agreement were made. Most people in the oil industry know this well enough by now. Discipline is not an oil producer's strongest trait.

Naimi said Saudi Arabia was not concerned about global demand, freezing production would eventually take excess crude out of the oil market and prices would pick up, he said. Saudi Arabia could survive with an oil price at \$20/b, he said, adding that inefficient, uneconomic producers would have to get out of the market. Naimi said that high-cost

producers would have to lower costs, borrow money or liquidate.

That would be the most efficient way for the market to rebalance, he said, adding that an inevitable reckoning would come that would eventually allow for supply and demand to realign.

Saudi Arabia's production is more than 10 million b/d, and Naimi said his country had no intention of cutting back. Besides Russia, Qatar and Venezuela agreed to freeze output.

But Iranian Oil Minister Bijan Namdar Zangeneh dismissed Riyadh's proposal for a production freeze as ridiculous, saying that it makes "unrealistic demands" of Iran, which is planning to boost production and exports in an attempt to recapture its share of the market after several years of economic sanctions forced it to cut production and curtail exports.

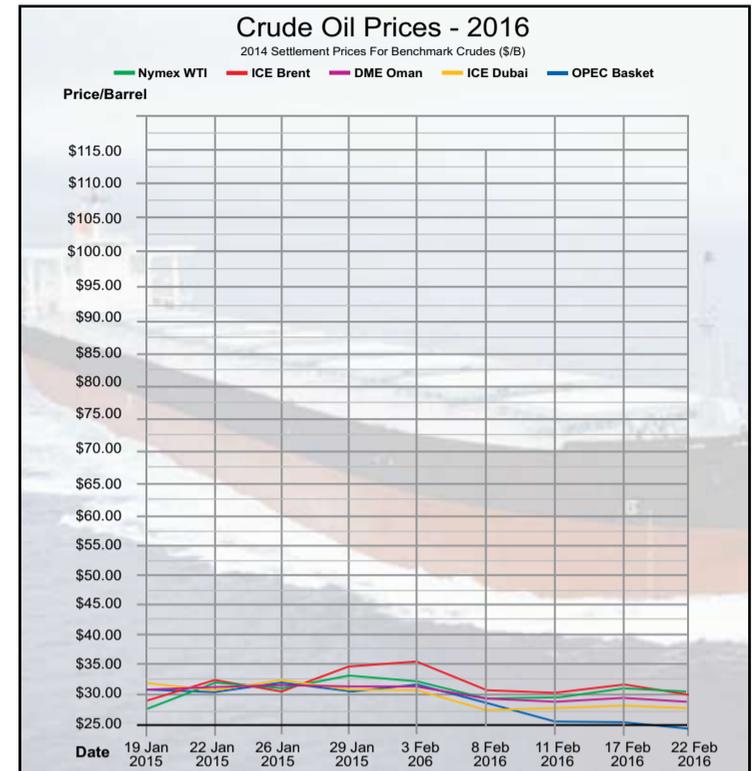
Iran is hoping to bring production to near 4 million b/d by the end of the decade and has targeted Europe as a primary market. It has already signed a 60 000 b/d deal with Greece. Iran also seeks to recapture lost markets in Asia, particularly China, where the economy is slowing.

The push for more output from Iran and continuing gains in production in Iraq will likely keep the market overstocked for many months to come, even if Saudi Arabia and Russia stick to the production freeze.

With US production still high and stocks at record levels, and Asia economies taking a downturn, some analysts have forecasts that oil prices could hit \$25/b in the coming months. And some see prices in the current range for another 18 months.

Another consideration is that while US shale producers are being forced to shut down because of falling prices, their operations will come back into production once prices go back up. US shale producers have been hit the hardest by Saudi oil policy and more than 40 US oil firms have declared bankruptcy over the last year. More are expected, but the current situation will not spell the end of the shale oil industry.

According to the latest edition of the *Medium-Term Oil Market Report*, released by the International Energy Agency (IEA) in late February, US oil production is expected to hit 14.2 million b/d by 2021, although it will



decline in the short term. Terming shale as light, tight oil (LTO), the IEA report said shale output would decline by 0.6 million b/d during 2016 and fall by a further 0.2 million b/d in 2017 "before a gradual recovery in oil prices, combined with further improvements in operational efficiencies and cost cutting, allows production to resume its upward climb."

The US will remain as the largest contributor to supply growth during the five-year forecast period, accounting for more than two-thirds of the net non-Opec increase, the report said. Opec member Iran will boost production by 1 million b/d to 3.9 million b/d by 2021.

But it will take until 2017 before the market begins to see a return to a balance in fundamentals, the IEA report said. Lower prices, however, will likely result in a decline in investment that could lead to a risk that the market will experience a spike in price near 2021.

It said the belief that balance would return to the oil market in 2015 was "wide of the mark," and that rebalance would only begin to happen in 2017. However, the enormous accumulation of stocks will act as a "dampener" on the pace of recovery in prices once the market begins to draw down those stocks.

Gas

US shale gas debuts on global LNG market

US shale gas has been introduced to the global market in the form of LNG from Cheniere Energy, prompting concerns of further pressure on global LNG prices.

Mark Goetz

The first shipment of LNG from the US embarked from the Sabine Pass terminal in Cameron Parish, Louisiana, for Brazil on February 24. The introduction of US gas on the international market has raised concern that it will put further downward pressure on global LNG prices, but US producers are hoping LNG exports will ease the gas glut that has come about through the advent of hydraulic fracturing (fracking). The gas surplus has forced US gas prices down to their lowest levels in 10 years.

Cheniere Energy is the first US company to produce LNG for export and several others are in the course of bringing liquefaction trains online. But industry analysts point out that the market has changed considerably since the LNG bug first bit in the US due to the fact that gas prices have declined and because there is a lot of

production capacity preparing to come on-stream in the near future.

As of January this year, the Federal Energy Regulatory Commission (FERC) has approved seven LNG export terminals, all of them located on the east or Gulf coast. Another 23 are awaiting approval. For its part, Canada has approved three export sites and approval for another three is pending.

Cheniere Energy has invested \$18 billion in the construction of six LNG trains at Sabine Pass, each with a production capacity of 4.5 million tons annually for a total of 27 million tons per year. Five trains at Sabine Pass remain under construction. The train that produced the first shipment has yet to reach full capacity, but will do so as other trains come online in the months ahead. Cheniere also has under construction two more trains at Corpus Christi, Texas.

