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Confident of success: France's President François Hollande

Cautious optimism ahead of COP21

With Intended Nationally Determined Contributions (INDCs) being submitted by over 150 countries and a bilateral agreement between France and China, the mood going into the COP21 climate talks is one of cautious optimism. **Junior Isles**

Recent developments combined with pledges on emissions targets from over 150 countries means a deal is likely to be struck at crunch climate talks in Paris running from November 30th to December 11th.

Just weeks before the start of the UN's 21st Conference of Parties (COP21) climate summit, China and France agreed that any global pact on climate change in Paris should include a mechanism to monitor progress on emission cuts every five years, with a view to ratcheting up commitments.

François Hollande, France's President, said that support for a monitoring system from China, the world's biggest polluter, was a "major step" forward that created a "likelihood the Paris conference will succeed".

Environmental groups said the bilateral agreement between France and China was a step forward, showing intent by Beijing, and was in stark contrast to the country's level of engagement ahead of the Copenhagen climate summit in 2009.

Jennifer Morgan, director of the climate programme at the World Resources Institute, said the support of China for this mechanism would help "put pressure on others," such as the US and India to support it as well.

But the agreement was labelled an "incremental step forward" by campaigners at Greenpeace, who highlighted the vague language.

The statement said each signatory to the Paris accord should have their progress reviewed every five years to see if they are achieving their "approved long-term goals". But it remained unclear who would conduct the review or how it would be enforced. Rolling five-year commitments is seen as one of the key issues to be agreed at the summit.

At another meeting of ministers in Paris in the run-up to COP21, French Foreign Minister Laurent Fabius said ministers from about 60 countries had made progress on a number of crucial areas.

He noted governments have made progress towards a target of limiting global warming by submitting Intended Nationally Determined Contributions (INDCs) to the UN as part of the COP21 negotiations.

Christiana Figueres, Executive Secretary of the UN Framework Convention on Climate Change, said that the ministers maintained that it was entirely possible to reach an agreement despite the challenges.

Figueres said: "We are coming to the last possibilities to turn the curve on emissions that continue to increase even today. We have to get them to the point where they turn the corner and begin to decrease."

According to a French working document, however, more than 30 core issues remained unresolved before the

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IEA sees "clear signs" of energy transition

The latest *World Energy Outlook 2015* (*WEO 2015*), released by the International Energy Agency, says there are clear signs that the energy transition is underway.

It said renewables contributed almost half of the world's new power generation capacity in 2014 and have already become the second-largest source of electricity (after coal). It also says the coverage of mandatory energy efficiency regulation has expanded to more than one-quarter of global energy consumption.

The climate pledges submitted in advance of COP21 are "rich in commitments" on renewables and energy efficiency, says the IEA, which predicts that renewables are set to become the leading source of new energy supply from now to 2040.

In the power sector, renewables overtake coal as the largest source of electricity generation by the early-2030s. Renewables-based generation reaches 50 per cent in the EU by 2040, around 30 per cent in China and Japan, and above 25 per cent in the United States and India.

Speaking at the launch of *WEO 2015*, Dr Fatih Birol Executive Director of the IEA said that in a 2°C world, all fossil fuels will suffer but some more than others. "All fossil fuels cannot be lumped together. The biggest hit will be on coal and inefficient coal fired power plants. One third of the fossil fuel resources we have today will be stranded unless we see a major push in carbon capture and storage. But for CCS to be profitable, you need a significant carbon price, regulation, etc."

The net result of the changes seen in the *WEO 2015* central scenario is that the growth in energy-related emissions slows dramatically, but the emissions trajectory implies a long-term temperature increase of 2.7°C by 2100. A major course correction is still required to achieve the world's agreed goal keeping global temperature rise 2°C below pre-industrial levels, it states.

The IEA's forecasts, however, have been questioned. The international network of scientists and parliamentarians Energy Watch Group (EWG) accused the IEA of "continuously publishing misleading projections on solar PV and wind energy over the past 10 years".

According to the EWG, *WEO 2015* "once again underestimates sharply" the potential of solar photovoltaic (PV) and wind energy and puts an emphasis on conventional energy sources. Furthermore, the EWG claims the decline in the expansion of wind and solar energy, projected in the report, is not correct.

It noted that the *WEO 2015* has significant impact both on the political and economic decisions of world governments regarding energy and called on the IEA to "finally release realistic energy projections".

In late November, 16 leading energy and technology companies launched their action plans 'Scaling up renewables' to nearly double renewable energy capacity by supporting the global deployment of 1.5 TW of additional capacity by 2025.

Meanwhile, the recently published *BP Technology Outlook* predicts wind and solar will continue reducing costs at around 14 per cent and 24 per cent, respectively, per doubling in installed capacity, consistent with past performance, and hence become more competitive over time.

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the start of COP21.

Mark Kenber, CEO, The Climate Group, said finance was one of the three main issues in securing a climate deal.

"Finance will be a big, big issue for two reasons. First, clearly there needs to be a shift in investment and financing towards both lower carbon energy, transport, agriculture systems and to support adaptation.

"There are multiple estimates as to what that investment cost is, but it's important that it is seen as an investment, and not just as a cost. When investing in cleaner energy or transport, you are providing energy and transport services. It is an investment that in the short term may be more expensive than the least cost option."

The second reason he gave is that

Kenber: financing is "a political lubricant"

financing is a "political lubricant." He said there are many developing countries that will be most impacted by climate change, but have done the least to cause the problem.

"These countries", he said, "genuinely need funding. Financing is the totem or key demonstrator of willingness by the industrial countries, which caused the problem, that they are prepared to be collaborative and contribute."

A recent analysis of the national climate action plans, released by the UN climate change secretariat, found that a quarter of the emissions reductions pledged are conditional on receiving financial and technical support to make them happen.

In early November, the United Nations fund to support developing nations' fight climate change approved its first eight projects. The projects will receive a total of $168 million and the announcement is a key step going into COP21.

Meanwhile, the Green Climate Fund (GCF) has pledged $10.2 billion that will be provided by developed countries, which will also be an important part of the COP21 negotiations.

Although shifting to a clean economy is important, maintaining economic growth is seen as vital – especially to developing countries.

Just days before talks were due to begin, the International Energy Agency (IEA) presented four key messages, which it says "could help COP21 shift the energy sector onto a low-carbon path while supporting economic growth and providing energy to more people".

The four messages are:

- Take five key actions, led by energy efficiency and renewables, to peak global energy emissions
- Use the Paris Agreement to drive short-term actions consistent with long-term emission goals
- Accelerate energy technology innovation to make decarbonisation cheaper and easier
- Enhance energy security by making the energy sector more resilient to climate change impacts.

Speaking at the launch of its *World Energy Outlook 2015* in London, Dr Fatih Birol Executive Director of the IEA noted: "The Paris agreement needs to have energy at the core or it will risk being a failure, as the energy sector is responsible for more than two thirds of the emissions."

GE-Alstom deal changes European equipment supplier landscape

- Ansaldo acquires Alstom heavy-duty GTs
- Alliance will support renewables growth

Junior Isles

The completion of a deal that saw GE purchase most of Alstom's power business looks set to change the landscape of power equipment suppliers in Europe.

At the start of November, GE announced that the long-running deal to acquire Alstom's power business had been completed.

Last year, GE agreed to buy Alstom's gas turbine operations and create joint ventures in the steam turbine, renewable energy, and transmission businesses in a €12.35 billion deal. GE said that the final purchase price, adjusting for remedies, joint ventures, and changes in the deal structure, is expected to be about €8.5 billion.

Notably, the deal's completion was conditional upon GE selling most of Alstom's gas turbine assets to Italy's Ansaldo Energia. The move was taken to allay Commission concerns that the original deal would leave only Siemens as GE's main rival in Europe in the large heavy-duty gas turbines market.

Ansaldo will now own Alstom's GT26 product line for new unit sales as well at its new GT36 technology development programme, which upon completion would result in an H-class gas turbine product. It will also takeover services contracts for 34 GT26 units.

Margrethe Vestager, Competition Commissioner for the EU, commented that Ansaldo would now have "a true fighting chance" of competing in the European market.

In addition to altering Europe's gas turbine landscape, GE's deal with Alstom, which saw the formation of GE Power, will have an impact on the renewables and high voltage transmission sectors.

GE has now moved its renewable energy business from Schenectady to Paris as part of the series of concessions to the French government and also because Alstom has a robust offshore wind business.

The new renewable energy business, known as GE Renewable Energy, will be led by Jérome Pécresse and will focus increasingly on offshore wind from the Paris location.

The move has drawn the interest of EDF, which sees the merged GE and Alstom Energy as the perfect partner for its own plan to diversify its energy mix.

With 86 per cent of its current installed capacity being in onshore or offshore wind, EDF Énergies Nouvelles is particularly interested in partnering up with GE and Alstom Energy on both offshore and onshore wind projects.

The tie-up of GE and Alstom's wind businesses aligns with the integration of the two companies' transmission systems businesses, which sees the creation of a joint venture known as Grid Solutions. One of the main aims of the new business, which will have revenues in excess of $6 billion, is to enable the integration of renewables in the energy mix.

Speaking at a web conference outlining the company's strategy, Frédéric Lalanne, Global Sales and Marketing Leader, said: "The integration of renewables is a key challenge. Renewables will represent half of the power generation in 2040 and we will need to connect all this distributed generation and have a stable network."

The new JV noted that high voltage direct current (HVDC) will be a "key pillar" of the future strategy "along with all activities related to power electronics".

EU Energy Union on track

The European Energy Union strategy is said to be on track, nine months after its launch.

In presenting the first State of the Energy Union Report last month, Maroš Šefčovič, European Commission Vice-President responsible for Energy Union said that while everything was on track, much remained to be done.

Looking ahead to 2016, Mr Šefčovič said: "First, the EU should continue to lead in the transition to a low-carbon economy. Second, that transition should be socially fair and consumer-centred. And third, the geopolitical challenges that we faced this year will not go away; 2016 will also be the year in which we will lay the foundations of a robust governance system bringing predictability and transparency, which is what investors need."

Notably, the European Commission said that if necessary, it would introduce measures and policies to complement actions by Member States to reach the EU-wide renewables target by 2030.

The news was welcomed by the European Wind Energy Association (EWEA), which called the address "a statement of intent".

Giles Dickson, EWEA's CEO, said: "For the first time the Commission brings clarity on how it intends to administer the binding renewable energy target by saying it's ready to apply the rules if Member States do not step up to the plate on renewables."

The Commission must now define the circumstances under which it would intervene and how such measures would be enshrined in the new Renewable Energy Directive.

One of the key objectives of the Energy Union is to deliver energy security to the region. This involves reducing dependence on Russian gas.

In addition to expanding its gas pipeline network and importing LNG from countries such as the US and Canada will be options for the EU.

Speaking at the Canada Europe Energy Summit in London, Dr Rem Kortweg, Senior Research Fellow at the Centre for Economic Reform commented: "Energy security is one of the top three priorities in Brussels. From a European perspective Canada is increasingly looking interesting as a supplier… in particular, North America is lurking on the horizon. In December, Cheniere is going to start its LNG exports into the European market."

He stressed, however that Russia will continue to play a very important role.

Still arguing a case for coal

Despite coming under increasing environmental pressure, particularly against the backdrop of climate change negotiations, some still see a role for coal in the future power generation mix.

Lobbying for coal ahead of the COP21 climate talks, Andrea Clavarino, Chairman of the Italian coal association, Assocarboni, said: "Coal has made huge steps towards environmental sustainability, making itself the fuel of choice to accompany the growth of renewables on the path of climate change mitigation. The COP21 will have to take this into account."

Modern high efficiency low emission coal plants, now available and producing electricity in Italy, emit 25-33 per cent less CO_2 and can significantly reduce or eliminate non-carbon emissions compared to older, less efficient subcritical technology.

If these highly efficient technologies were extended to the over 3000 inefficient coal plants, with an average efficiency of 33 per cent, operating in the developing countries, 1.5 billion tonnes of CO_2 per year would be eliminated, according to the estimates of the European Power Plant Suppliers Association (EPPSA).

A new white paper by the Electric Power Research Institute (EPRI) finds that several technologies are available or in development that have the potential to enable power plants fuelled solely by coal to significantly CO_2 reduce emissions through more efficient combustion and use of heat.

The paper: 'Can Future Coal Power Plants Meet CO_2 Emission Standards Without Carbon Capture and Storage?' analyses current and anticipated US and global CO_2 emission standards for coal plants; identifies key challenges associated with CCS deployment; and provides detailed descriptions of coal-only technologies that are not ready for commercial deployment but that present significant opportunities to reduce CO_2 emissions.

Today's most efficient coal-fired plants are the "ultra-supercritical" plants that produce steam at high temperature. EPRI's paper looks at several advanced technology options for increasing the thermal efficiency of the processes for generating electricity with coal. However, none of the options considered in EPRI's analysis are currently commercially available, economically viable, or suitable for broad deployment and need funding to accelerate their deployment.

"It's critically important for the electric power industry to have as many generation technology and fuel options as possible," said EPRI Vice President of Generation Tom Alley. "Reducing emissions will be one of the key drivers as the industry makes decisions about existing assets and about the designs and fuels used in the next generation of power plants. EPRI research like this can be invaluable in informing those decisions."

According to a new report by environmental group Greenpeace, Global coal use declined 4.6 per cent in the first nine months of 2015. The one bright spot for coal, says the report, is India where consumption has increased about 5 per cent.

Even here, however, a transition is taking place. At the end of October it was reported that Reliance Power, one of the three largest private power groups in India, is urgently seeking to change the fundamentals of its business strategy.

A detailed analysis of public statements, annual reports and press reports relating to the company by Tim Buckley, Director of Energy Finance Studies at the Institute for Energy Economics and Financial Analysis (IEEFA), all point to a major strategic refocus away from thermal to renewable electricity generation.

- Germany's economics minister and energy companies have agreed steps towards taking lignite-fired power plants off the grid. The plan is to help Germany reach its climate targets.

Senate votes to block Obama plan

Senators in the USA have voted to block Obama's climate plans in order to show the world the opposition the President faces back home as he heads to Paris.

Siân Crampsie

US President Barack Obama's plans to curb power sector emissions have been dealt a blow as Senators last month voted to block the new rules.

The Senate voted 52-46 in favour of a resolution designed to scuttle Obama's Clean Power Plan, which aims to cut emissions from existing power plants. A second resolution aimed at overturning a rule to limit emissions from future fossil fuel fired plants was also passed by 52-46.

The votes came as the US Environmental Protection Agency (EPA) issued its final rules for the Clean Power Plan and greenhouse gas regulations, setting the clock on compliance and also opening them formally to legal challenges.

The resolutions – which are largely symbolic – were led by republican lawmakers keen to undermine Obama's influence at December's COP21 talks in Paris. The Clean Power Plan and its related rules are the centrepiece of Obama's efforts to address climate change.

The votes brought fierce criticism from environmental groups but are unlikely to derail Obama's climate plans on their own. The White House said in a statement that Obama would veto the resolutions if they crossed his desk because they "threaten the health and economic welfare of future generations by blocking important standards… that take a flexible, common sense approach to addressing carbon pollution".

Environmental group the Sierra Club said the votes were "pointless attacks" and showed that "big polluters are trying to pull back even the most modest steps forward".

The US Chamber of Commerce applauded the resolutions, however, as did coal lobby group the American Coalition for Clean Coal Electricity (ACCCE). "We look forward to similar House efforts to provide a unified voice in opposition of this illegal rule-making," said Mike Duncan, President and CEO of ACCCE.

ACCCE believes that Obama's proposed rules would cost US consumers $30 billion or more per year in compliance costs. "The economic costs associated with these burdensome rules cannot be justified in exchange for ineffectual environmental benefits," continued Duncan. "The damage inflicted upon not only our energy grid's reliability, but the pocketbooks of everyday Americans, will spread far beyond what is tenable."