"This historic event opens a new chapter for the country in energy trade

and is a significant milestone for Cheniere," acting company chairman Neal Shear said. The company plans to ship 8-10 more cargoes in the next two months on a spot basis. Those cargoes are expected to go to either Europe or Brazil.

Besides Sabine Pass LNG, other companies that will be coming into operation are Cameron LNG, Freeport LNG, Cove Point LNG, Corpus Christi LNG, Sabine Pass Liquefaction, and Lake Charles LNG. With the exception of Cove Point, which is located in Maryland, the others are situated in Texas or Louisiana.

US LNG is expected to have a significant impact on world prices. Analysts forecast a dramatic impact on LNG prices for Europe and Asia, and sellers are expected to have to offer flexible terms and low prices in order to compete. Most LNG is sold under long-term contracts or for small short-term contracts with contract prices

linked to other fuels. Some analysts see the market expanding with as much as 50 per cent of production sold on a short-term basis compared to only 30 per cent today.

One consideration for US LNG is it possibly providing Europe with an alternative to Russian gas, which accounts for as much as 40 per cent of Europe's supply. There has been talk of US LNG being delivered to Ukraine via a new LNG import terminal based in the northern Aegean Sea in Greece. A pipeline from there would deliver the gas to Southeast Europe and to Ukraine. There is also speculation of US LNG deliveries to northern Europe and the Baltic States.

However, most US LNG producers got into the business when fracking was beginning to show that it could produce large volumes of natural gas and international gas prices were high. Cheniere has been lucky enough to sign take-or-pay contracts

with buyers that cover 87 per cent of its production.

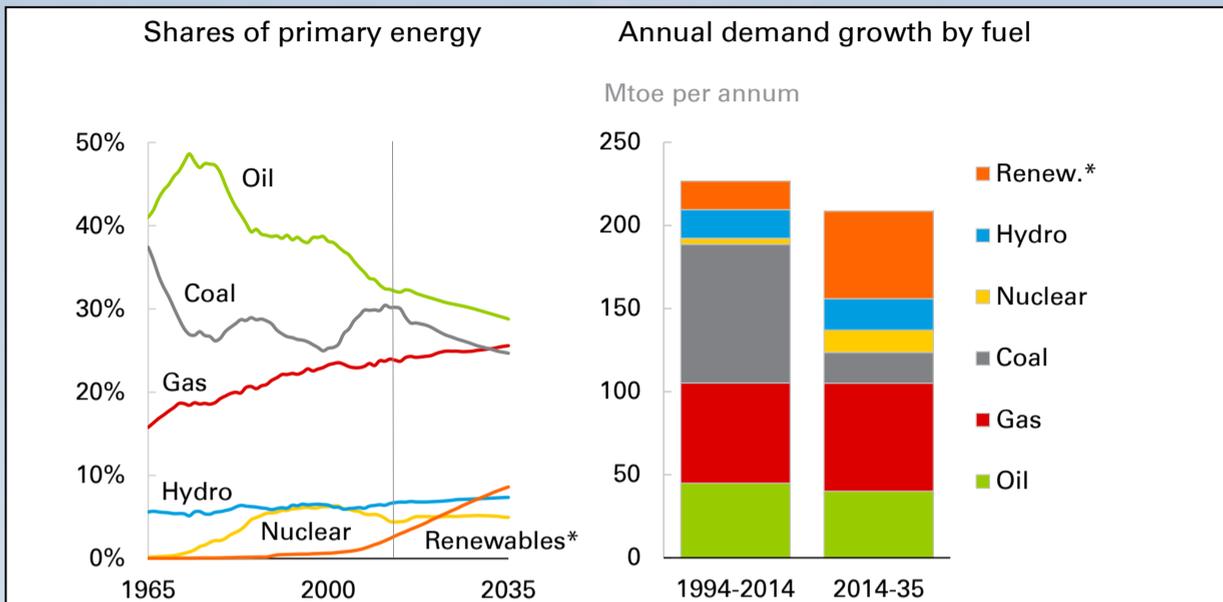
Cheniere has contracts to sell 42 cargoes of Sabine Pass LNG to France's EDF Trading between 2016 and 2018. Another 12 cargoes will go to France's Engie between 2018 and 2023. Those shipments will begin once the first export train is fully commissioned in April or May.

Meanwhile, Cheniere is searching for a new CEO to replace company founder Charif Souki, who was ousted in December for wanting to expand the company with more trains too quickly. Board members aligned with investor Carl Icahn argued that the company should concentrate on getting the current project completed and generating cash flow.

Souki announced in late February that he had formed a new LNG development company called Tellurian Investments that would pursue the projects that the Cheniere board rejected.

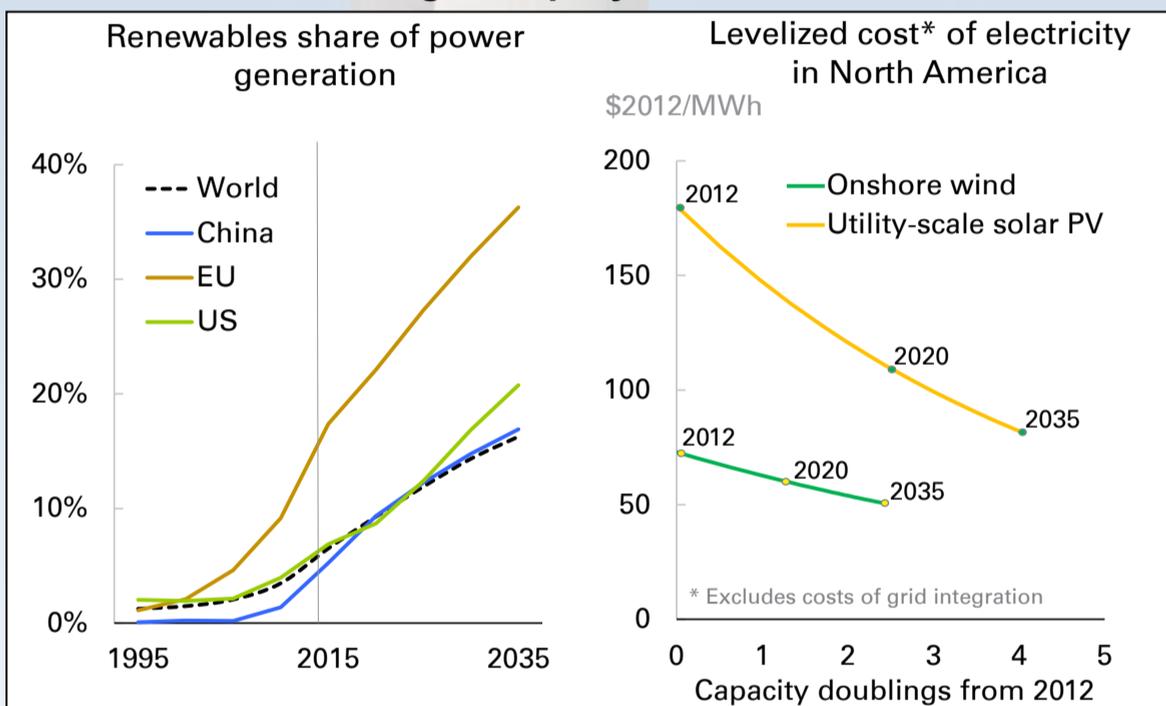
12 | Energy Industry Data

The fuel mix is set to change significantly

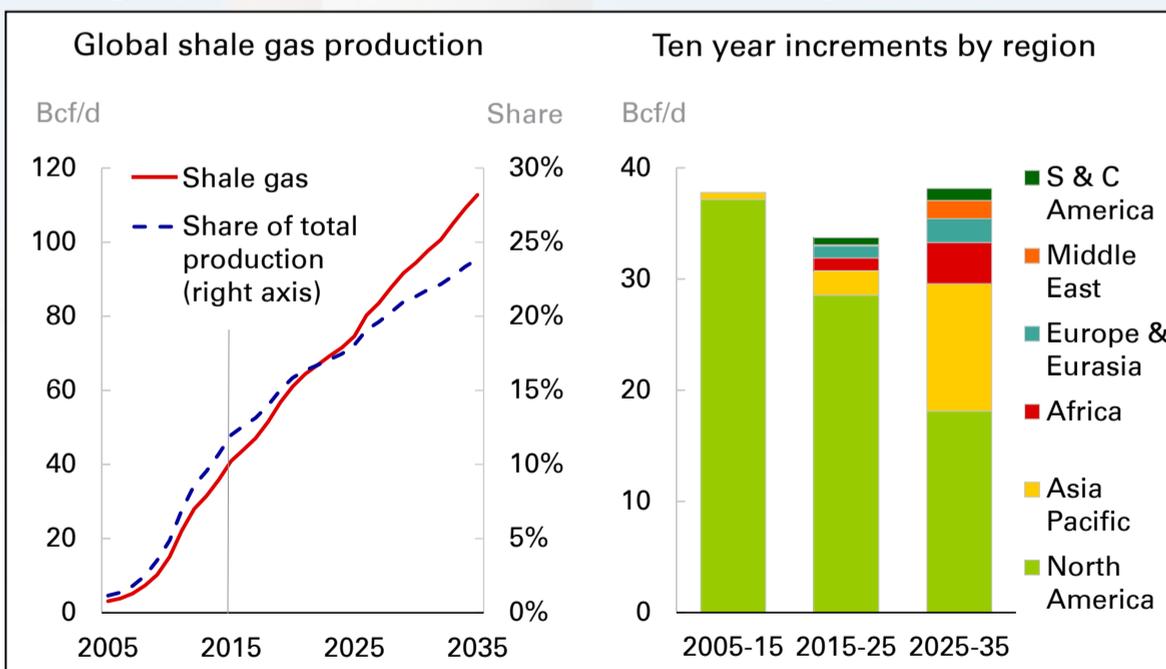


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Renewables continue to grow rapidly



Shale gas production continues to expand rapidly



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Poland's government is under national pressure to preserve its coal sector. At the same time it has to meet its EU obligations on climate commitments. *TEI Times* hears why diversification is its only choice.

Ian Wood and Rob Broom

Poland is amongst the least carbon efficient member states of the EU due to its extraordinary dependence on coal. Hard coal and lignite-fired power plants produce around 85 per cent of Poland's electricity and currently renewables meet around 10 per cent of the country's energy needs, compared with the average of around 20 per cent in EU member countries.

Poland's conservative Law and Justice Party (PiS), which came into power in October has pledged to save the loss-making, state subsidised coal sector. However, fulfilling this promise to the electorate and adhering to its legal obligations under the Industrial Emissions Directive (Directive 2010/75/EU) and the Renewable Energy Directive (Directive 2009/28/EC) will present a challenge, especially when the message is clear – the future of Europe lies in renewables and investing in coal technologies, which are harmful to the environment, may prove unprofitable in the long term.

Perhaps an obvious point therefore but nonetheless worth making, is that Poland should diversify its energy mix from coal and step-up the pace of developing nuclear and renewable energy rather than prioritising the replacement of old coal plants with new more efficient coal plant that produce less greenhouse gas emissions.

Poland's coal mining sector is affected by the plummeting coal prices caused by global oversupply, decreasing demand and high production costs. In 2015 the sector made a net loss of Zloty1.67 billion (\$420.7 million) and lost Zloty21.98 on every metric tonne of coal sold in the first three quarters of that year.

This drop in profitability in the coal

mining sector has forced foreign utilities to exit the Polish market. In mid-2015, Engie (formerly GDF Suez) confirmed it would abandon its plants to build a 500 MW coal fired plant in Łęczna in southeast Poland. Similarly, French utility, EDF (which holds a 15 per cent share of the heating market) last January launched a sale of its Polish coal fired heating and power plants, worth up to Zloty2 billion (\$498 million). The sale includes EDF's 1.7 GW coal fired power station located in Rybnik, which generates about 7 per cent of the electricity consumed in Poland.

In a bid to maintain around 100 000 jobs (the majority of which are located in Upper Silesia) the Polish government has spent billions of Zlotys in subsidies. From 1990 to 2012 this totalled Zloty170 billion. Poland's (and the EU's) biggest miner Kompania Węglowa ('KW') is currently seeking an injection of Zloty1.5 billion to assist with a restructuring project, which involves transferring 11 of KW's mines to a new single entity, in a bid to lower the average cost of coal production to Zloty 214 per metric tonne by 2017. In December last year, PiS approved a bill that allows the coal sector to continue functioning until 2019 without closing any mines.