In November Obama called on world leaders as well as the private sector to do more to protect the environment. "No nation is immune to the consequences of a changing climate," said Obama, speaking at the APEC CEO Summit 2015 at in Manila, Philippines. "The old rules that said we can't grow our economies and protect our environment at the same time, those are outdated. We can transition to clean energy without squeezing businesses and consumers."

EGP boosts Mexico capacity

Enel Green Power is expanding its presence in Mexico with a $250 million investment in a new wind farm.

The Italy-based renewable energy firm has started construction of the 129 MW facility, which will be owned by Enel Green Power Mexico's subsidiary, Energia Limpia de Palo Alto.

The new wind farm will increase the company's wind energy capacity in Mexico to 600 MW.

Enel Green Power has already signed power purchase agreements for the project, which will comprise 43 wind turbines. Operations are expected to start in the second half of 2016.

Enel Green Power is targeting Mexico alongside Chile and Brazil as strong growth markets for its Latin American business.

Fundy Ocean Research Centre for Energy (FORCE) in Canada

Triton tidal funding success

A tidal energy platform scheduled for deployment in Canada has become the first commercially financed project in the tidal energy industry.

Black Rock Tidal Power (BRTO) and Schottel Hydro have successfully raised C$10.5 million of private equity for a new project company set up to take over operations of the Triton tidal energy platform once fully commissioned.

Triton is a floating platform carrying a number of Schottel Instream turbines that generate 2.5 MW from tidal currents. The device is planned to be installed in autumn 2016 at the BRTP berth at the Fundy Ocean Research Centre for Energy (FORCE) in Canada.

The equity investment will be leveraged by an additional C$4.5 million commercial loan. The private equity includes investments from the shareholders of the Schottel Group, the Singapore-based clean tech investor Envirotek and as lead investor Inerjys Ventures, a Canadian investment company that acts in clean energy.

"Inerjys is convinced that Schottel Hydro and Black Rock Tidal Power offer the most cost-effective tidal energy technology at a growth stage and for future large-scale projects," said Stephan Ouaknine, Managing Partner at Inerjys, "Furthermore, Inerjys is partnering with Schottel Hydro on a growth equity round. This hybrid investment strategy insures commercialization for the product company and efficiency for projects."

Together with the berth at FORCE, BRTP has been awarded the developmental tidal feed-in tariff (FIT) and the respective power purchase agreement (PPA) with Nova Scotia Power. The electricity generated will be fed into the North American power supply system and the project company will operate the device over the 15 years duration of the FIT.

"The successful closing of the equity finance in our project sets the path for further Triton projects in the Bay of Fundy and globally," said Sue Molloy, General Manager of BRTP. "This is good news for the tidal industry in Nova Scotia and an important step towards proving the commercial viability of our technology and of tidal energy in general."

Caricom sets out ambitious renewables path

Caribbean economies could achieve an ambitious regional target of 48 per cent renewable energy generation by 2027, according to the WorldWatch Institute.

WorldWatch Institute has released a sustainable energy roadmap and strategy report for the Caribbean (C-SERMS), and also suggests a 33 per cent reduction in the region's energy intensity.

Achieving these two goals would result in a decline in carbon dioxide emissions of 46 per cent over the period to 2027, and would make the Caribbean Community (Caricom) global sustainable energy leaders, said WorldWatch.

In its report, WorldWatch outlines a programme of priority initiatives, policies, projects and activities that will help Caricom member states achieve clean energy goals. It was released on the day the government of Barbados launched the Caribbean Center for Renewable Energy and Energy Efficiency, a hub to help Caribbean states navigate the renewable energy and energy efficiency investment climate and provide hands-on assistance in investment and financing proposals and the creation of public-private partnerships.

According to WorldWatch, Caribbean governments are increasingly aware of the enormous financial, environmental, and social costs associated with continued dependence on fossil fuel imports. These and other concerns have spurred a broad regional dialogue on improving energy security and independence, fostering sustainable economic growth, and reducing greenhouse gas emissions through the development and efficient use of local and renewable resources.

"C-SERMS is pivotal to the attainment of the sustainable energy and development goals of the Caribbean Community," said Devon Gardner, Program Manager for Energy in the Caricom Secretariat and Head of the Caricom Energy Unit. "Caricom envisions that implementing the C-SERMS Baseline Report and Assessment advances regional goals whilst simultaneously supporting Member States."

Last month Jamaica secured more than J$20 billion ($167 million) of investment in renewable energy projects, including a 36.3 MW wind farm and a 20 MW solar farm. The country has set a target of 20 per cent renewable energy by 2030.

Last month also saw the completion of the first phase of a 10 MW solar farm in Antigua and Barbuda. Speaking at Caricom Energy Week, Tourism, Economic Development Investment and Energy Minister Asot Michael said the later phases would include construction of a 4 MW solar farm and the installation of rooftop solar panels on government buildings.

Bolivia settles over nationalisations

An international arbitration process has helped Spain's Iberdrola to reach an agreement with the Bolivian government over compensation for the 2012 nationalisation of four electricity companies.

Bolivia says it will pay Iberdrola $34 million to compensate for the expropriation of majority stakes owned by Iberdrola in four power distribution firms – Electropaz, Elfeo, Cadeb and Edeser. Bolivia has also agreed to pay $19 million to Britain's Paz Holdings Ltd., which also had operations nationalised.

The nationalisations were part of President Evo Morales' push to put energy resources under state control. It also nationalised several oil, telecoms, mining and power generation companies.

Last month Morales and German Chancellor Angela Merkel initiated a new phase of bilateral cooperation focused on the energy sector. Cooperation between the two countries would give Bolivia access to German technology, while Merkel noted Bolivia's "impressive economic growth".

During the visit to Germany by Morales, Bolivia signed a memorandum of understanding with Siemens on energy cooperation and future collaboration in the field of products and services for the oil & gas industry as well as in renewable energy and transmission and distribution.

Siemens said the deal could be worth over €1 billion and would support Bolivia's efforts to improve energy access for its population.

India could meet renewables targets early

Bouyed by falling solar costs, India's government believes it can hit its renewables targets early and help secure a concrete deal on climate change in Paris.

Syed Ali and **Junior Isles**

A massive solar roll-out programme being driven by the falling cost of solar PV has seen the Indian government announce that it is aiming to reach its renewable energy targets two years early, and is looking to introduce more ambitious energy policies.

The country is currently targeting a total of 100 GW of installed solar power capacity, 60 GW of wind energy, 10 GW small hydropower, and 5 GW biomass-based power projects to be operational by March 2022.

However, Piyush Goyal, Minister of Power, Coal, and New & Renewable Energy, recently said that the government will try to achieve this 175 GW renewable energy capacity target two years early by 2020.

The rapid increase and ambitious forecast for renewables is not being driven by social or government policies, but by the demand-supply gap and economics.

Speaking on the sidelines of the Economist Energy Summit in London last month, Ravi Kailas, CEO of renewables power developer, Mytrah Energy, said: "The renewables play in India is very different to Europe because both wind and solar are at grid parity, if not lower. That's a fundamental difference. The price at which we are actually producing power is competitive with coal, the world's cheapest form of power."

Solar power tariffs, which were in the range of Rs15-17 per unit till 2012-13, have fallen to as low as Rs4.63 per unit in a recent reverse e-auction conducted by NTPC. This was in the first week of November.

Further, solar power prices would be around 10 per cent lower than coal power prices by 2020, according to a recent report by KPMG. The analysis shows that grid scale solar power cost will fall to Rs5.83 per unit, while that of coal would be Rs6.37/unit.

The rapid fall in price of solar power has seen even large power companies with predominantly thermal generation move to solar.

Late last month, billionaire Anil Ambani, owner of Reliance Group, announced: "The Reliance Group has signed an MoU to develop Solar Park and Solar Projects of 6000 MW capacity, spread over nearly 30 000 acres, over the next six years."

Meanwhile, state-run Coal India (CIL) said it will invest Rs6000 crore ($1.1 billion) to set up 1000 MW of solar power generation capacity over the next five to six years, according to a senior company executive.

The Indian government's announcement on its increased renewables ambition came just weeks before the start of the UN's COP21 climate summit in Paris, at which India also said it plans to launch an alliance between solar-rich countries.

It also came as India signed agreements with both the UK and Belgium aimed at supporting economic growth, energy security and energy access.

Announcing the move to launch the solar alliance, Prime Minister Narendra Modi, said: "Our goal is to make solar energy an integral part of our life and reach it to the most unconnected villages and communities."

Looking ahead to the COP21 summit Modi said: "When the world meets in Paris in December, we look to see a comprehensive and concrete outcome that is based on the well established principles in the UN Convention on Climate Change."

The Prime Minister went on to say: "We will all do our part for it. But, we also want to see a genuine global public partnership that makes clean energy affordable; provides finance and technology to developing countries; and the means to adapt to the impact of climate change."

World Bank supports Pakistan electricity reform

A recently approved $500 million loan from the World Bank will help Pakistan reform a power sector that is reeling under frequent power cuts.

The loan, scheduled to be issued in April, was delayed due to the government's failure to implement key conditions imposed by the bank. It was finally approved by the World Bank after the government fulfilled over half a dozen conditions, including setting up an independent entity to purchase electricity from producers.

Among the conditions met included giving an application to the power sector regulator for determining multi-year electricity tariffs to make power distribution companies attractive for privatisation. The government also agreed to submit the Energy Efficiency and Conservation Bill to the parliament. It also agreed to set up the Central Power Purchasing Agency (CPPA) Guarantee.

The World Bank approved the loan after the government fulfilled several conditions

Novel plan could close dirty coal plants early

Australia could slow the continued increase in electricity sector greenhouse emissions without a carbon price or expensive government subsidies under a radical plan proposed by the Australian National University.

Under the plan, proposed by academics Frank Jotzo and Salim Mazouz, large brown coal power stations near the end of their operational life would submit bids for how much money they would need to receive in order to shut straight away. The cost of the winning bid would not be paid by the government but would be spread across all the other generators, in proportion to their own carbon dioxide emissions.

The generators that continued to operate would benefit from an increased electricity price and the prospect of running their other plants closer to capacity, and the government would finally have a way to reduce emissions from Australia's electricity sector, a task too expensive for its $2.5 billion emissions reduction fund.

According to initial estimates the increase in the retail electricity price would be small – around 1-2 per cent. This is based on a one-off payment for closure of between $400 million and $1 billion, shared between the remaining power generators. And the reduction in greenhouse emissions from closing a big brown coal fired plant would be between 2 million and 7 million tonnes of carbon dioxide a year, even taking into account that some of the generation would move to hard-coal fired stations.

Jotzo, associate professor at the Crawford school of public policy, says the idea could be refined after detailed modelling.

In an article explaining their plan, Jotzo and Mazouz write that "without a carbon price in place, the running costs of brown coal fired plants are extremely low: they sit right next to open-cut coalmines and there is no alternative use for the brown coal, so the fuel cost is minimal".

"... So there is the risk that the next large power station to shut down is one that produces electricity with much less carbon output than the brown coal plants, and that the high-emitting brown coal plants stay put."

Old highly polluting brown coal fired plants, particularly in Victoria's La Trobe Valley, were the biggest winners after the carbon price was abolished with coal generation hitting a three-year high of 75.6 per cent of the east coast market in October. This trend that makes it almost impossible for Australia to meet its promises of long-term cuts in greenhouse emissions even with increased renewable generation from the renewable energy target.

■ A Climate Council report argues that by 2018, due to advances in battery storage and solar cells, Australian households going off-grid will become more cost competitive, creating a potential A$24 billion ($17.36 billion) market if just half of Australia's households adopted the technology.

Indonesia and and Malaysia eye power plant cooperation

Indonesian coal mining company PT Bukit Asam Tbk is eyeing permits from the Indonesian and Malaysian governments for a 800-1200 MW power plant project, intended to serve consumers in both countries.

The coal power plant, planned for Riau, across the Malaka Strait from Malaysia, is a three-way cooperation between Bukit Asam, Indonesia's state-owned electricity firm PT PLN and Malaysia's National Energy Company (TNB), the country's main energy provider.

Bukit Asam's CEO Milawarma said the project was now undergoing a feasibility study, and would be subject to both governments' agreement before progressing. He predicted the project would need an investment of $1.8-2.2 billion.

"After the feasibility study, both governments must approve transmission connections. Estimating a six-month approval process, and a year of raising funds, we should see the project begin in 2017," Milawarma said.

If all goes to plan, the power plant will be connected to the ASEAN power grid which serves Malaysia, Thailand, Myanmar, Vietnam and Laos. Milawarma declined to comment on the plant's electricity selling prices, saying they were yet be negotiated with TNB.

The cooperation will consider the balance of peak demand in the two countries. Peak demand in Indonesia was usually at night, explained Milawarma, while in Malaysia it usually happened during the day – allowing the grid to support both countries' demands.

UK "resets" power sector with focus on gas and wind

The bold step to bring coal fired power generation to an end has been praised but there are immediate concerns over energy security and green targets.

Siân Crampsie

The UK has become one of the world's first major economies to put a firm deadline on an end to coal-fired generation after its government said that all unabated coal-fired power plants would be closed by 2025.

The move is part of a "resetting" of the electricity sector announced by Energy and Climate Change Secretary Amber Rudd in November that also included prioritising new gas fired power generation projects and a commitment to offshore wind.

The announcement was followed in late November by news that the UK would scrap its £1 billion carbon capture and storage (CCS) competition because of government budget cuts.

In a major policy speech, Rudd reaffirmed the government's commitment to nuclear energy and said that the UK's dependence on coal for power had increased in the last few years. "So despite intervention we still haven't found the right balance," said Rudd.

"One of the greatest and most cost-effective contributions we can make to emission reduction in electricity is by replacing coal fired power stations with gas," Rudd added.

The proposed move away from coal was widely welcomed by environmental groups because of the tone it set in the run-up to COP21 in Paris. Business groups also welcomed the government's clear policy direction. However, concerns have been expressed about reliance on a small number of technologies.

"We are starting today from a point where around a quarter of all the UK's demand for energy is met from coal fired power stations. Policy needs to be affordable for consumers while meeting our international climate targets," said Lawrence Slade, chief executive of Energy UK. "The energy sector will fully play its part but we need government to provide long-term policies so investors find energy projects attractive.

"Britain also needs a mix of technologies. Renewables play an important role alongside gas and nuclear so we can meet the country's ongoing future energy needs at the lowest cost and with the least environmental impact."

Rudd also said that the UK is likely to see 10 GW of offshore wind capacity installed by 2020, and that if certain conditions on cost reductions are met, the government would fund three auctions for offshore wind in the next three years.

"Amber Rudd's commitment to supporting the growth of offshore wind should be welcomed," said Phil Grant, energy advisor at Baringa Partners. "There has been considerable competition and innovation in this field in recent years and the UK is well placed to become a world leader if the government provides the necessary support."

In a letter to colleagues leaked to *The Ecologist*, Rudd admitted that the UK will not meet its 2020 renewables target. In the letter Rudd states that the UK is on a trajectory to miss its 15 per cent target and also said the remaining options open to government appear insufficient to meet the shortfall.

A surprise move was the scrapping of a £1 billion fund to support the development of CCS technologies in the UK. In a statement DECC said: "The £1billion ring-fenced capital budget for the Carbon Capture and Storage (CCS) Competition is no longer available … This decision means that the CCS Competition cannot proceed on its current basis. We will engage closely with the bidders on the implications of this decision for them."

Dr Luke Warren, chief executive of the Carbon Capture and Storage Association said the news was "devastating". He commented: "Only six months ago the government's manifesto committed £1 billion of funding for CCS. Moving the goalposts just at the time when a four-year competition is about to conclude is an appalling way to do business."

Rudd's speech followed in the footsteps of a debate on energy security, and in particular the UK's diminished generating margin. In early November, National Grid issued an urgent request for energy companies to make additional power available and said that it was expecting to issue several more alerts in the coming months.

"Given energy margins are the tightest they've been in a decade, it's hardly surprising that the National Grid expects to issue more emergency alerts to balance supply and demand for electricity this winter," said from David Hunter, energy analyst at Schneider Electric.

"In the long term, there must be a continued focus on replacing ageing energy infrastructure and 'rewiring Britain' to meet our low carbon energy needs in the future. Investment in renewable energy must be encouraged, along with demand response solutions, energy storage and flexible backup supplies."

Interconnectors bring risk to TSOs

- Germany most supportive for interconnector investment
- GB developers face greater exposure

Energy companies developing new electricity interconnections in Europe face varying levels of risk depending on the size and location of the projects they are constructing, Moody's says.

The investment ratings agency believes that while risk factors are generally well mitigated, some regulatory regimes result in greater exposure to risks than others.

The European Commission estimates that €40 billion of investment will be required over the period to 2020 to meet the target that all Member States have an electricity generating capacity equivalent to ten per cent of their generating capacity.

"Many of the European TSOs will be involved in developing additional interconnector capacity over the coming years," said Phil Cope, Moody's Analyst, in a research note.

"The risks faced by the TSOs vary according to the scale of the interconnector investment programme and specific development risks but may be mitigated by factors including the cost recovery mechanism and the TSOs overall financial strength and flexibility."

Moody's views the German regulatory framework as being the most supportive for interconnector investment, while developers of regulated interconnector assets in Great Britain face much greater exposure to potential delays and cost overruns.

Construction of long subsea cables typically pose greater risks than onshore network enhancement projects, said Moody's. In addition, the ability of TSOs to handle risks varies depending on their overall financial strength and flexibility.

Risks faced by developers of international subsea interconnections include the exposure of the construction phase to weather and unpredictable sea conditions, and the limited number of HVDC cable suppliers, which presents greater risk of supplier failure.

Statoil proceeds with Hywind floating wind farm pilot

The Norwegian firm's final investment decision will trigger investments of around NOK2 billion ($230 million) and marks an important step forward for offshore wind technology, it said.

The Hywind pilot park will consist of a 30 MW wind farm on floating structures at Buchan Deep, 25 km off the coast of Peterhead, Scotland, and will be the world's first floating wind farm.

Statoil is aiming to take advantage of the local oil sector supply chain in the execution of the project.

In November the UK's Energy Technologies Institute (ETI) said that floating offshore wind technology has the potential to deliver cost effective, secure and safe low carbon energy for the UK from the mid 2020s.

IRENA sets out Polish roadmap

Poland has a critical role to play in the fulfilment of Europe's clean energy goals, according to the International Renewable Energy Agency (IRENA).

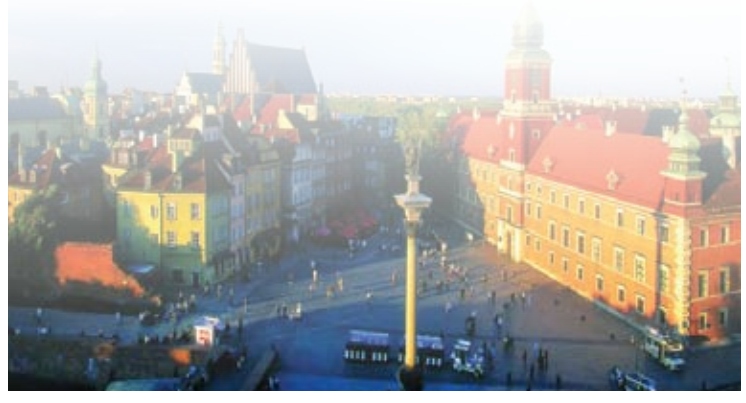
In its latest report on Poland, IRENA says that the country could increase its share of renewable energy in power generation from seven per cent in 2010 to 38 per cent by 2030.

In addition, it could increase the share of renewable energy in final energy consumption two-fold to nearly 25 per cent by 2030, IRENA said.

"As one of the European Union's largest energy users, Poland plays a critical role in fulfilling the region's energy and climate goals," said Adnan Z. Amin, Director-General of IRENA. "Even in a country like Poland with cheap fossil-fuel based sources, renewable energy can be cost-competitive, reduce air pollution, enhance energy security, benefit the economy, and play a leading role in fighting climate change."

Under current policies, the share of renewable energy in Poland's total final energy consumption would increase to just 15.5 per cent by 2030. The IRENA report estimates that renewable energy could feasibly reach 25 per cent if investments double to $4.5 billion annually. Doing so would reduce Poland's carbon dioxide emissions and could save up to $2 billion per year by 2030 when taking into account externalities related to health and environmental costs.

- EIB has provided two loans totalling almost PLN 2 billion (€475 million) to PGE Group for electricity network modernisation and the construction of two cogeneration units in gas fired, combined heat and power plants. The new units are located within the boundaries of the existing plants in Gorzów and Rzeszów and are reducing the current activity of coal fired installations. An EIB loan of PLN 1.5 billion has been earmarked for the extension and modernisation of PGE's electricity distribution networks in Central and Eastern Poland.



Zambia expands capacity

- Coal and hydropower projects make progress
- Government seeks renewables investors

Siân Crampsie

Zambia is adding new generating capacity to its grid to meet growing demand domestically as well as in the Southern African Power Pool (SAPP).

National utility Zesco said in October that construction of a 600 MW coal fired power plant in Sinazongwe would start in the next two months.

The firm also announced that it had signed a contract with Sinohydro Corporation of China for the construction of a 750 MW Kafue Gorge Lower (KGL) hydropower plant.

Zambia's has a power deficit of about 560 MW because of declining water levels in key reservoirs, forcing Zesco to implement regular power rationing.

In response to the crisis, the government has called for a meeting with potential investors in renewable energy alongside the country's investment agency, the Zambia Development Agency (ZDA), and the Industrial Development Corporation (IDC), an institution that holds government shares in selected firms.

An advertisement placed in Zambian media read: "The objective of the meeting will be to engage with project promoters and developers of renewable energy such as solar, wind, geothermal as well as other alternative sources of energy with a view of finding a lasting energy solution for Zambia."

The government has also invited other stakeholders such as financial institutions, professional bodies, academia to the meeting that will seek to unlock Zambia's energy potential and redress the energy crisis in the southern African nation.

Zesco said that it was about to finalise the power purchase agreement for the Sinazongwe power plant, which would help Zambia to reduce its dependence on hydropower.

The KGL project will cost $2 billion to build. Zesco acting managing director Victor Mundende said that the project was of critical importance to reducing power shortages in the country.

Noor 1 prepares for operation

Morocco is preparing for the commercial operation of the Noor 1 CSP plant at the Ouarzazate solar complex.

The 160 MW solar plant represents the first phase of a large-scale renewable energy project at Ouarzazate and will help Morocco achieve its ambitious solar energy goals.

Local media reported in November that the plant would start operating in December in line with its planned Q4 start-up date. The plant will use parabolic trough mirror technology and is equipped with molten salt thermal storage to enable it to store three hours of full thermal load.

Saudi Arabian firm ACWA Power is leading the consortium building the Noor 1 plant for Masen, the Moroccan Agency for Solar Energy.

It is also building Noor 2 and 3, which together will bring the output of the Ouarzazate complex to 500 MW.

The Noor project is supported by the World Bank, African Development Bank and European financing institutions, and is Morocco's first utility-scale solar energy project. It marks a critical step in the Moroccan solar energy programme, which aims to add 2 GW of solar energy capacity to the grid by 2020.

"The project underlines the country's determination to reduce dependence on fossil fuels, turn to increased use of renewable energy, and move towards a low carbon development strategy," the World Bank said.

Morocco is the largest energy importer in the Middle East, and depends heavily on foreign sources for over 97 per cent of its energy. Noor will reduce the country's energy dependence by about 2 and half million tons of oil, according to the World Bank.

UK seals India energy deals in Modi visit

British solar energy firm Lightsource is spearheading a £2 billion investment in India after striking deals with a number of Indian companies.

The deals follow a visit to the UK by Indian Prime Minister Narendra Modi during which the two countries agreed on partnerships to work together to address climate change and promote secure, affordable and sustainable supplies of energy.

Lightsource has announced plans to design, install and manage more than 3 GW of solar photovoltaic (PV) infrastructure in India over the next five years. The move has come largely in response to a contracting market for solar in the UK resulting from a decrease in government support.

Lightsource CEO Nick Boyle said that India "will be a key market for Lightsource in the future". The firm's deals were part of £3.2 billion of commercial agreements, joint research programmes and initiatives signed during Modi's visit.

"The UK and India's partnership on energy is going from strength to strength. We share world-class expertise in research and innovation," said British Energy Secretary Amber Rudd. "The UK's experience in green finance and technology in particular makes us well placed to work together to promote secure, affordable and sustainable supplies of energy and address climate change."

The two countries also agreed on the need for an ambitious and comprehensive global agreement to tackle climate change in Paris and that the agreement should signal to investors and innovators the long term commitment of governments to clean and more sustainable economies.

They also welcomed the completion of negotiations for a Nuclear Cooperation Agreement and a Memorandum of Understanding related to closer civil nuclear collaboration between the UK and India.

Lightsource's first partner is SREI Infrastructure Finance Limited, a leading infrastructure finance firm in India.

Clean energy drives value for utilities, says study

The creation of an efficient and low carbon energy system could create new value and business opportunities for utilities, according to a new study.

By cutting waste in power generation, developing low carbon electricity sources and installing carbon capture and storage or reuse technology, utilities could achieve growth and improve competitiveness, says the study, which was authored by Accenture and CDP, the UK-based climate think-tank.

According to the report, globally utilities could create between €245 billion and €380 billion by 2030. Opportunities also exist in new energy efficiency services, distributed generation and the flexible management of electricity supply and demand through advances in storage and other technologies.

Capitalizing on this opportunity would require the sector to transform its business models, according to the report, "Low-Carbon, High Stakes." In particular, it calls on utilities to consider decoupling electricity generation revenues from sales volumes, divest non-core assets and businesses, and form more cross-industry partnerships.

"The global response to unmitigated greenhouse gas emissions and water scarcity will put the existing electricity generation and supply model at risk and threaten the bottom line of utilities," said Peter Lacy, managing director, Accenture Strategy. "To sustain growth, improve competitiveness and drive business value, the industry must be ready to transform and take advantage of the business opportunities that arise from a low-carbon energy system."

Accenture Strategy and CDP identify six emerging value pockets that are potentially worth €135 billion to €225 billion in saved and avoided costs, and €110 billion to €155 billion in new revenue per year worldwide in 2030. In total, this brings the potential value available to between €245 billion to €380 billion per year in 2030.

Energy efficiency in power generation could create €35-55 billion in value a year from savings in operational and CO_2 emissions costs.

Demand for energy efficiency could generate €65-80 billion a year by providing energy-as-a-service. Electric utilities could offset losses from reduced demand by capturing a share of the growing market for energy-management products and services. This could be supplemented with rising demand for electric vehicles, which could generate an additional €35-45 billion a year.

Low-carbon power generation can create the largest opportunity of €100-160 billion a year. Revenues from renewable electricity would offset the losses from displaced fossil fuel generation.

G20 disappoints ahead of Paris

International civil society and climate groups say they are disappointed at the outcome of the G20 meeting in Turkey last month because of the group's lack of action on climate and fossil fuel subsidies.

The G20 met in Antalya, Turkey in mid-November. Although it pledged in its final text to support sustainable growth, energy access and renewable energy, it did not go far enough in scaling up climate action and eradicating fossil fuel subsidies, according to groups such as For The Climate.

"Heads of State could have provided a clear and powerful signal ahead of the Climate Summit by putting a date for the end of fossil fuel subsidies, and agreeing to stop funding fossil fuel projects around the world," Ümit Şahin from İklim için (For The Climate) said.

"Instead they have rehashed worn positions and in doing so risk being on the wrong side of history," he added.

The C20 Sustainability Working Group, which represents almost 500 organisations from 91 countries, had called on the G20 ahead of the Antalya summit to implement a comprehensive plan for phasing out fossil fuel subsidies by 2020.

It said that the G20 promised to phase out fossil fuel subsidies completely in 2009. But G20 governments still pump $452 billion annually into exploration and production of fossil fuels, according to a recent report from the Overseas Development Institute.

"G20 members are currently spending 789 times more on fossil fuel subsidies than they are on the Green Climate Fund, and yet they say in the communiqué how critical this Fund is and climate finance is," Ethemcan Turhan from Ecology Collective said.

"The threat of new and expanding coal plants and mines in Turkey remains unattended to. This is deeply shameful, people are sick and dying from filthy coal and plans are afoot for international finance to build even more – this is a global problem of major significance," Cem İskender Aydın from TEMA Foundation said.

"On long term goals and ambition we can see some reference on ambition but no foresight about plans to decarbonise our economies, as we know we must," Ümit Şahin from İklim İçin (For the Climate Campaign) said.

"We must hope that these Leaders display the leadership in Paris that they failed to deliver here in Turkey on all matters to do with climate change, the most pressing of our global problems. The world is depending on it and the world is most certainly watching," Şahin said.

Special Project Supplement

Hummel will debut triple-pressure DrumPlus technology

The new Panda Hummel gas fired power station is one of the largest coal-to-natural gas power conversion projects in the United States. In order to meet the requirements of high efficiency, low emissions and the capability of flexible operation in the future, the plant will feature triple-pressure DrumPlus boilers – a first in the US. **Junior Isles**

Artist's rendering of the new Hummel power station

The stacks of the old Sunbury coal fired plant in Snyder County, Pennsylvania, USA, are a much-loved landmark for the local community. But after 65 years of operation, the 400 MW plant has finally been closed – to be replaced by a new efficient, gas fired station in a project that is being hailed as one of the largest coal-to-natural gas power conversion projects in the United States.

The new Hummel power station will be capable of delivering 1124 MW, enough to supply power to more than one million households in the large electricity markets in the Mid-Atlantic region, including Philadelphia and the New York metropolitan area. A key feature of the plant will be its ability to operate at high base load efficiency while meeting Pennsylvania's strict rules on emissions compliance.

A major contributor to meeting the market's needs is the use of Siemens' Flex Plant technology combined with NEM's DrumPlus boiler technology at the plant.

Notably, the new Hummel power plant marks only the second installation of the DrumPlus boiler, following the first deployment at the El Segundo combined cycle plant in California. Unlike El Segundo, however, this boiler will feature three pressure levels for higher plant efficiency while enabling overall emissions compliance.

Indeed reducing emissions in the state was one of the key drivers behind the entire project. Pennsylvania, like the rest of the US, is going through a transition from coal to natural gas, driven by legislation designed to reduce power plant emissions as well as cheap, abundant, shale gas.

Hummel power station is being developed by Panda Power Funds, a private equity firm headquartered in Dallas, Texas. Panda Power was established in 2010 to develop, acquire, construct, finance and operate large scale, natural gas-fuelled power generation facilities. Hummel is one of seven of the company's combined cycle plants either completed or under construction with a combined generating capacity of 5.8 GW.

Commenting on Hummel and the general move towards gas fired generation, Bill Pentak, Panda Power Fund's Vice President of Investor Relations and Public Affairs, said: "Coal is a dying fuel source in the United States. Just in the last year or so, there has been something like 10 000 MW of coal fired generation in the PJM Interconnection region that has been retired.

"Coal is not only environmentally challenged, particularly by the Obama administration, but is also economically challenged with the advent of shale gas.