Currently, Poland is building around 14 new coal fired power plants all at various stages of planning and construction, although not all may be completed. It is anticipated that four new coal fired power plants are expected to come on line by 2019, as the country faces a deficit of around 8 GW of capacity starting in 2020, once the EU's Industrial Emissions Directive kicks in. The

regulations will force dirty generation units to shut down and Poland is desperately seeking to replace them.

New coal power production will therefore require expensive carbon capture and storage so as not to fall foul of EU emissions quotas. Even if the plants produce less emissions, the use of coal in household heating has created high levels of potentially cancerous and life threatening dust particles. In Krakow, Poland's second city, local authorities approved a ban for citizens (effective from August 1, 2019) from heating their homes with coal and wood after figures showed the town's atmosphere is among the worst polluted in Europe.

Progress to develop nuclear capacity has been rather slow. In 2009, the Polish government made Poland's largest utility, Polska Grupa Energetyczna SA (PGE) responsible for leading an investment to build the country's first two nuclear power plants with a combined capacity of 6 GW. PGE (which supplies 42 per cent of Poland's electricity) hopes that by 2035, 36 per cent of its electricity generated will be from these two plants, the rest will be from gas (11 per cent), renewables (14 per cent), lignite (33 per cent) and coal 5 per cent.

PGE and Polish state-controlled utilities Tauron Polska Energia SA, Enea SA and copper miner KGHM are likely to be co-investors in the first 3 GW plant. Progress has been slow and plans to build the first 3 GW plant by 2024 have been pushed back to 2027. Perhaps consolidation in Poland's power industry through the merger of PGE, Tauron, Energa and Enea into two groups, a plan initiated by PiS and which will be sub-

ject to competition approval by the EU Commission, could speed up the process.

PGE EJ1, the nuclear power subsidiary of PGE is looking for strategic partners, this is believed to have been one of the main goals behind President Duda's visit to Beijing last November, where a Chinese-Polish memorandum for the construction of a nuclear plant in Poland was signed. However even with a strategic partner signed up (and this is not clear), generating by 2027 remains an ambitious target given the delays besetting other nuclear new build programmes across the globe.

Despite PiS' pursuit to save the coal sector, it will need to comply with the 15 per cent renewable energy target for final energy consumption by 2020. This target is encompassed in Poland's National Renewable Energy Action Commissioned by Directive 2009/28/EC. According to the Polish Geological Institute, the resources of renewable energy in Poland is estimated as follows: (i) hydropower – 12-15 TWh/year, (ii) biomass resources – approximately 750 PJ/year and (iii) wind energy, which could cover 12 per cent of Poland's electricity requirements – gross demand for domestic electricity in 2015 was 152.8 TWh.

Clearly, the theoretical potential for wind is substantial in Poland. However, in June 2015, PiS contemplated raising the minimum distance between wind turbines and dwellings to 3 km due to concerns over the impact wind turbines would have on the Polish landscape, this measure could have severely impacted the on-shore wind industry.

Full utilisation of the wind potential has not been reached. In 2015 wind generation accounted for 6.2 per cent of Poland's total electricity generation. In addition, the Polish Renewable Energy Act which is designed to incentivise renewable energy investment by providing a feed-in-tariff (FiT) for micro-generation (up to 10 kW) and replacing the green certificate system with auctions was due to take effect on January 1, 2016. However, a recent amendment by the PiS adopted on December 29, 2015 delayed the Act's implementation until 30 June 2016.

Signing the COP21 deal in December, Poland obtained the best agreement it could have hoped for. Rather than rule out the use of coal, the deal set out a framework for more sustainable development, including achieving balance between emissions and absorptions, e.g. by forests.

There is no doubt coal has a place in Poland's energy mix, but diversification through nuclear and the full utilisation of renewables potential will be the real answer to complying with international obligations.

Ian Wood and Rob Broom are Partner and Energy Specialist, respectively, at King & Wood Mallesons, Energy & Infrastructure – EMEA



Wood: Poland needs to step-up the pace on nuclear and renewables



Broom: Full utilisation of the wind potential has not been reached

Turning up the heat on coal

With carbon capture and storage facing economic challenges, the Electric Power Research Institute (EPRI) has conducted a study that finds several technologies are available or in development that have the potential to enable power plants fuelled solely by coal to significantly reduce CO₂ emissions through more efficient combustion and use of heat. **Jeff Phillips**

Technologies considered in EPRI's analysis, relative to EPA's standard

Current carbon capture and storage (CCS) technologies and anticipated near-term commercial offerings for systems to reduce carbon dioxide (CO₂) emissions from fossil-fueled generating plants will not only increase capital costs but also impose significant performance penalties, challenging the competitiveness of new coal generation. Further, many locations lack suitable geology for CO₂ storage, one of several factors expected to constrain CCS deployment.

This poses the question: is technology available or in development that would enable power plants fuelled solely by coal to operate so efficiently that a CO₂ emission standard of 636 kg/MWh (1400 lb/MWh) or less could be met without partial CCS?

A new white paper, 'Can Future Coal Power Plants Meet CO₂ Emission Standards Without Carbon Capture and Storage' published by the Electric Power Research Institute (EPRI), believes the answer is a qualified "yes".

The pressure facing today's coal fired generators is global and the COP21 climate change agreement will only add further burden.

On August 3, 2015, the US Environmental Protection Agency (EPA) released its 'new source performance standard' (NSPS), requiring new coal power plants in the United States to emit no more than 636 kg (1400 lb) of CO₂ per megawatt-hour (MWh) of gross power produced. Current state-of-the-art coal-fired plants, based on operations at ultra-supercritical (USC) steam conditions above 593°C (1100°F), emit approximately 800 kg (1760 lb) CO₂/MWh. Several US states and a number of countries have announced or are considering similar

restrictions on CO₂ emissions from new coal fired plants.

Except in China, existing and proposed government standards for CO₂ emissions cannot be met solely by building an efficient coal power plant using current state-of-the-art USC technology. To achieve EPA's limit, the conventional wisdom is that more than 20 per cent of a new US coal plant's CO₂ emissions would have to be captured for long-term sequestration.

Carbon capture with underground storage has been deemed by EPA as the "best system of emission reduction," but applications are constrained by technology, policy, and market factors. Power plant developers evaluating possible investments are reluctant to consider new coal generation due to uncertainty, the cost of capture, and the difficulty in finding a suitable storage location.