A lot of this gas is located in the Marcellus shale, which is right under the state of Pennsylvania."

The facility's access to Marcellus Shale gas through the Marc I and Transcontinental regional gas pipelines is expected to provide Hummel Station with a significant operating cost advantage.

The availability and volume of shale gas in the US has not only brought the price of natural gas to near historic lows but has also reduced the price volatility. With more than a third of generating assets in the PJM region being older than 48 years old, Pentak sees a big opportunity for gas fired generation.

"With most of the plants coming to the end of their useful life, the question is: what will you replace them with? You can't replace it with renewables – for the most part, they have an availability factor of about 10 per cent; to replace a 400 MW plant, you would need 4000 MW of wind and solar… and nuclear is virtually a stalled generation fuel... So the only thing that's available is natural gas; it's the smart play."

Pentak also sees a tremendous opportunity for generators to build new capacity in deregulated markets like Pennsylvania. He noted that some regulated markets in the US are still dominated by local utilities, which allow old, inefficient coal fired plants to continue operating by including costs into the rate base. This is not the case in PJM territory.

"One of the things we like, is that it is a liquid market," said Pentak. "It's a transparent market where PJM acts as a market-maker." He added: "Their dispatch model is an economic model based on the efficiency of the unit. This means a new, efficient, combined cycle plant will be at the start of the dispatch curve. So this means it will run often."

In the expectation that the plant will run in base load, Panda Power opted to build what it calls "one of the most efficient, state-of-the-art" power plants.

While base load efficiency is paramount, opting for technology that also provides operational flexibility makes sense. In a deregulated market,

Special Project Supplement

Aerial view of the Sunbury coal fired station. The new plant will be located on an 18-acre site next to the old plant

there is always the possibility that a plant's operating profile could change in the future.

A small environmental footprint was equally important. When completed, the project, which will occupy an 18-acre site, will produce greenhouse gases at a rate that is about a third of the previous coal plant.

Siemens Energy Inc. in consortium with Bechtel Power Corp., will build Hummel on a turnkey basis. Siemens will deliver the power island, while Bechtel will be responsible for the engineering and procurement for the balance-of-the-plant (BOP), and the installation, construction and commissioning of the facility.

Hummel will consist of three SGT6-5000F gas turbines, one SST6-5000 steam turbine, three SGen6-1000A air-cooled generators as part of the gas turbine packages, one hydrogen cooled SGen6-2000H generator as part of the steam turbine package, three NEM DrumPlus HRSGs and the SPPA-T3000 control system for Panda Power.

Each gas turbine has a nominal rating of 242 MW and the steam turbine has a capacity of more than 470 MW and accomodates supplemental duct firing in the boiler.

According to Siemens, the '3-on-1' configuration gives the widest operating range. Jacki Engel, Product Line Manager, Siemens Energy Solutions Americas, noted: "It's a 3-on-1 that can be turned down to a 1-on-1. The plant output can be increased steadily, bringing the gas turbines on [one at a time], all the way up to include supplemental firing. So over 1 GW of capacity is available in under an hour from a hot start in a 3-on-1 [configuration]. Although the plant is expected to run full-out, it gives them the flexibility down the road to meet the needs of the overall PJM market."

The gas turbines can reach full load in less than 30 minutes and the plant has a ramp rate of more than 40 MW/min. However, Siemens says the real key is emissions compliance.

"The Flex-Plant design allows for operation in emissions compliance in under 30 minutes," said Engel. "This facility is designed for low emissions during base load operation and can integrate Siemens' CleanRamp technology for controlling transient emissions, should the facility's operating profile change in the future."

Meeting the demands of the currently expected base load operating regime and low emissions, while considering the potential need for operational flexibility in the future, led to the selection of triple-pressure DrumPlus boilers at the back-end of each gas turbine.

Pentak said: "It was all about emissions. The DrumPlus has a quick-starting capability that helps to reduce emissions. It provides the degree of quick start we needed to make sure we were in compliance with our air emissions."

Hans J van der Weiden, Director of Sales, NEM USA added: "In the last year or so that we 've been talking to developers and EPC contractors, we have seen, particularly in Pennsylvania, that emission regulations have been tightening – not only for base load operation but also during start-up. It has gone as far as limiting the total emission volume in pounds of NOx, CO and volatile organic compounds (VOCs) per starting cycle, which can be 2-4 hours. Pennsylvania is certainly setting the new standard in the region."

According to NEM, Hummel will utilise the latest, most advanced emissions control technology to make it one of the cleanest natural gas-fired power plants in the nation. The boiler design allows the use of a conventional selective catalytic reduction (SCR) and CO catalyst to ensure emissions from the gas turbines meet the required levels. This plant will operate with emissions levels below 2 ppm for both NOx and CO.

While the new power station will supply 180 per cent more power than the coal plant it replaces, sulphur dioxide and nitrogen oxide emissions will be reduced by more than 90 per cent.

In many ways, the triple-pressure DrumPlus technology enables Panda to cover all bases. According to van der Weiden, some developers, EPC contractors and engineering firms are having difficulty interpreting the new air permits that have been released by the EPA. Their challenge is also compounded by uncertainty on future emission requirements. With these factors in mind, many are investing in Best Available Technology that can also meet potential future demands.

"The complexity of the emissions regulations that are coming into force now, the complexity of dealing with them and even interpreting what is required [during base load and start-up], has become more complicated," he said. "It would make sense to build in certain flexibility in a base load plant, especially for the critical components, so that you don't have to make another significant investment in the future in order to comply with the environmental regulations."

The Panda Hummel generating station will also help preserve Pennsylvania's fresh water resources by using 97 per cent less water for cooling purposes than the retired coal-fired Sunbury plant. The low water usage is one of the main benefits of the DrumPlus. Its water consumption is low even when compared with once-through Benson technology.

Jan Verkleij, NEM USA Sales Manager, commented: "DrumPlus is like a standard traditional drum-type boiler with natural circulation, which gives the standard water chemistry requirements.."

The fact that DrumPlus is a drum-type boiler is a definite bonus in the US, where plant owners are more comfortable with drum technology. DrumPlus boilers do not have strict water quality requirements and can therefore operate without additional feedwater equipment such as a condensate polishing plant.

Three Siemens SGT6 5000F gas turbines will be integrated with a steam turbine and DrumPlus boilers to deliver 1124 MW

Back to the future

The four-unit Sunbury facility, which began operation in 1949, was shuttered last year after 65 years of operation. Originally built for Pennsylvania Power & Light, it was sold to a private firm in 1999. The closure was blamed on economic and regulatory factors – competition from natural gas and impending Environmental Protection Agency mercury regulations.

On visiting the plant soon after its closure Bill Pentak, Panda Power Fund's Vice President of Investor Relations and Public Affairs recalled: "It's an absolutely massive plant. At the time it was built, it was considered one of the most state-of-the-art in the world.

"The first time I walked in there, it was like stepping back into the 1940s. The handle rails on the stairways all over the plant are made of solid, beautifully finished maple. There was an industrial cafeteria, where they fed all the workers. It's an amazing museum piece."

The plant sits in the heart of Sunbury and its closing was, as Pentak put it, "a big deal for the community". Indeed, many of the city's residents have become attached to the old station.

"When we came in and talked to the community about building a new gas fired plant, they asked if we could leave the old coal stacks up because, being so big, they are the point of reference for everyone in the town… even the town logo has those stacks in them," said Pentak.

It was decided that the stacks could stay – even though the old plant would close to make way for the new Hummel gas fired combined cycle station.

The new generating station will be located on the west bank of the Susquehanna River in Shamokin Dam Borough on the site of, and immediately adjacent to, the retired Sunbury coal plant. It will utilise existing infrastructure at the site for the electrical interconnection, water intake and storm water run-off systems. Construction will take approximately 30 months.

Hummel Station will benefit from its close proximity to the Susquehanna-Roseland Electric Reliability Transmission Project, a recently completed 234 km (146 miles) , 500 kV electric transmission line that was one of seven nationwide projects fast-tracked by the Obama Administration's Rapid Response Team for Transmission.

Financial closure for the project was achieved last month (November). The transaction marks the seventh financing of a new, large-scale power facility by Panda Power Funds in three-and-a-half years, representing approximately $6 billion in total combined capital. Goldman Sachs, ICBC and Investec arranged debt financing totalling $710 million, and Siemens Financial Services will invest $125 million in equity.

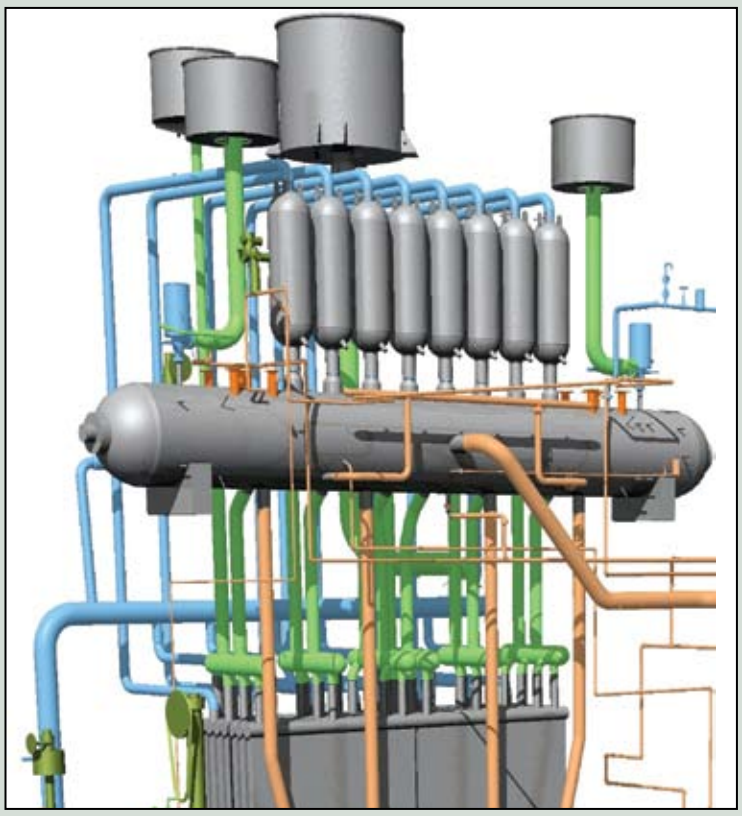
Development of the boiler first began around 2005/06. At this time NEM obtained a patent covering the initial R&D work, which focused on the drum itself. The aim of the programme was to develop a horizontal drum-type boiler with the pressure parts optimised that allow gas turbines unrestricted, daily start-ups.

For a boiler to operate flexibly, its pressure parts must be able to handle rapid temperature transients. Generally, this means they should be smaller and thinner in order to limit thermal stress. However, the trend towards larger gas turbines with higher efficiency meant that pressure parts were becoming thicker in order to handle the higher steam temperatures and flows.

This is the exact opposite of what engineers were looking to achieve. Although the aim was to go faster, such pressure parts only allow slower transients.

NEM designed a smaller drum by removing certain components from the drum, enabling it to be smaller in diameter and therefore thinner, and thus allowing it to handle faster temperature changes.

A water/steam drum has two main functions. The first is to separate water and steam, with water being sent back into the evaporator and steam fed to the superheater. Secondly, before steam is sent to the superheater, it has to be dried to remove droplets of mist



CAD drawing of NEM's DrumPlus design. The HRSG consists of a small drum for primary water/steam separation and bottles for secondary water/steam separation

from the steam. If this second function is taken out of the drum, the drum can be made smaller with thinner walls. This enables it to accommodate higher thermal transients for the same thermal stress.

Instead of having a large high-pressure steam drum, NEM decided to take the secondary water/steam separators out of the drum and place them inside individual pressure vessels, or bottles, at the top of the boiler.

Although this is a patented design, NEM wanted to stick to conventional parameters and off-the-shelf products as much as possible. The number and height of the bottles are based on the required steam quality and conventional feedwater requirements.

The other area that enabled a reduction in drum size is the 'retention time', also known as 'hold-up' time, which allows an operator to take action if something happens with the upstream feedwater supply. The amount of time relates to the amount of water reserve in the drum. NEM has managed to design a boiler with an actual hold-up time of about 50s.

These two developments allowed NEM to make the drum diameter about 35 per cent smaller than a conventional drum (1300 mm vs 2000 mm). Consequently, wall thickness is also reduced: 60-90 mm (depending on HP drum pressure) compared with 140 mm in a conventional steam drum.

Work on other details of the boiler started in 2007 when Siemens in Orlando, USA, approached NEM to develop a boiler for its Flex Plant 10 CCGT plants. NEM worked with Siemens on a boiler design for the El Segundo units, with the key consideration being that it should not restrict the operation of the gas turbine.

In addition to the changes in the drum, modifications were made to the evaporator bundle. Smaller diameter tubes were used so that there is less water in the tubes. This limits the amount of swell or shrink of the evaporator during fast start-up or shutdown.

This first DrumPlus boiler has been operating according to design expectations since September 2013.

Indeed NEM has been pushing the boundaries for boiler technology in the US, and like El Segundo the three-pressure design at Hummel is also described by van der Weiden as a "novelty".

He noted: "The triple-pressure reheat Benson boilers we have delivered to Panda's Temple I project in Texas were the first triple-pressure reheat with supplementary firing in the US. For Hummel Station, a DrumPlus with triple-pressure reheat and duct firing is another first in the US."

It is also an important development for Siemens' Flex-Plant technology. Engel said: "Hummel is really a blend of what you see at El Segundo and Panda's Temple I facility, with full Flex-Plant capabilities. The real key is integration of all the balance-of-plant (BOP) systems. The DrumPlus design has the ability to start-up at the full ramping capability of the gas turbine without any impacts on lifetime.

"Several years ago, when we were looking at how to capture the exhaust energy of the gas turbine, bringing it up to load quickly, and maintaining BACT emissions, Siemens introduced a single-pressure, fast-start design. This technology also applies to triple-pressure design, which merged the previous Flex-Plant 10 and the Flex-Plant 30 designations into the current Flex-Plant portfolio."

The fact that Hummel is a triple-pressure reheat unit is the main difference versus El Segundo, which is a single-pressure boiler. The low-pressure section generates 8 kg/s of steam at a pressure of 6 bar[a] and temperature of 264°C; the intermediate-pressure section generates 11 kg/s of steam at a pressure of 33 bar[a] and temperature of 262°C and the high-pressure section generates 68 kg/s of steam at a pressure of 125 bar[a] and temperature of 566°C. Reheat steam throughput is 77 kg/s at 32 bar[a] at 565°C.

These steam parameters bring a much higher efficiency to the whole cycle. The efficiency of Hummel will be significantly higher than the 49 per cent at El Segundo.

"El Segundo was really developed as a peak shaver," said Verkleij, "so efficiency is less important." With the number of operating hours being much lower, electrical efficiency was not the main design goal; fast start and low emissions were the main drivers.

In addition to higher efficiency NEM has also made progress in the constructability of the boiler by increasing the level of modularity to lower construction time and cost. Verkleij explained: "The level of prefabrication of the modules and piping, etc., that we do in the shop is much higher. This reduces the amount of work needed at the job site."

The level of prefabrication at Hummel was possible because of its location. It is a greenfield site with ample space and, unlike El Segundo, it is not next to a beach. This means that there is better access to the site, which in turn enables bigger pieces to be shipped.

NEM notes that working with Bechtel allowed a higher level of prefabrication.

Verkleij said: "Having worked on Stonewall, they gave us a lot of feedback on how to design, for example, pipe hangers, in order to reduce the number of hours at the job site and, therefore, cost. Generally, one hour in the shop is three or four times lower cost than an hour at the job site."

Greater prefabrication is allowing NEM to get a head-start on the project. With modules already being fabricated, along with all the main components, NEM says that the project is going at "full speed".

"The project was fully released by Panda in September but we started the project earlier in order to meet commercial operation date planned for the first quarter of 2018," said van der Weiden.

HRSG erection is scheduled to start in May 2016 with the erection of main steel followed by lifting of the modules and installation of drums, piping, inlet duct and outlet duct in the stack.

When installed, NEM expects the commissioning to be smooth despite it being a first.

"El Segundo was our serial number one and two for DrumPlus," said van der Weiden. "We put a lot of effort into designing it and analysing the lifetime, the specific flow patterns inside the HRSG, all the details of the drum and separators, etc. It worked without us needing to make any significant modification to the design, and required very little tuning. We have not had to touch the design concept; the only difference is that the pressure is a little higher, so we have every reason to believe it will work again."

NEM says that DrumPlus deals with the problem of fast start and the resulting lifetime issues in an "elegant way", without sacrificing any of the important market requirements such as emission compliance.

It is certainly an elegant solution for Panda Power in terms of utilising a technology that satisfies both its present and future needs. Although the old coal stacks will be staying as a landmark, the community will now enjoy low cost power without the emissions.

El Segundo: site of the first NEM DrumPlus boilers

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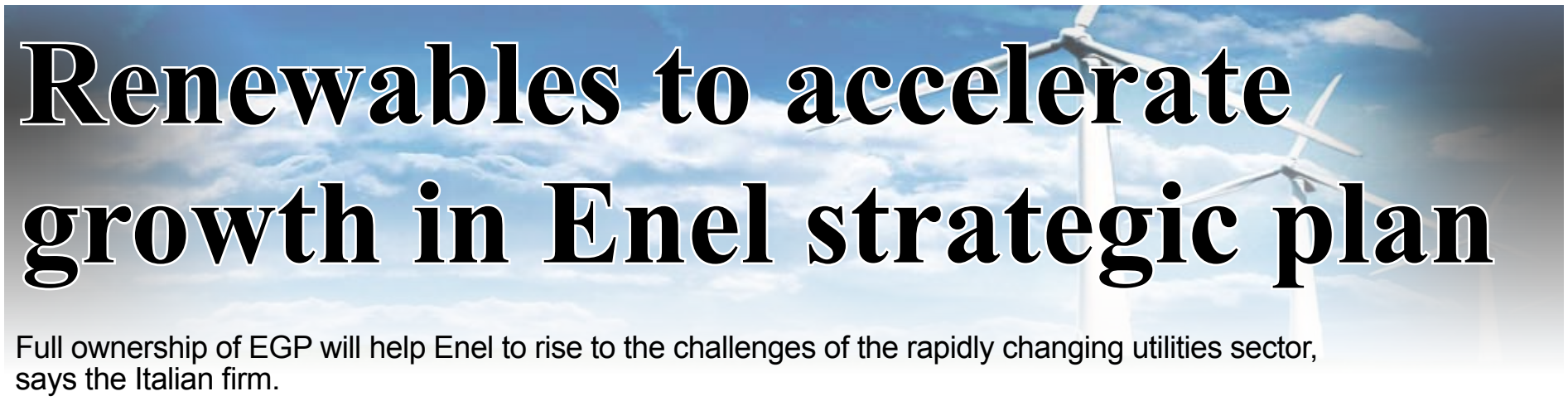


Renewables to accelerate growth in Enel strategic plan

Full ownership of EGP will help Enel to rise to the challenges of the rapidly changing utilities sector, says the Italian firm.

Siân Crampsie

Enel is to put renewable energy at the heart of its business after securing a deal to buy out minority shareholders in Enel Green Power (EGP).

The deal is part of a wider strategic plan for the next four years to improve efficiencies, simplify corporate structure and secure growth in the challenging utilities sector.

Under the agreement with EGP, shareholders will receive Enel stock at an exchange ratio of 0.486 Enel shares for each EGP share.

After the transaction, Enel will become the sole shareholder in EGP and will be well positioned to take advantage of new business opportunities resulting from "profound" changes taking place in the energy sector, the firm said.

"Enel Green Power is one of the growth engines of the Enel Group, and as such it will sit at the centre of our integrated business model," said Francesco Starace, CEO and General Manager of Enel. "Bringing the business under 100 per cent ownership will allow us to accelerate both EGP's growth and that of the other business lines."

EGP has a market capitalization of nearly €10 billion and operates a portfolio of over 10 GW of capacity, 70 per cent of which is located beyond Italy's borders. Integrating the renewables business into its mainstream business will have significant strategic, industrial and financial benefits, Enel said, including increasing its capacity to make investments, and generating operational and management synergies.

"This is the right time to integrate Enel Green Power into the Enel Group," said Francesco Venturini, CEO and General Manager of EGP. "Increased investment firepower, greater flexibility in capitalising on market opportunities are just some of the many benefits to this transaction."

Enel said in mid-November that the "fast pace of change" in the utilities sector required the firm to have an inherent flexibility. It said that its strategic plan for 2016-19 gave it "a clear vision" for capturing opportunities in the utility sector.

Enel has already made faster than expected progress on an existing plan to reduce costs and drive growth in spite of a deterioration in the macroeconomic environment and downward pressure on power prices. It has therefore added a fifth objective to its plans – group simplification – which include targets for recycling capital from existing assets for reinvestment.

Enel said it would increase its target for asset sales from €5 billion to €6 billion and reduce its workforce by encouraging early retirements. It is planning to increase capital expenditure by €2.7 billion to €17 billion over the 2016-2019 period, with a shift towards lower overall risk profiles on technology and geography.

Enel is thought to be close to a deal to sell its controlling stake in Slovakia's largest electric utility, Slovenske Elektrarne (SE).

The *Financial Times* reported that a deal to sell half of its 66 per cent stake in SE to Czech energy firm EPH was likely to be agreed by the end of November.

Firms target industrial sector in new collaboration

Ericsson, E.On and ABB are aiming to create a world-leading research and innovation environment in smart energy solutions through a new collaboration. The three firms have signed a cooperation agreement to develop innovative products and services to deliver smart energy solutions for a number of industries.

They say the aim of the partnership is to help customers reduce energy and operation costs, and could lead to a new European model for sustainable urban planning.

The collaboration will focus initially on four sectors: commercial real estate, transport, solar energy production and data centres in an area in Lund, Sweden.

The products and services created by the partners will be delivered to the market through Brunnshög Energi AB, E.On's start-up innovation company. At the heart of the collaboration are data gathering, analysis and dissemination, ABB said in a statement.

"ABB's Next Level strategy emphasises the importance of partnership to achieve sustainable growth," noted Johan Söderström, CEO of ABB. "Our technology strategy focuses on the benefits of the application of the Internet of Things, Services and People.

"We see great potential for creating smart solutions together with Ericsson and E.On for both commercial and domestic users. Brunnshög is a hub for leading edge research, creating a platform for innovation in a number of fields."

In the transport sector, the collaboration will work to meet the future mobility needs of people and goods. By combining connected vehicle and various forms of collected data analysis, new innovative business ideas and scalable models for sustainable transport will be developed.

In the solar energy production area, the parties are looking at solutions to simplify production to make it more commercially attractive to produce solar energy.

In the data centre area, the parties are working on complete solutions for cost optimisation, improved performance and smart power utilisation with the aim of reduced energy consumption and environmental impact as a result.

Areva deal stalls over Finnish nuclear project

Liabilities over the Olkiluouto 3 nuclear power plant are threatening to derail the multi-million euro deal to bail out troubled French industrial group Areva.

Areva, EDF and the Frech government signed a provisional agreement earlier this year for EDF to buy a majority stake in Areva NP, Areva's loss-making nuclear reactor business.

However negotiations over a final deal have stalled because neither EDF nor Areva will assume liability for further problems at Olkiluouto 3, which is nine years behind schedule and €5 billion over budget.

EDF is due to pay €2 billion for a 75 per cent stake in Areva NP, a move that will help shore-up Areva's finances. Completion of the deal would also trigger a state-backed capital injection to help Areva raise the €7 billion it needs to stay afloat.

Earlier in November Mitsubishi Heavy Industries (MHI) said it was interested in acquiring a stake in Areva NP from EDF if the deal proceeds.

The Japanese conglomerate said the move would enable it to forge closer relations with its French partners and build on existing partnerships with Areva NP and EDF.

"I have high expectations that an investment by MHI into Areva NP would realise and strengthen the ties between the Japanese and French nuclear energy industries further, which in turn will enable us to contribute to the improvement of the quality of nuclear power plants around the world," said Shunichi Miyanaga, MHI President and CEO.

MHI said in a statement that it will consider conditions for proposing to EDF and Areva a potential minority stake investment into Areva NP, including ownership ratios.

Separately China National Nuclear Corp. (CNNC) has expressed an interest in acquiring a minority stake in Areva after the sale of the nuclear power plant business to EDF.

Areva and CNNC have signed a memorandum of understanding for a possible partnership that includes a capital injection into Areva as well as industrial collaboration.

US start-up attracts utility investors

Advanced energy management firm Bidgely has succeeded in attracting major utility investors to support its strategy to expand its business.

The California-based start-up has closed a $16.6 million funding round with capital from Constellation Technology Ventures, the venture capital arm of Exelon Corp., and European energy firms E.On and RWE.

The addition of E.On and RWE to its investors will give Bidgely access to 65 million new homes worldwide, enabling it to expand in the home energy market with its suite of applications that give energy users more control of their energy use.

"Our success in helping utilities transition to a more consumer-centric engagement model has led to this investment by the very community that we serve. This will accelerate our already rapid market adoption with several full-scale deployments globally," said Bidgely CEO Abhay Gupta. "Our HomeBeat platform gives consumers information and guidance at their fingertips and helps utilities earn customer loyalty in an evolving energy landscape."

"We want to offer our customers individually tailored, innovative products for an increasingly digitalised world. This partnership will enable us to do even more to help them save energy and manage their usage better," said Susana Quintana-Plaza, Senior Vice President for Technology and Innovation at E.On, which has taken stakes in more than a dozen start-ups in the United States, Europe, and Australia.

In the past year alone, Bidgely has secured numerous multi-million dollar customer contracts that cover more than 3 million homes across four continents. The company is currently deploying 12 customer projects with energy firms such as ComEd, London Hydro and TXU.

It is estimated that the home energy management market will surpass $22 billion in value in the next eight years.

Americas

El Salvador to build LNG fuelled power plant

Finnish power and marine technology company Wärtsilä is to build a new power plant in Acajutla, El Salvador.

The company has signed a contract with local energy firm Energia del Pacifico S. A., to build the 378 MW power plant in the coastal city.

The plant will be the largest power plant in the country, and the first in Central America to use LNG as fuel, according to Wärtsilä.

Construction will start in 2016 and the plant will enter operation in 2018.

Smart Power fixes Michigan reliability

Wärtsilä is to provide Marquette Board of Light and Power (MBLP) in Michigan, USA, with a 50 MW power plant to help overcome reliability problems.

Wärtsilä will supply a 'Smart Power Generation' plant based on three 50 DF dual fuel engines running primarily on natural gas. The plant's black start capability, instant ramping and flexibility will help MBLP to secure supplies.

MBLP said that it has a reliability problem because of ageing coal plants and because its service area lies on the periphery of the grid.

The plant will be fully operational in early 2017.

ABB to strengthen US grid

ABB has won an order worth around $40 million in the United States from Public Service Electric & Gas (PSE&G), New Jersey's largest utility, to supply Gas Insulated Switchgear (GIS) to two substations and help strengthen grid reliability.

The substations are part of PSE&G's programme to protect and strengthen utility substations against increasingly frequent severe weather occurrences and enable reliable and resilient energy delivery.

ABB's order scope includes design, supply and commissioning of 420 kV GIS type ELK-3, a compact and modular GIS solution in which key components including breakers, switches, contacts and conductors are protected with insulating gas.

Ideal Power marks largest single order

Ideal Power Inc. announced today that it has received an order for 14.5 MW of its power conversion products for use in Battery Energy Storage Systems predominantly for California and Hawaii, USA.

The order comes from an existing customer and includes a mixture of Ideal Power's 30 kW battery converter, grid-resilient 30 kW multiport power conversion system, and the newly released grid-resilient 125 kW power conversion system.

The order is the largest from a single customer in Ideal Power's history. Initial deliveries will start in early 2016.

Gamesa strengthens US presence

Gamesa has been awarded a contract for the supply of 37 wind turbines for an onshore wind project in the US state of New York.

The Spanish firm will supply 37 of its G114-2.1 MW units, with deliveries starting in 2016. It will transport, install and commission the wind turbines, which are optimised for low and medium wind speed sites.

Commissioning of the wind farm will take place in 2016.

Asia-Pacific

MHPS, Daelim win boiler order

Mitsubishi Hitachi Power Systems (MHPS) and Daelim Industrial Co. have received an order for a boiler to be installed at the Shinseocheon thermal power plant in Korea.

The 1000 MW coal fired ultra-supercritical Shinseocheon power plant is being constructed by Korea Midland Power Co. at a site 200 km south of Seoul.

The boiler will be a core component of the large-scale high-efficiency power generation plant that is slated to commence operation in September 2019, MHPS said.

Phu My benefits from GT upgrade

GE's Power Services business has announced the first GT13E2 MXL2 gas turbine upgrade order in Asia at a combined cycle power plant in Vietnam.

GE will upgrade four GT13E2 gas turbines with MXL2 upgrade packages for state-owned enterprise EVN Power Generation Corporation 3 at the Phu My power complex in Vietnam.

The upgrades are the first to be announced since GE completed its acquisition of Alstom's power generation assets in early November and are expected to deliver a combined cycle efficiency increase of 1 per cent, resulting in fuel savings of almost 2 per cent and reduced CO_2 emissions. Power output will increase by 50 MW, and gas turbine inspection intervals will extend to 48 000 equivalent operating hours to reduce maintenance and repair expenses, GE said.

Vestas wins 200 MW in China

Vestas is to provide 100 wind turbines for the Azuoqi 1A and Azuoqi 1B projects in the Inner Mongolia Autonomous Region after winning a contract from China's Hanas Group.

The projects will add a combined 200 MW to the grid and are expected to be completed in 2016. Vestas will also provide a two-year Active Output Management 4000 service contract.

AP solar tender moves on

A tender to procure 500 MW of solar energy capacity in India has moved on to a second round.

Some 28 bidders have been selected to move to the second round of bidding, according to reports. The tender has taken solar power tariffs to a record low, according to reports.

Bidders in the selection process include Renew Power, Tata Power, Fotowatio, Enel, Trina and SunEdison.

Doosan wins fuel cell deal

Doosan has signed a Won40 billion ($35 million) fuel cell supply deal with Korea Western Power, an affiliate of state-run Korea Electric Power Corporation.

The fuel cells will be installed at the power company's new plant in Incheon, west of Seoul, generating 5 MW of energy. The plant will be operational in April 2016 and will supply power to nearly 3000 houses.

Europe

PBS orders gensets for UK

Finning UK & Ireland (Finning), the sole dealer for Caterpillar in the UK and Ireland, has signed a contract to supply Power Balancing Services Limited (PBS) with 15 brand new 2 MW gensets for installation in the UK.

The deal covers two Cat G3516H and 13 Cat CG170-20 gas-powered generators, which will be installed at five sites across the UK over the next three years and produce a combined 30 MW of power.

PBS will primarily use the generators to meet contracts it signed under the UK government's Capacity Mechanism.

Siemens supplies French onshore project

Siemens has been awarded an order for the delivery, installation and commissioning of 12 direct drive wind turbines at the Les Gourlous wind farm in France.

Siemens will provide its SWT-3.2-113 turbines for the wind farm, located in the Champagne-Ardennes region. The facility will produce 38 MW of energy and is scheduled to start operating in late 2016.