Some industry executives are beginning to wonder if an easier path to regulatory compliance might be found through advanced coal technology. The answer is clear: without CCS, a CO₂ limit of 636 kg/MWh (1400 lb/MWh) or lower can only be achieved by increasing the thermal efficiency of the energy conversion processes involved in generating electricity from coal – a challenge more easily stated than accomplished. EPRI found:

■ Even with steam temperatures exceeding 800°C (1500°F) – some 200°C (360°F) higher than those currently achievable – USC coal plants based on the conventional Rankine steam-electric cycle alone are not capable of meeting the standard.

■ USC plants used in high efficiency combined heat and power applications are capable of meeting the standard – but only at sites with "thermal hosts"

Country or US State	Standard
	CO₂/MWh
United States	636 kg (1400 lb) gross
California	500 kg (1100 lb) net
Maine	500 kg (1100 lb) net
Washington	500 kg (1100 lb) net
New York	420 kg (925 lb) net
United Kingdom	450 kg (992 lb) net
Canada	420 kg (925 lb) net
China	763 kg (1679 lb) net

Recent CO₂ emission standards for new coal plants

capable of using large volumes of steam.

■ Gasifying coal then firing the synthesis gas in a conventional combined cycle configuration can meet the standard – but only for certain types of gasifiers, and only when the integrated plant is fuelled by high quality coal.

■ Assuming further technological progress, coal gasification provides multiple pathways for achieving the standard, including gasifiers integrated with: solid oxide fuel cells; combined cycle plants having firing temperatures for the combustion turbine approaching 1700°C (3100°F); or with novel cycle designs.

■ Power producers interested in new coal plants could explore potential thermal hosts for combined heat and power (CHP, also known as cogeneration or "cogen") projects or the economics of gasifying and firing high-quality coal.

CHP plants can achieve very high utilisation rates. The technology is commercially mature. Examples of typical "thermal hosts" for the exported heat from CHP plants are oil refineries, food processing facilities, and central heating districts for commercial buildings, large hotels, hospitals, and university campuses.

Because exported heat can displace the burning of fossil fuel that would otherwise have been used to generate heat at the thermal host's location, EPA's standard offers CHP plants full credit for any heat that is exported and put to good use, as determined by a specific formula.

State-of-the-art USC technology operating in a CHP configuration can meet the EPA emissions target, but only at power plant sites near a refinery or other thermal host large enough to utilise at least 14 per cent of the steam exiting the intermediate-pressure turbine. CHP plants based on advanced USC steam conditions (760°C; 1400°F) represent a possible future option with potential for meeting EPA's standard as well as the limits of 500 kg/MWh (1100 lb/MWh) and lower proposed or existing in US states and nations such as the UK and Canada.

To assess the CO₂ emission intensity of cogen applications based on EPA's formula, EPRI explored four CHP cases, one based on current USC steam conditions and the others starting from an advanced USC plant design with a main steam pressure of 276 bar (4000 psi) and main and re-heat steam temperature of 760°C (1400°F). The latter three cases are based on extracting 12.5 per cent, 25 per cent, and 50 per cent of the steam at the crossover between the intermediate- and low-pressure turbine sections.

EPA's standard of 636 kg/MWh (1400 lb/MWh) could be achieved by a new cogen plant based on current

state-of-the-art USC technology like that employed at American Electric Power's John W. Turk, Jr. Power Plant, but also incorporating at least 14 per cent steam extraction and utilisation. The limit also could be met by using at least 12.5 per cent of the steam from an advanced USC plant.

Lower standards set by US states and other nations could be achieved based on higher CHP fractions. However, scale is an issue. An advanced USC plant producing nominally 750 MW of net electric power with 12.5 per cent steam extraction would require a thermal load of approximately 150 MW – about 50 kg/s (0.4 million lb/h) of steam at 4.7 bara (68 psia) and 367°C (693°F). As a point of reference, the cogen plant supplying steam to Total's Gonfreville refinery in Normandy, France, has a thermal load of 330 MW.

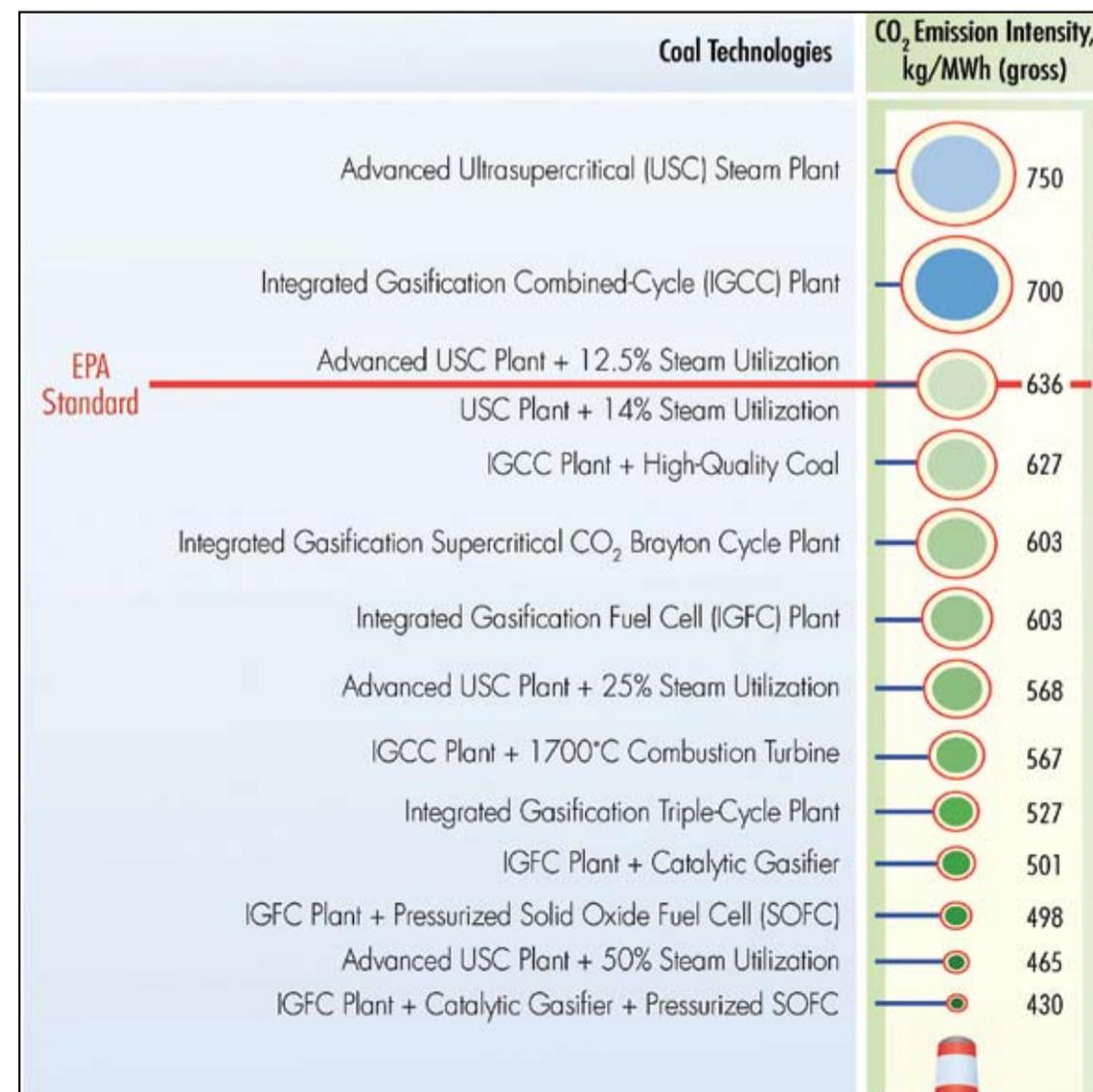
Because only a modest number of thermal loads sized at 150 MW or larger are likely to be available, smaller advanced USC plants operating in CHP mode may represent a more widely applicable approach for achieving a CO₂ emission intensity of 636 kg/MWh (1400 lb/MWh) or lower.

In summary, of all the options firing sub-bituminous coal considered in EPRI's analysis, none with potential to meet the standard are commercially available, economically viable, and suitable for broad deployment.

To help expand the available options for generating electricity with coal while achieving CO₂ emission standards, additional public-private R&D investment is needed to accelerate the commercialisation of solid oxide fuel cell (SOFC) technologies, higher-temperature turbines capable of operating on coal-derived syngas, and supercritical carbon dioxide (SCo₂) Brayton cycles.

National R&D programmes in the US, Japan, and elsewhere are making progress. Greater resources and increased collaboration are recommended due to the challenges facing CCS deployment. In addition, a study of existing and potential future thermal hosts capable of accommodating large volumes of steam in the US and other countries is recommended. This would help determine the extent to which the CHP option may be available for building new coal fired power plants and achieving CO₂ emission standards without the need for partial CCS.

The paper – 'Can Future Coal Power Plants Meet CO₂ Emission Standards Without Carbon Capture and Storage' (EPRI report 3002006770) – is available at www.epri.com. Its author, Jeff Phillips, is Senior Program Manager, Advanced Generation at EPRI, responsible for managing advanced coal R&D.



A soft approach to matching supply and demand

Making the grid and energy markets reliable again in the face of an increasingly distributed generation landscape and unpredictable demand is the vision of one US software and data analytics company. **Junior Isles reports**

There is significant evidence to suggest that the power sector in many parts of the world is moving away from large centralised power generation towards more small-scale distributed generating sources.

But following load demand in an energy landscape where generating sources might include intermittent renewables, storage, excess power

with a lot of certainty on the demand side as well as on the supply side, with large very controllable power plants. Now we have generation in the distribution grids, which is causing some problems. Our vision is to make the grid and the energy markets reliable again."

One way the company is doing this is by managing demand flexibility. In the US, for example, this is often through behavioural demand response programmes that help reduce energy loads during peak price times.

In June last year, Bonneville Power Administration (BPA), an agency of the US Department of Energy responsible for delivering and managing power across the Pacific Northwest, said the use of AutoGrid's Demand Response Optimization & Management System (DROMS) had allowed it to shed more than 500 MWh. BPA said it had been using DROMS since February 2015 to schedule and signal demand response (DR) events, executing more than 20 events in the range of 18-28 MW between the February to June period.

The company has over 15 customers for DR programmes in the US – these projects range from peak-time reduction, behavioural DR, automated DR, to integrating renewables.

"There are a huge range of projects," noted Dr Stechert, "from peak-time demand reduction, all the way to what we call 'bring your own thing'. It doesn't matter what device you have at home – it could be a thermostat from Schneider or a Nest device from Google – it could be any device in the home that has some flexibility and is connected to the energy internet. It can be signed up with the local utility, which can let you partake in the value you're adding or offer you a cheaper tariff in return for being allowed to, say, change your thermostat setting."

The incentive for households to do this is not insignificant; AutoGrid talks of potential savings of \$300/year per household.

But the use of such technology is not limited to DR programmes. In December last year Electro Power Systems (EPS), a supplier of smart oxygen and hydrogen-based integrated systems for clean energy storage, selected AutoGrid's Predictive Controls technology to build and operate 'Software-Defined Power Plants' with their energy storage systems.

AutoGrid's Predictive Controls technology provides EPS customers with the ability to forecast, optimise and control a portfolio of energy storage systems, along with other distributed energy resources such as combined heat and power (CHP) plants, solar power systems and demand response resources, in real-time and at scale. These software capabilities enable EPS' customers to: create software-defined power plants that aggregate storage and other distributed energy resources into a single flexible dispatch-grade resource, which they can use to reduce their demand charges; to participate in utility demand response programmes; or to trade directly in

electricity markets.

According to AutoGrid, the implementation of software-defined power plants is an area that is receiving growing attention, especially in Europe.

Towards the end of last year, Dutch sustainable energy group Eneco also selected AutoGrid's Predictive Controls technology and its DROMS application to build and deploy what is claimed to be the industry's first software-defined power plant.

Explaining the driver behind Eneco's decision, Dr Stechert said: "Eneco has a big risk in its portfolio, since it has a lot of wind generation. If its forecast is off, or there's a mismatch between the wind generation, which they cannot control, and the demand, which they also cannot control, they need some flexibility from a grid perspective but mostly from a market perspective to hedge against the risk. So what we have done for them is to create a virtual power plant that behaves just like a real power plant, where energy production can be increased or decreased very quickly."

AutoGrid's Predictive Controls technology platform provides Eneco with the ability to forecast, optimise and control a vast network of distributed energy resources in real-time and at scale – a capability the company says is unique.