RWE consortium bids for Borssele

RWE Innogy, EDP Renewables and Macquarie Capital have formed a consortium to participate in the Dutch offshore wind tenders for the Borssele I and II projects.

The tendering procedure for the two 350 MW projects is due to start on 1 December 2015, and close on 31 March 2016. The winner of the tender is expected to be announced in July 2016.

Peter Terium, CEO of RWE AG, said: "We want to expand our position as the leading operator of offshore wind farms in Europe. The planned participation in the tender for Borssele is another step in this direction."

Doosan Škoda Power wins sixth contract in Poland

Doosan Škoda Power has signed a contract with Fortum Power and Heat Polska Sp. z.o.o for the delivery of a complete turbo-set for a new power block in Zabrze, Poland.

The contract for the 75 MW unit also includes the delivery and assembly of the district heat exchanger system along with the steam turbine and generator set.

The plant is scheduled to be commissioned in the third quarter of 2018 and will operate in cogeneration mode with the new units delivering heating and electricity to around 70 000 households in Zabrze and Bytom.

Areva awarded contract for Trillo

Areva has been selected by the Spanish utility CNAT (Centrales Nucleares Almaraz-Trillo) to supply fuel assemblies to the Trillo nuclear power plant.

The company will supply six fuel reloads to CNAT from 2017 to 2022, continuing its long-term cooperation with the Spanish firm that began with the construction of the nuclear power plant in the 1980s.

Trillo is a pressurised water reactor with a gross capacity of 1066 MW. Areva has been supplying fuel to the Trillo nuclear power plant from its fuel manufacturing plant in Lingen, Germany, since the plant started operation in 1988.

Energie Thun selects L+G

Landis+Gyr has won a contract to support the Swiss energy supplier Energie Thun AG with the roll-out of a smart metering system.

Landis+Gyr is supplying Energie Thun with smart electricity meters, a load management system and receivers, as well as AIM software. The first smart meters were installed in September this year in the area of Breitenweg, located in the region of Thun in central Switzerland.

Energie Thun said that the smart metering system would support the Swisspower Masterplan 2030.

International

Doosan Skoda wins Oman contract

Chinese EPC giant SEPCO III has awarded Doosan Skoda Power a contract to provide two turbine sets for the Salalah power plant in Oman.

The Salalah power plant is being expanded from simple cycle to combined cycle operation by an EPC consortium comprising ACWA Power of Saudi Arabia, Japanese multi-national company Mitsui, and Omani company Dhofar Generating Company.

The project will increase the output of the power plant from 273 MW to 450 MW.

Capstone secures 2 MW order

Capstone Turbine Corporation has received an order for two C1000 microturbines to provide combined heat and power (CHP) in Hungary.

Both C1000 microturbines will be installed in a grid connected configuration to provide electricity to the customer's facility. The microturbines will be deployed in a CHP application that allows the customer to utilise the thermal energy from the exhaust for local processing and production purposes.

Regale Energy Zrt, Capstone's Hungarian distributor, secured the order, which is expected to be commissioned in May 2016.

Parsons to undertake FEED for solar project

Parsons has won a contract to provide the front-end engineering design (FEED) for a giant 1021 MW solar thermal park being jointly developed by Petroleum Development Oman (PDO) and GlassPoint Solar Inc. at the Amal oilfield in south Oman.

Parsons says it will provide the basic engineering for the initial construction phases of the massive facility, which is designed to harness solar energy to produce heavy and viscous oil from the Amal field.

Dubbed 'Miraah', the project will involve the installation of a large number of parabolic trough mirrors that will capture solar energy to produce the massive quantities of steam necessary to heat the reservoir to stimulate the flow of heavy crude to production wells. PDO plans to invest an estimated $600 million in the venture, which will rank among the world's largest solar thermal plants boasting a peak energy output of 1 GW. First steam from the scheme is anticipated in 2017.

Siemens to build Kenya-Ethiopia link

Siemens is to build a new HVDC link between Kenya and Ethiopia in consortium with Isolux Corsan.

The 1000 km-long Ethiopia-Kenya Power Systems Interconnection Project will improve the exchange of energy between the two countries and optimise the use of distributed energy sources in this region.

The order was placed by the Ethiopian Electric Power Corporation and the Kenya Electricity Transmission Co. Ltd. The total value of the project is worth approximately $450 million. The HVDC link is scheduled to go into operation by the end of 2018.

Oil

Crude continues its march into questionable territory

- Demand will increase by less than 1 per cent annually
- Fall in exploration investment will impact long-term supply

David Gregory

Crude oil prices in late November averaged in the lower $40/b range with analysts wondering how long it might be before West Texas Intermediate (WTI) crossed into that unbelievable world of oil at $39/b or less. Brent crude bobbed around at under $45/b late last month amid signs that it could go lower.

Crude oil prices are way down compared to a year-and-a-half ago and with stocks high and production averaging around 3 million b/d more than needed, the possibility of crude prices moving significantly higher any time soon are slim.

Some analysts are beginning to see Saudi Arabia's plan to force the competition out of the market by keeping production at record rates in defense of market share as a strategy that is not working. While Saudi Arabia sought to force shale oil out of the game – and this has happened to some extent – the innovative technologies being used in the extraction of shale oil are keeping output high at reasonable costs.

According to the International Energy Agency's (IEA) recently launched *World Energy Outlook 2015* (*WEO 2015*), oil demand will increase by less than 1 per cent annually from now until 2020 and only by 0.7 per cent in the years after that. Demand on that scale will not be enough to absorb the huge amount of oil that is currently in the market and therefore prices are expected to climb no higher than $80/b by 2020.

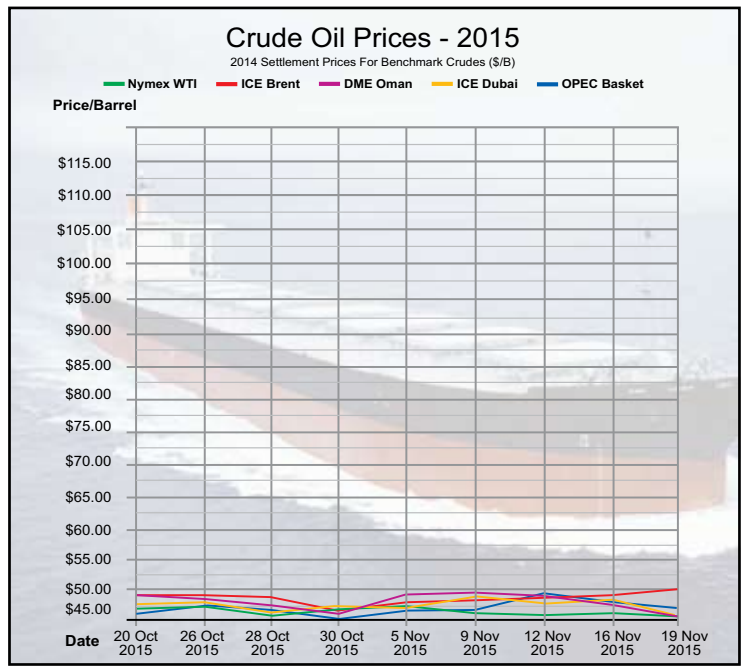
Some argue that shale oil is the new swing producer in the oil market. Therefore, those shale producers that have been forced to halt production because of the drop in oil prices, could return to production when prices increased to a level that was profitable for them. This would lead to more oil coming back onto the market, contributing to another slide in prices just as they were beginning to improve, and thus keeping oil prices down.

But Saudi Arabia's Minister of Petroleum, Ali al-Naimi, isn't thinking that way. During a conference in Bahrain last month, Naimi said Arab oil producers need to invest $700 billion in petroleum sector projects over the next 10 years. This would keep the oil and gas industries in the Middle East and North Africa sustainable.

Forecasting the increase in oil demand at 1 million b/d annually in the coming years, Naimi said currently producing oil fields are depleting at a rate of 4 million b/d per year. By that reasoning, Arab oil producers need to add a total of 5 million b/d of new production every year to meet future demand.

"This needs financial solutions at the Arab and international level," Naimi said. "Investment should include all the phases of production and manufacturing."

Referring to current prices, Naimi said Saudi Arabia was ready to work with other oil producers, whether Opec members or not, to maintain oil market stability. This was misconstrued as a suggestion that Saudi Arabia was willing to make some adjustment in its current oil policy, leading to a slight rise in oil prices. But as it became clear that Saudi Arabia had no intention of cutting production, prices returned to their downward track.



Saudi Arabia produced some 10.23 million b/d of crude oil in September, down slightly from 10.26 million b/d in August, according to data released by the Joint Organizations Data Initiative (JODI), part of the Riyadh-based International Energy Forum. In June, the country pumped a record volume of 10.564 million b/d.

Saudi exports averaged 7.11 million b/d in September, up by 113 000 b/d over the previous month. Meanwhile, domestic consumption amounted to 3.24 million b/d in September.

Meanwhile, IEA Executive Director Dr Fatih Birol, like Naimi, warned that a decline in investment in oil and gas exploration development would have an impact on long-term supply. Investment in the sector is expected to fall during 2015 and 2016.

"We have never seen this in the last 30 years," Birol was quoted by the *Wall Street Journal* as saying. "This will have implications for the oil markets, if not tomorrow then the day after tomorrow."

Falling oil prices has led oil producers to cut back on investment by more than 20 per cent during 2015 and the trend is expected to continue during 2016.

"The decline in investment means the growth in production will be negatively affected in the next years to come," Birol said.

Despite declining prices and the introduction of renewable energy, hydrocarbons will continue to dominate energy consumption.

According to the *WEO 2015*, renewables will contribute only about 17 per cent of global energy by 2040 and fossil fuels will continue to cover most of the balance of demand.

Gas

Baltic States look to reduce dependence on Russia

Baltic stakes are hoping LNG from the US and closer integration of Europe's energy network will reduce their dependence on Russia.

Mark Goetz

The Baltic states of Lithuania, Latvia and Estonia are looking to end their dependence on gas supplies from Russia by making use of the new LNG terminal installed in Lithuania at the end of last year. A consensus among the three appears to be growing and focusing on lining up supplies from US company Cheniere Energy, which is expected to make its first shipment to Europe early next year.

Lithuania currently receives 540 million m^3 annually from Norway's Statoil at the floating storage and regasification unit (FSRU) at Klaipeda under a five-year contract. Six deliveries have been made to the terminal, which was supplied by Norway's Hoegh LNG under a 10-year contract and which is capable of processing 4 million tons of LNG per year.

Now Lithuania is looking to secure a long-term arrangement with Cheniere. The two signed a non-binding agreement last February to proceed with negotiations.

Media reports have stated that Cheniere may start to deliver to Klaipeda as early as next February, Lithuanian officials have said that talks between Lithuania's Lietuvos Energija and Cheniere have yet to be concluded. The officials said the primary concern for Lithuania is securing a competitive price.

Delegations from the Baltic States visited Washington earlier this year to garner political support for US gas shipments to the region, which, due to their nature in challenging a traditional Russian gas market, are geopolitical in nature.

Regional politicians are also pressing Europe to not support Russia's plan to expand the Nord Stream gas pipeline project. The first pipeline in that project bypasses the Baltic States and Poland by stretching from western Russia to northern Germany with a subsea pipeline running through the Baltic Sea. They are also encouraging the EU to build a good political atmosphere and framework that would streamline deals to receive US gas.

As it now stands, US LNG is expected to be available to European markets at competitive prices. Cheniere, whose LNG export facility is based in Louisiana, is for its part interested in receiving the best possible price for its exports, but as LNG prices come down in Asia, it is expected that large volumes of US gas will end up in Europe.

Estonia and Finland were considering a joint LNG terminal project, but that idea is giving way to the proposed Balticonnector gas pipeline which would enable the Baltic states to cover their annual demand of 5 billion cubic metres (bcm) and ship a further 5 bcm/year to Finland. The gas would be delivered to Klaipeda and distributed from there. The Balticonnector would have a capacity to transport 5 bcm/year.

Lithuania and Poland have moved ahead with efforts to coordinate gas policy with a new pipeline connecting their two countries. Poland is building its own LNG terminal at Swinoujscie. It is due to come on-stream in May 2016 and reach its full capacity of 5 bcm/year by 2018.

Meanwhile, Lithuania has expressed its willingness to supply Latvia, Estonia and Finland through the Klaipeda terminal. Using the Balticonnector pipeline, this would eliminate the need to install another regasification system in the Baltic. In October Estonia's TSO Elering Gaas and Finland's state-owned Baltic Connector OY applied to the European Commission for co-financing for the construction of a subsea pipeline connecting Estonia and Finland.

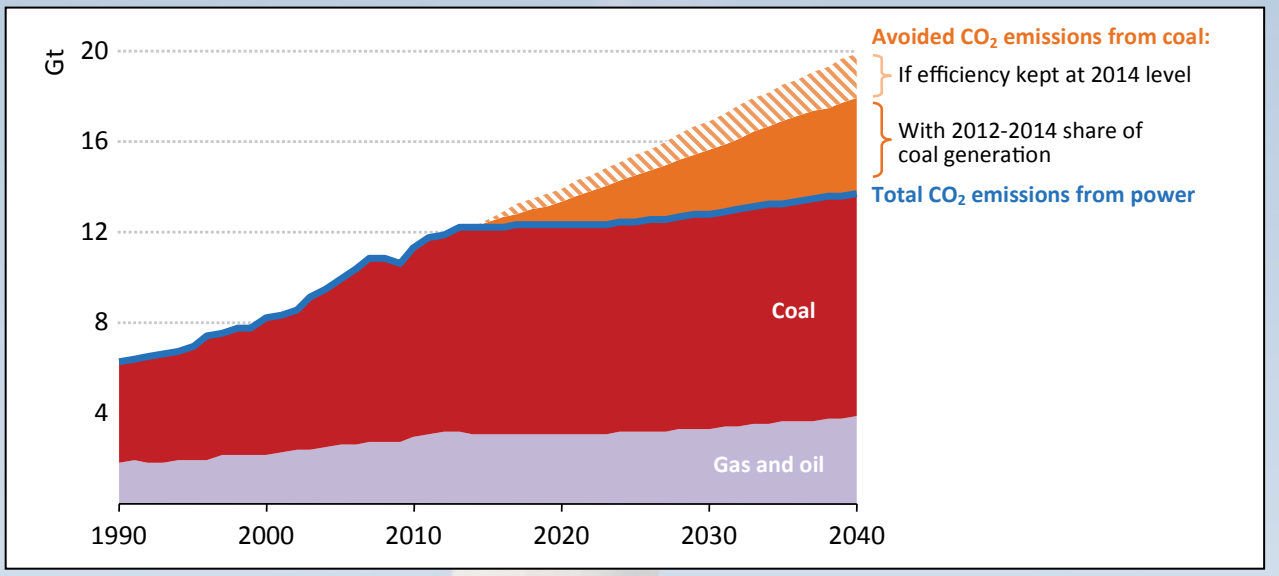
For its part, Latvia is in the process of reforming its national gas sector in relation to the EU's Third Energy Package. This may not be completed until 2017. Latvia is considering the creation of one company that would be responsible for transmission and storage and another for trading that would be involved with distribution. But until Latvia completes its reforms, gas shipments from Lithuania could likely be stalled.

The Baltic States, Poland and much of Eastern Europe have been almost wholly dependent on gas supplies from Russia, which is accused of abusing its position and charging the countries exorbitant prices. Aware of this, the EU is working to increase and expand gas pipeline connections through the EU and in Eastern Europe in particular with projects such as the North-South pipeline system and the Vertical Gas Corridor in Southeast Europe.