The software-defined power plant integrates flexibility from customer-owned CHP units in greenhouses, industrial demand response, and other flexible distributed energy resources into a single, reliable resource. The aggregated 100 MW generating resource, allows Eneco to react in real-time to market signals from Dutch wholesale electricity markets run by the Dutch Transmission System Operator (TSO), optimise a large portfolio of distributed generation assets and trade in these markets 24 hours a day, seven days a week, 365 days a year.

This capability allows Eneco to integrate more renewable energy resources into its generation portfolio and reduce imbalance costs associated with renewable intermittency, helping it to cost-effectively reduce its greenhouse gas emissions.

Essentially, Eneco makes use of its customers' CHP plants by linking them all together so they are centrally accessible.

According to AutoGrid, setting up such a system is fairly straightforward. All that is needed is access to the metering information and an interface to send an on-off signal to the plant.

The system is a Cloud-based solution, whereby the AutoGrid platform is able to communicate with devices connected to the grid via standard protocols as well as via proprietary interfaces for several meter manufacturers such as Schneider Electric and Silver Spring.

Systems can be implemented very quickly and at very low upfront cost. The Eneco programme was up and running in just six months.

"All you need is a tiny hardware investment in the range of hundreds

of dollars to the few thousand range, the license fee and you're good to go. It's a very attractive business case," noted Dr Stechert.

John McClean Director of Product Marketing, added: "It's a fraction of the cost and time [of building a conventional power plant] and it's 100 per cent clean. Compared to a coal fired plant, an AutoGrid implementation is roughly 1/10th of the cost and 1/20th of the time."

By aggregating capacity in this way, Eneco can share revenue by taking this generating flexibility to the market in a way that would not be possible for a household or a customer with a small installation. It is a win-win situation for all involved, as Dr Stechert explains: "It gives Eneco a way to enable its customers to earn more money and makes the entire energy system cheaper and more efficient."

Eneco's 100 MW virtual power plant is part of AutoGrid's growing global total, which stands at about 550 MW. Noting the significance of this, Dr Stechert says: "This is getting into the range of a nuclear reactor but this is not power that is static. The entire response time – from receiving a market signal from the TSO, to dispatching to the devices and receiving the response from the devices – is 30 seconds at most. Our contribution to that, i.e. doing all the forecasting, optimisation, meter data management etc., takes less than four seconds."

Such a fast responding system is potentially also useful for grid congestion, which may become an issue in distribution grids as electric vehicles, for example, become more widespread.

Indeed, AutoGrid is confident of the future prospects of the technology. Eneco's programme, for example, is currently restricted to CHP plants but the same system could be used to include resources such as batteries, EVs, smart homes, etc.

In countries, where ageing coal and nuclear capacity is being closed down, such virtual power plants will become an increasingly important tool in combatting potential capacity shortfalls.

The reliability that comes with the ability to pool a wide range of assets is a key benefit of this approach.

"A lot of our big data analytics and predictive control goes into making unreliable assets reliable. You do that by pooling enough flexibility across assets, customer-types and load types, so that when you do dispatch, you ensure you are getting the expected amount of megawatts," said Dr Stechert.

With apparently endless possibilities for the technology, the future seems bright.

McClean summed up: "What we hear from some of the utilities we work with is that AutoGrid's vision of the energy internet and the energy internet of things is really in line with where they see their business going. There are benefits for all involved: customers see lower emissions; utilities can lower costs and vendors can sell more equipment."



McClean says AutoGrid's vision of the energy internet and the energy internet of things is in line with where utilities see their business going

from industrial CHP schemes etc., is not as straightforward as in the old traditional centralised set-up.

Energy companies are therefore looking at how they can best utilise these varied generating sources to flexibly meet demand. US-based company AutoGrid Systems Inc., a specialist in big data analytics for the electricity and energy industry, is one company that has been busy addressing the issue.

Dr Thorsten Stechert, Solution Architect-Europe, AutoGrid Systems, explained: "It used to be an industry

Dr Stechert: "it's a very attractive business case"





Junior Isles

We've been a long time tipping

A recent report from Berenberg Thematics says there have been “many false dawns” in the mass adoption of batteries in the automotive and utilities industries in the last 20 years. Few would disagree. How many times have we heard: “Storage is on the verge...”?

The report, called ‘Battery adoption at the tipping point’, argues, however, that this time things are different. Berenberg bases its belief on three key factors: the rapidly growing number of electric vehicles and expanding charging infrastructure; rising renewable generation; and falling battery costs.

Looking at the stationary battery sector specifically, Berenberg predicts that the market will grow from \$0.5 billion today to \$14 billion by 2020. It sounds almost too good to be true, but the calculations seem plausible.

In 2015, approximately 0.5 GW of storage was added globally. With an energy-to-power ratio of about 2:1, this translates into around 1 GWh of additional storage capacity. Berenberg Thematics expects the energy-to-power ratio for energy storage systems to rise to 4-5:1 by 2020 as more load shifting storage systems are installed to integrate renewables.

Both grid scale and residential/commercial storage are expected to more than double per annum over 2016-2020 as power networks move from being centralised to distributed interconnected systems. Berenberg predicts that by 2020, annual storage installations will rise to 10 GW, which translates into approximately 45 GWh of annual storage. Assuming all-in battery costs in the region of \$300/kWh, this translates into the \$14 billion market by 2020 prediction.

According to Berenberg three factors will drive stationary storage uptake by utilities, the commercial sector and households over the next five years – rising renewable generation, reduction in battery costs and regulatory requirements.

Statistics show that battery costs are falling by half every five years as manufacturing scale rises. “As the comparative cost of batteries finally moves towards parity with incumbent

hydrocarbon solutions, mass market adoption is close to tipping point,” states the report.

This view was also echoed in a recent Whitepaper published by the Global Smart Grid Federation (GSGF). GSGF’s work group on Battery Storage in the Electrical Grid highlights that there are already market conditions in several countries, where batteries can thrive as a solution for grid issues.

Evidence of this was presented at the Smart Energy UK & Europe conference in London at the end of January, where US-based company AES said it already has 2.5 GWh of service delivered and last year took the decision to do 10 projects globally.

Yet despite the growing momentum, challenges remain. According to the GSGF, today the largest obstacle is bridging the gap between using batteries for demonstration projects, and them becoming a viable economic solution. The key, it says, is to create a regulatory environment that can adequately value battery energy storage economically. This will in turn increase production, lowering prices for batteries so they become economical for important applications, such as renewable energy integration, even without subsidies.