The EU hopes to reach a point where gas grid systems would enable connections from the Baltic, Adriatic and Black Seas in an effort to create an integrated gas distribution system. There is also the possibility of LNG entering Europe from one or possibly two terminals in Greece. Each geographic location provides an opportunity to US LNG exports.

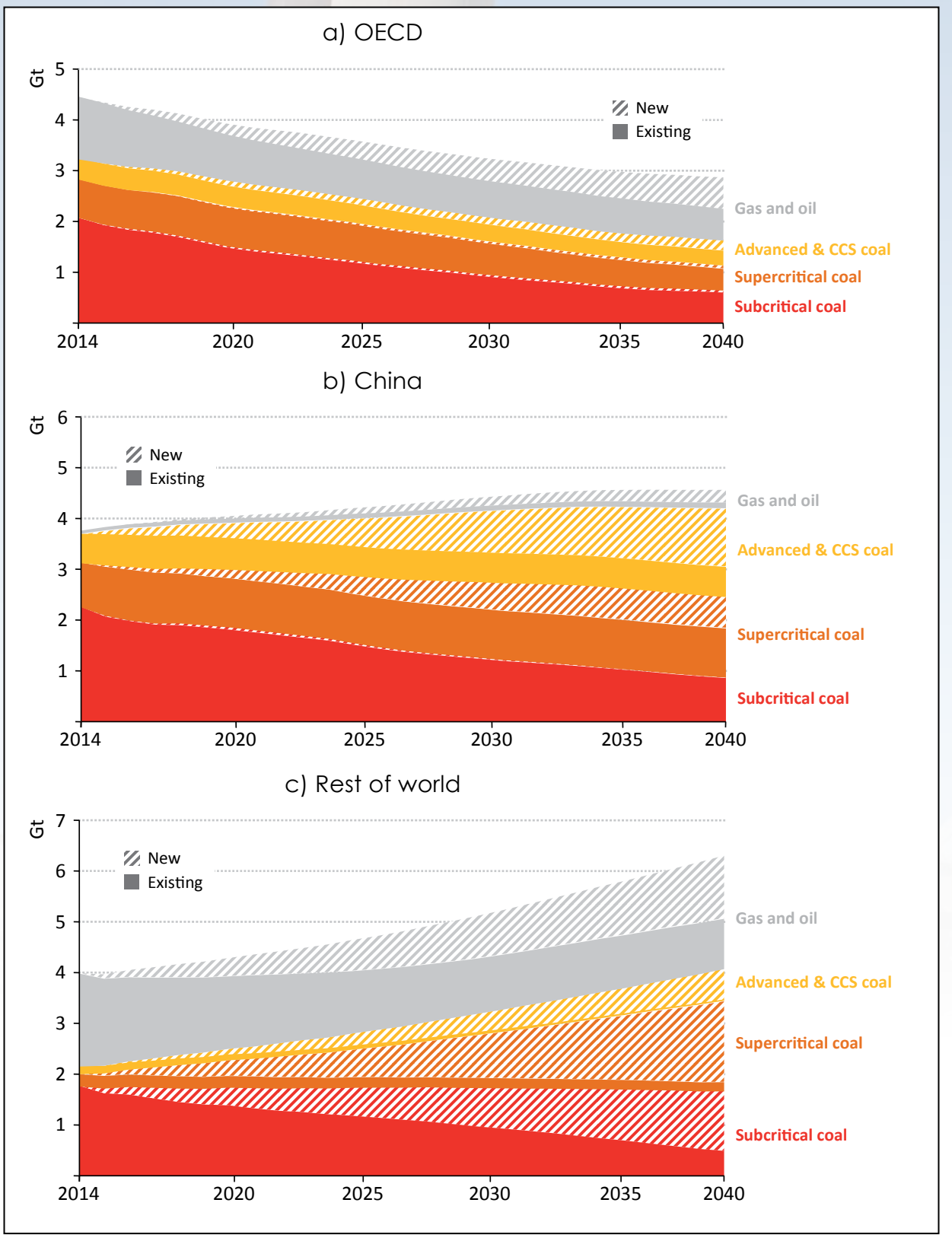
Meanwhile, the Baltic States are also considering a move to connect their electricity grids with Scandinavian countries, another move that will decrease their energy dependence on Russia.

CO_2 emissions from power generation by fuel in the New Policies Scenario



World Energy Outlook 2015, © IEA/OECD, Figure 8.17; page 335

CO_2 emissions by fuel and coal technology in selected region



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Source: World Energy Outlook 2015

The long road from Paris

Over the last few years, the World Energy Council has been analysing areas for improvement in the policies of the 130 countries. Its latest annual Energy Trilemma Index report is key and core to developing a pathway beyond COP21.

Joan MacNaughton

As we approach the 21st Conference of the Parties (COP21) in Paris, we have an opportunity to build on the positive platform that has been created by over 140 countries submitting their Intended National Determined Contributions (INDCs) setting out their commitments to reduce greenhouse gas emissions.

While the extent of these commitments is unprecedented, and shows great promise for the global effort to address the challenge of climate change, the real work is just beginning – to agree a mechanism for monitoring outcomes and for reviewing commitments in future so that they can grow to ensure we contain average global temperatures to no more than 2°C above pre-industrial levels.

The setting of a clear, measurable, global emissions reduction target responds to the call from more than 2500 industry leaders and policymakers whom the World Energy Council, supported by global consulting firm Oliver Wyman, has surveyed. As set out in our 2015 *World Energy Trilemma Report*, they called for the target to be underpinned by five policy enablers which are key to the successful transition to a low carbon energy system:

- Remove barriers to trade and enable technology transfer, including tariffs on environmental goods and services, and protecting intellectual property rights
- Set a carbon price to level the playing field and redirect investment towards low-carbon solutions
- Provide the right policy signals to scale up investment, accompanied by a portfolio of bankable projects to attract more private capital
- Place greater emphasis on demand management including increasing energy efficiency across all sectors covering residential, commercial, industrial and transport
- Prioritise innovation, principally in the investment case for new technologies, and move into a new era of collaboration on R&D between the public and private sectors.

While some countries have in place some of these enablers of the transition to a low carbon economy, for many of them translating their INDCs into effective national level actions will be a stretch. The key to success rests on applying an "Energy Trilemma" approach, ensuring that all three goals – energy security, energy equity and environmental sustainability – are addressed. We know that priorities will vary from country to country, but our research shows that failure to balance the three pillars of the Trilemma is fatal to delivering a sustainable energy system.

Over the last few years, we have been analysing what works. Our latest annual Energy Trilemma Index report, published on 11th November, registers areas for improvement in the policies of the 130 countries we have assessed across the three dimensions of the energy trilemma. This year only two countries, Sweden and Switzerland, achieved a 'AAA' balance score.

McNaughton: The key to success in translating INDCs into effective national level actions rests on applying an "Energy Trilemma" approach

The UK rating was downgraded to a 'AAB' reflecting the impact of the rising cost of electricity in relation to the cost of living and it remains on the negative watch list because of the risks to energy security posed by the complex reform of its electricity market and the need to replace ageing legacy infrastructure. The UK retains a high ranking – fourth overall – and remains a "Pack Leader". But its downgrading, and its being on negative watch, is symptomatic of the challenges faced by countries across the world to apply a balanced approach to energy policy while securing the finance to transform their energy systems.

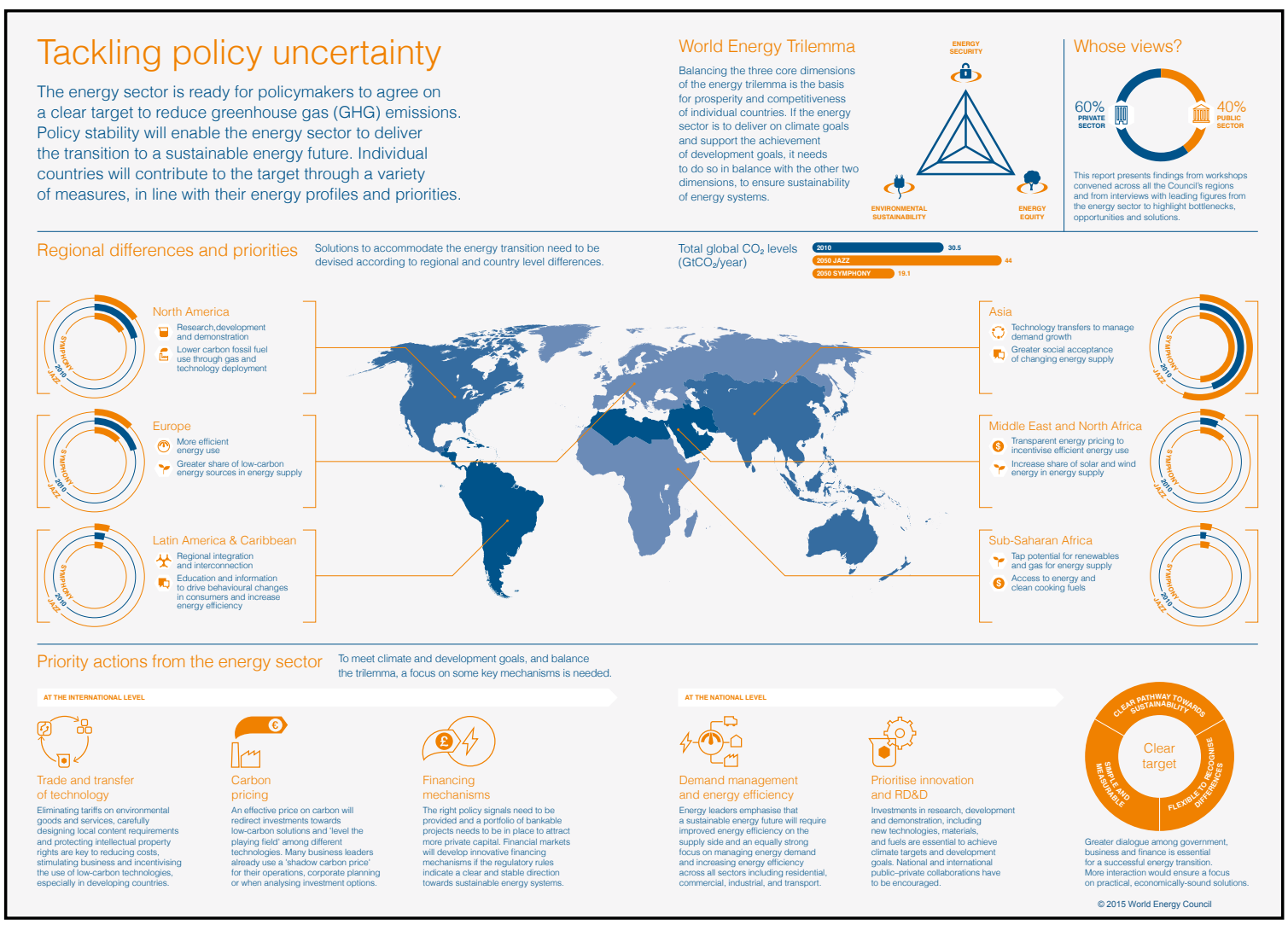
What the 'AAA' countries have in common is stable and consistent policy frameworks that are clearly articulated and communicated. All energy business leaders tell us that this is fundamental if their industry and the finance sector are to have the confidence to unlock the around $68 trillion investment which the low carbon transition requires by 2040, according to the International Energy Agency.

The Index is key and core to developing a pathway beyond COP21. It helps each country understand the challenges and identify their own particular opportunities for how to build a more sustainable energy mix, providing practical recommendations on a national level on how to make changes in order to meet their INDCs commitments on the long road that will inevitably emerge from Paris. Indeed, some governments are already drawing on our results to help them devise well targeted policies.

But the pace needs to pick up – even if it is a 'long road from Paris', it has become clear over the five years that the Energy Trilemma Index has been published that progress is slow. It will only be sped up by more collective engagement of policymakers, energy business leaders, and the finance sector, to translate the words of the INDCs into effective actions at national level.

The 2016 World Energy Congress will be the first major meeting of energy leaders after COP 21. It provides an unparalleled opportunity for them to take stock of the implications of the Paris agreement, to share approaches and solutions so that all countries have strategies and actionable plans commensurate with the promises made for COP 21 and their responsibilities to their people for protecting them from the ravages of runaway climate change.

Joan MacNaughton is World Energy Council Executive Chair of the World Energy Trilemma.



Turning up the heat

Gas fired combined heat and power has its challenges in Europe but opportunities still exist for the right technology in the right situation. **Junior Isles**

Combined heat and power (CHP) or cogeneration is seen by many as a cornerstone to Europe meeting its energy efficiency target, and an important technology in tackling climate change. According to the European Commission, increased cogeneration could lower greenhouse gas emissions by up to 250 million tonnes by 2020.

The potential for more cogeneration is significant. The European Roadmap of the CODE (Cogeneration Observatory and Dissemination Europe) 2 project, published at the turn of the year, estimates that 122 GWe in CHP capacity could be added by 2030 to the existing approximately 110 GWe. At the same time, it says CHP could generate 1264 TWh of heat (an increase of around half on current levels) by 2030 using a range of increasing amounts of renewable energy sources. CODE 2 also notes that cogeneration could further reduce total inland energy consumption by 870 TWh – more than the 2030 total projected gross inland energy consumption of the Czech Republic, Slovakia and Slovenia (830 TWh).

As part of its 2012 Energy Efficiency Directive, whereby the EU must reach an energy efficiency target of 20 per cent by 2020, the Commission has stipulated that each EU country carries out a comprehensive assessment of the national potential of cogeneration and district heating and cooling (a main user of cogeneration) by December 2015.

Further, 2016 sees the publication of Europe's first-ever heating and cooling strategy, with revision of the main EU legislation to promote energy efficiency and the introduction of measures to revise electricity market design. The outcome of these changes will fundamentally affect the profitability of combined heat and power (CHP) plants in Europe.

As Europe's industrial heartland, Germany is the major CHP player and is continuing its efforts to maintain leadership in the sector.

Germany has a target of 25 per cent electricity of thermal power generation from cogeneration by 2020. The current level, however, has stabilised at around 17-18 per cent since 2010. The government therefore put forward proposals in August aimed at increasing the share of cogeneration in power supply.

Under the new rule, scheduled to come into force on January 1, 2016, new cogeneration units would have to be fired with gas; coal would be ruled out. Tariffs received for new installations will be increased and a bonus would also be paid so that existing units running on coal could be retrofitted for a switch to gas.

According to the draft proposal, support will amount to:

- €8 ¢/kWh for installed capacity up to 50 kW
- €5 ¢/kWh for installed capacity over 50 kW up to 250 kW
- €4.4 ¢/kWh for installed capacity from 250 kW up to 2000 kW
- €3.1 ¢/kWh for installed capacity above 2000 kW.

In line with the government's plans to reduce CO_2, the surcharges increase by an additional €0.6 ¢/kWh for capacity that replaces capacity in existing hard coal or lignite powered CHP plants.

Regardless of the increase, however, some observers point out that if CHP is to have a place in Germany's future almost 100 per cent renewable power sector, it would have to become flexible enough to facilitate a system dominated by fluctuating power from wind and solar. This would particularly require more thermal storage.

The use of heat storage and power-to-heat can increase the flexibility and cost-effectiveness of CHP. Several municipal utilities that run local power stations and district heating networks, have invested in such schemes in recent years.

Perhaps the most notable of these installations, in terms of innovation and size, is the recently inaugurated new Stapelfeld CHP project owned by HanseWerk Natur GmbH. At nearly 10 MWe, it is the largest and most powerful CHP plant in Northern Germany. The plant will produce power for 21 500 households and heat for 6000 average single-family homes in Northern Germany.

HanseWerk Natur GmbH, a wholly-owned subsidiary of HanseWerk AG, is one of the largest regional providers of heat and decentralised energy in Northern Germany. It owns around 200 decentralised plants in Hamburg, Schleswig-Holstein, Mecklenburg-West Pomerania and Northern Lower Saxony.

The company's district heating networks total more than 900 km. Using heat connection networks and numerous CHP and heating plants, HanseWerk Natur reliably supplies residential buildings, public facilities and commercial operations in Northern Germany, 24 hours per day, 365 days per year.

In addition to decentralised energy production, HanseWerk Natur is actively encouraging the future of energy with innovative projects, such as highly efficient CHP plants with an efficiency coefficient of nearly 100 per cent, virtual power plants for the generation of operating reserves, or the hybrid model, a CHP plant with a combined heating network designed to retain excess heat or to extract heat when additionally required.

Its Stapelfeld plant is perhaps the most significant of its projects to date. It represents an investment of €6.8 million, which will cut CO_2 emissions by about 60 per cent, i.e. more than 11 000 t annually. It is also an important project for GE in Jenbach, the supplier of the J920 Flextra genset at the heart of the project.

It is not the first time GE's Jenbacher gas engine technology has been used in such an application in the region. The company has installed a J624 and three J620 engines at the Stadtwerke Rosenheim cogeneration facility, which notably is also the site of the first J920 Flextra field validation unit. This unit has been operating at the installation since April 2013.

Like Stapelfeld, the Stadtwerke Rosenheim installation is also a CHP plant with district heating and thermal storage. Stapelfeld, however, takes heat recovery and therefore overall efficiency to the next level. In addition to recovering heat from the engine and an adjacent waste incineration plant, the new installation also includes a heat pump to further boost the amount of heat that can be fed into the heating network.

The heat pump adds an extra 3-4 per cent in plant efficiency by capturing low-grade heat from three sources: heat from the engine room; heat from the generator cooling; and heat from a heat exchanger at the engine exhaust, known as the condensing heat exchanger. The temperature of each heat source is around 30°C. The heat pump raises this temperature up to 70°C.

The heat pump consumes about 160 kW but uses the heat sources to generate an additional 840 kW of heat, increasing the annual heat output of the plant by up to 6.7 GWh for district heat. Using every scrap of energy in this way gives Stapelfeld an overall energy conversion efficiency of more than 95 per cent, according to GE.

Such a high efficiency is important to the profitability of HanseWerk Natur. Although the company did not reveal the additional cost of the heat pump, it said its inclusion still made sense because of the high economic value of the heat.

While noting that the plant would have been more profitable under the new CHP law, Thomas Baade, CEO of HanseWerk Natur said: "Heat accounts for a high proportion of our revenue. There would have been greater profit had we started next year but the plant is still profitable now even with the current subsidies in place."

Baade also noted that the new plant also enables HanseWerk Natur to take advantage of the electricity market. The flexible gas engine in Stapelfeld is well suited for grid stabilisation. This is becoming ever more critical in a market where the increasing amount of fluctuating wind and solar is presenting challenges for the power grid.

HanseWerk Natur will integrate the new CHP plant into its virtual power plant, which already consists of 65 CHP plants. As part of the virtual power plant, CHP plants operate as an interconnected generating asset to respond quickly to a surplus of electricity in the network (negative operating reserve). If there is a power shortage, the CHP plant in Stapelfeld is able to feed energy into the grid within five minutes (positive operating reserve).

"This allows us to make a significant contribution to the stability of power supply in the Hamburg metropolitan region," said Baade. "The high versatility of the new plant is crucial for this project."

The importance of flexibility was evidenced in August this year when GE signed a contract to install 20 Jenbacher J920 gas engines for Stadtwerke Kiel. The new cogeneration plant will supply a total output of 190 MW of electrical and 192 MW of thermal energy, which will be fed into the electrical and district heating network, thus contributing to grid stability.

As Germany pursues its *Energiewende*, such plants will become increasingly important – both in terms of maximising energy efficiency and helping with the integration of renewable energy sources.

Accordingly, GE sees the country as a key market for gas engines. "It's a critical market for us," said Oliver Klitzke, Executive Operations, GE Germany. "Because there are the heat networks, and the industry as one of the off-takers, CHP is one of the main drivers of the German power market and a significant pillar of the German *Energiewende*."

Although Europe remains the world leader in CHP, providing 15 per cent of its heat requirements and 11 per cent of its electricity needs, the main barrier to future growth is the currently weak business case. A low spark spread, low CO_2 prices and slow economic growth are combining to make a difficult market.

Nevertheless, significant opportunities remain in applications where there is a need for large amounts of hot water and there is the possibility to take advantage of a dynamic electricity market. Such scenarios bode well for installations like Stapelfeld that use flexible gas engine technology.

Stapelfeld is taking heat recovery, and therefore overall efficiency, to the next level

Pushing the boundaries of multi-terminal UHVDC

The first phase of a new multi-terminal UHVDC link has been recently commissioned in India. Operating at 800 kV, the 8000 MW link sets a new world record for power converter capacity.

Junior Isles

Although the Himalayas in the northeast of India has abundant and untapped renewable resources, load centres are thousands of kilometres away. In a move to address the shortage of power in north India, the first phase of a new ultra high voltage direct current (UHVDC) transmission line, known as the North-East Agra link, was recently commissioned for transmitting power to Agra for onward distribution across northern India.

Energising of the link on September 29th this year marks a major milestone in the evolution of HVDC technology. It is the world's first multi-terminal UHVDC link to operate at a voltage of 800 kV, and sets a world record in terms of converter capacity (8000 MW).

The $1.1 billion contract for the project, awarded in 2011, is being executed by ABB together with government-owned power company Bharat Heavy Electricals Limited (BHEL) on a turnkey basis. ABB's order scope worth $900 million covers design, system engineering, supply, installation and commissioning of the HVDC link for Power Grid Corporation of India Ltd (POWERGRID), India's central transmission utility.

It is the fifth HVDC project to be built by ABB in the country, which, along with China, is fast becoming a proving ground for advances in high voltage power transmission.

HVDC has several advantages compared to HVAC technology. In the case of the North-East Agra project, two benefits that were most important are its significantly lower losses over long distances and its smaller footprint.

A 2000 km DC transmission line at 800 kV loses about 5 per cent of its power to heat, while the power losses in an AC line of similar voltage are about twice as high. For ABB's 'HVDC Classic' technology used in the project, the losses are estimated at about 0.5 per cent per converter station per pole. Meanwhile, its transmission corridor is about one third of that needed for an AC circuit. This is crucial in the North-East Agra project, as the line must pass through a narrow strip of land some 22 km wide and 18 km long that borders Nepal in the north and Bangladesh in the south, and connects the Northeast region with the rest of India.

The North-East Agra UHVDC link transmits clean hydroelectric power from India's northeast region to the city of Agra over a distance of 1728 km

Commenting on the need for the technology in the North-East Agra project, Patrick Fragman, Managing Director of ABB's Grid Systems Business Unit said: "The distance to Agra is in excess of 1700 km. Over such a distance you are far beyond the limits of traditional AC technology. And given the amount of power, you have to resort to ultra high voltage DC technology to minimise losses."

The 6000 MW UHVDC link will use four terminals in three converter stations with a 33 per cent continuous overload rating, enabling up to 8000 MW conversion (thus providing for contingencies) at ±800 kV. This is the highest ever converter capacity.

Two of the three converter stations positioned as 'sending' stations – one in Assam called Biswanath Chariali and the other in west Bengal called Alipurduar – convert power from AC to DC. Power from the two points is then pooled together and transmitted over a single DC power line that passes through the Siliguri Corridor before being delivered to a 'receiving' station in Agra where it will be converted back into AC for distribution to end users.

While this will be the standard mode of operation, reverse power flow from Agra to the northeast is another feature of the link, as this might be needed in the future. "There are some scenarios where power from the Agra area could be sent to the northeast," said Fragman.

He added: "Unlike point-to-point HVDC, there is some flexibility in how the in-feed is managed, from one terminal to the other. The multi-terminal application makes it quite easy to operate. If one of the poles is down, power can still be transmitted by upping throughput in the other pole."

The multi-terminal solution considerably reduces footprint and costs compared to the alternative of running separate power links from multiple hydropower plants to Agra.

Although multi-terminal HVDC technology has been available for some time, this is only the second to enter operation. According to ABB, it installed the first such link in North America (Québec-New England) in the 1990s but at a much lower voltage level.

According to Fragman, ABB's long experience with the technology has allowed it to push the voltage levels and capacity over the years. Having in-house expertise and manufacturing capabilities in the necessary power electronics, transformers, switchgear, etc., helps it to surmount the challenges others might face.

"There are some key areas that are always a little bit tricky and require experienced people. For example, experience in the area of control and protection is needed to perform the systems studies. ABB has good knowledge in this area," said Fragman. "Understanding the design margin of each component, allows us to optimise them from a system point of view."

He says the North-East Agra project was more of an evolution of the technology that ABB was already working on. "It was not a huge step in itself. This system is 800 kV but we have already been working on 1100 kV systems that have a capacity of 10 GW or more."

With commissioning of the first pole now complete, demonstrating the flow of 1500 MW in both directions, it is expected that the remainder of the project will be completed during the second half of 2016. When fully commissioned the link will have the capability to serve around 90 million people, based on average national household electricity consumption.

For India, it is a significant and timely project. As COP21 approaches, it will allow the country to demonstrate its commitment to its climate change agenda by avoiding the building of coal fired generation in favour of wheeling hydropower from the north. The link also provides the flexibility to transfer wind generation in the other direction when required.

The North-East Agra project is an important reference for other countries in Asia and Africa that need to transmit large amounts of power over long distances.

Fragman concluded: "For ABB, it's another demonstration of the increasingly deployed HVDC technology, which has the potential to be replicated across the globe. It is also in line with our 'Next Level Strategy' aimed at growth in satisfying energy needs in an environmentally friendly way; and secondly it demonstrates our commitment to on-time, on-cost and on-quality project execution."

The Assam sending station valve hall

Time to get down to business

Junior Isles

No doubt it will be jackets off as negotiators get down to intense discussions at climate change talks in Paris. The UNFCC's 21st Conference of Parties (COP21) summit in Paris is seen by many as the 'last chance saloon' in securing a credible global deal designed to avoid the consequences of catastrophic climate change.

As talks scheduled to last nearly a fortnight get underway, there is an air of cautious optimism. Certainly there has been unprecedented political momentum on climate change. Going into Paris, more than 150 countries have submitted pledges stating how, and by how much, they would reduce emissions by 2030.

Although this is a big step in the right direction, it is well known that it is not enough. While calculations show they will deliver a cut in emissions that are an improvement on business as usual, they are still insufficient to keep global temperatures from rising above the 2°C limit.

At the launch of its *World Energy Outlook 2015* in mid-November, Dr Fatih Birol new Executive Director of the International Energy Agency (IEA) said the global temperature has already risen 1°C above pre-industrial levels and will breach the 2°C limit 50 years from now.

If the pledges are implemented, the IEA calculates that global temperature will increase by 2.7°C. This, it says, will have serious implications.

"This rise is higher than the 2°C limit scientists tell us is needed to have a planet that is more or less like it is today. The difference between 2°C and 2.7° is not something where you can just take your jacket off and get on with life. It will have major implications for all of us," said Dr Birol.

He also stressed that "even the 2.7°C is not in our pocket" because the pledges are not yet legally binding.

> ... climate negotiators have their work cut out....with the current pledges on the table only getting us to a 2.7°C world, the big question still remains: how to get from there to below 2°C?

Speaking at the Economist Energy Summit last month, Mark Kenber, CEO, The Climate Group, said he saw the battle against climate change as a "marathon" and that "we need to start thinking about 2050".

Later, he told *TEI Times* that one of the key things that must come out of Paris is agreement on a long-term objective.

"The INDCs run through 2025 or 2030 but it's important that we have 2050 targets so that everyone, whether it's investors, businesses or governments, can build their plans. This is absolutely fundamental. We know Paris is not going to get us immediately on a 2° trajectory."

Indeed history shows that much can be achieved with clear long term targets, accompanied by the policies to back them up. The Montreal Protocol and the US Clean Air Act are good examples. Taking a long-term approach invariably results in targets being reached faster than expected and at lower cost.

Finance will certainly be a thorny issue during talks and probably will be the one that may see negotiations run into overtime. But another important outcome, and something that should be achievable is agreeing on a process going forward.

An effective process is required to facilitate the achievement of long-term goals. Having a lengthy negotiating process every time a new five-year commitment has to be agreed is not effective.

Kenber noted: "We are all aware that these UN processes are unwieldy, time consuming and fraught with politics, so you want to de-politicise, as much as possible, the increasing of ambition."

Paris therefore aims to secure rolling five-year commitments. Essentially this means that the next set of targets are automatically agreed – on the basis of progress made, new scientific evidence or technology developments, etc. – in line with the long-term target.

Most of the focus of the climate negotiations has been on what is known as Workstream 1, i.e., securing a global agreement, the underlying INDCs, etc. This kicks-in post-2020. Workstream 2 is about raising ambition levels between now and 2020 – according to the science, global emissions need to peak some time during the next five years. This will not happen with the INDCs submitted to date.

The big question, therefore, is where will the additional effort come from and what technologies will need to be employed in the near-term?

As has been seen with initiatives such as the RE100 campaign, the immediate effort will come from businesses, corporations and investors, as well as cities and state and regional governments. Beyond the next five years, it will be non-state actors that provide the additional effort needed to close the emissions gap.

With the falling cost of renewables, increased energy efficiency and demand side management, as well as technology developments such as energy storage, Kenber believes it could be "easier than people suspect" to achieve the targets.

With the 2°C target "under enormous pressure", David Walker, CEO of Energy at DNV GL, says there has to be a more holistic approach – at both national and international level – on the use of technology to tackle climate change.

Although a key component, it is not solely about accelerating the share of renewables, or replacing coal with gas or nuclear. There also has to be a focus on interconnectors and storage to provide back up for renewables and improving system security.

"Other technologies have to be considered as part of the mix," said Walker. "Renewables are intermittent, so we have to think more about how to blend them into the energy mix. We have to ensure that we have the right level of interconnectivity between markets and introduce storage as an offsetting capability within markets as well so cleaner energy can be shifted around the systems. The grid is often ignored, with there being too much of a focus on generation."

It is a fair point. Indeed many parts of the media are guilty of perpetuating the fixation on generation. Several national newspapers in the UK reported alarmingly that, with low wind power production and a lack of reserve generating capacity, National Grid had to import power and use demand-side management to address the situation. Arguably, this is how an electricity system should function.

Walker commented: "It was all spoken about as if some dreadful thing had happened because the UK didn't have enough backup capacity – which probably would have had to be coal or diesel. But what happened was the new future we should be looking at. So rather than National Grid being condemned, I would say that in this case they should actually be praised for using a menu of techniques to solve the problem without having to have a lot of excess capacity."

In the weeks ahead of COP21, stakeholders in the various sectors were lobbying for their technology to be part of the global climate change solution.

For its part, the IEA says the energy sector is responsible for two thirds of the emissions and therefore is at the heart of the climate challenge. It is suggesting four things to climate negotiators.

Dr Birol said: "First, we would like to see the coverage of the mandatory energy efficiency policies accelerated. Second, the support for renewables needs to increase. Third, we ask for the building of inefficient coal fired plants to be banned; and fourth, we would like to see the reduction of methane emissions from oil and gas production." Sound advice, even if not quite the holistic approach encouraged by Walker.

With recommendations coming from all corners, climate negotiators have their work cut out. No doubt there will be some form of deal in Paris but with the current pledges on the table only getting us to a 2.7°C world, the big question still remains: how to get from there to below 2°C? Clearly the work does not end in Paris; if anything, it is just the beginning.

Jackets are off and will have to stay off for some time yet.