Many argue, however that there is too much focus on cost alone. In January the World Energy Council’s ‘E-storage – shifting from cost to value’ report, said a narrow focus on cost alone may be leading to misconceptions about the real value of energy storage.

Paul Gardner, Segment Leader, Energy Storage DNV GL – Energy, which was lead author on the report said: “The people actually developing energy storage projects understand that in most cases they have to get value from several different places to make a project work financially.

“It’s not like just selling power. You need several different contracts, possibly with several different people.”

Potential developers want this to be understood by regulators and governments. The challenge is that regulators and governments appear to have no particular desire to see energy storage, especially in deregulated markets

like the UK.

“It’s not like renewables, where there is an overall policy ambition that renewables help to meet. Energy storage, of itself, doesn’t actually help to do anything. So regulators and government have no reason to make things easy for energy storage,” explained Gardner.

There may be a good argument for a network operator to install an energy storage device on a substation instead of reinforcing that substation to handle situations where the substation may be overloaded for just a few hours a year. Currently, however, licensing conditions make it very difficult for network operators to trade energy through that energy store.

And even if the licensing conditions were changed, as inherently conservative organisations, network operators would likely be slow to change the way they have traditionally planned and run their networks. Further, bringing about the necessary market and regulatory change is complex, as there is no single organisation with power to make the changes.

While regulation and the knock-on effect on costs will have a varying effect on the growth of energy storage, depending on where you are in the world, one common global driver is, and will continue to be, solar PV.

There has been notable growth in Germany, for example, where storage has become associated with PV installations. Thanks to policy support, Germany has installed 12 000 solar-plus-batteries systems since 2013 with a recent growth rate of 35 per cent, according to Lux Research.

Lux forecasts that distributed storage for solar systems will be worth \$8 billion in 2026 as solar combines with storage. In its report: ‘Helping Renewables Shine On: Analyzing the New Business Cases Where Batteries Make Sense for Solar Systems’, published at the end of January, Lux Research calculates that energy storage will increase the distributed solar market by 25 GW annually in 2026.

It says that adding storage increases costs, affecting revenue streams and addressable market size. However, as installed solar system costs decline –

from \$3.83/W in 2015 to \$1.87/W in 2035 – an attractive economic case will emerge in 2023, leading to strong growth.

Certainly the value of storage for solar installations in particular is easy to see. PV’s output is very much tied to the day, so storage has significant value. Gardner said: “You get to use the energy store once a day. Whereas if it’s being used for wind, you effectively get value out of it once every three or four days for normal European wind cycles.”

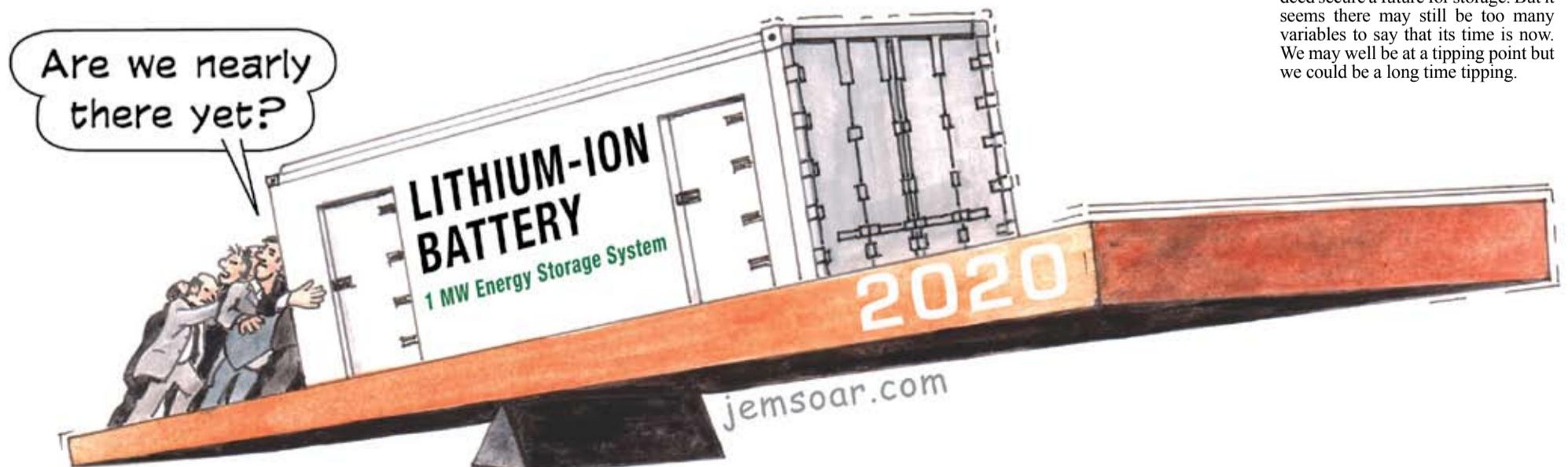
As the cost of battery storage continues to fall and more operating experience is gained, projects will become more bankable. Nevertheless, batteries still remain quite expensive and it is possible that other technologies will be used instead of batteries in certain applications. Costs may fall significantly in the next five years but not necessarily to the level where storage becomes widespread.

Gardner noted: “Storage still costs money and is still inefficient. Even in the best circumstances, you still may be throwing away 5-10 per cent of what you put in. That’s quite a penalty to pay if you don’t have to. Storage will not become ubiquitous but my gut feeling is that it is going to be a game-changer in terms of its effect on [the operation and planning of] electricity networks.”

Another factor when considering the outlook for storage is the impact of demand side management. According to Sharp Energy Systems, peak demand reduction is a major driver for energy storage in the US. Still, such applications could also be handled by demand response.

“The other thing we will see over the next five years, is a bit of clarity as to which of those wins,” said Gardner. “As you set up the conditions where storage can be economic – for the provision of ancillary services etc. – I wouldn’t be surprised to see demand response emerge to compete in those markets. And it will probably be quite successful in competing until the amount of available demand has been used up.”

The inexorable rise of renewables and the benefits energy storage can deliver to network operators may indeed secure a future for storage. But it seems there may still be too many variables to say that its time is now. We may well be at a tipping point but we could be a long time tipping.



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