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Plugging the leaks

Carbon leakage is a major issue for Europe and its Emissions Trading Scheme.

Page 13



Final Word

Germany wins on and off the football pitch, says Junior Isles

Page 16



News In Brief

EU funding boost for CCS

Carbon capture and storage technology may finally start making some headway in Europe following the announcement of EU funding for a large-scale project.

Page 2

CFE prepares for new plant tenders

Investment in Mexico's energy sector is preparing to ramp up in the wake of the country's efforts to reform elements of its oil, gas and power sectors.

Page 4

India gets solar back on track

Following delays and trade disputes, India appears to be getting the Jawaharlal Nehru National Solar Mission back on track.

Page 6

Offshore wind growth slows

Offshore wind remains the fastest growing power sector in Europe in spite of a contraction in installations in the first half of 2014.

Page 7

Italian acquisition adds string to Westinghouse bow

Westinghouse is venturing into the oil and gas business in a move that the nuclear firm hopes will help to balance its business.

Page 9

Energy Outlook: Integrating renewables

As renewables deployment reaches saturation in a number of European markets, the challenges of integration are becoming increasingly far-reaching.

Page 14

Technology: Ashlim is another tower of power

The completion of financing for a solar power tower project in Israel is another important milestone in the technology's deployment.

Page 15

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China-US climate cooperation focuses on CCS

China and the US are strengthening their cooperation on technology to tackle climate change ahead of Paris next year. **Junior Isles**

A new strategic partnership between China and the US aimed at tackling climate change will provide a much needed stimulus to carbon capture and storage (CCS) technology.

Four of eight partnership pacts signed between the two countries in Beijing last month deal with the exchange of technology regarding the exploitation, use and storage of carbon. The other four focus on smart grids.

The partnerships and consensus between the two nations were forged to curb carbon emissions, share technological knowledge and encourage pro-business opportunities. They are also being viewed as a determining factor for the signing of a global climate pact

in Paris next year to substitute the Kyoto Protocol.

In a joint press conference following the sixth round of the US-China Strategic and Economic Dialogue, US Secretary of State John Kerry said: "With these joint measures we hope to send a clear message: two countries with the largest emission of greenhouse gases in the world have come together to promote economic growth with lower carbon emissions."

Xie Zhenhua, Deputy Director of China's National Development and Reform Commission said that cooperation on climate change signaled a "new model of major-country relationships."

The fact that half of the partnerships are focused on a single climate change mitigation measure – carbon dioxide capture, utilisation and storage (CCUS) is significant.

China and the US are world leaders in CCUS research and development, and the agreements build on a long history of CCUS collaboration between the two nations.

Sarah Forbes, a senior associate at the World Resources Institute (WRI) commented that the "China-US partnership on CCS has in many respects now left the theoretical feasibility realm and entered the 'steel in the ground' phase".

Under the four CCUS partnerships

Huaneng Clean Energy Research Institute and Summit Power Group LLC agreed to collaborate on clean coal power generation technology i.e. integrated gasification combined cycle (IGCC) and CCUS/enhanced oil recovery (EOR); Yangchang Petroleum Corp. Ltd, Air Products and Chemicals, and West Virginia University agreed to cooperate on a clean fossil energy demonstration in northern Shaanxi (EOR); Shanxi International Energy Group agreed to work with Air products on a feasibility study for pairing a 350 MW Oxygen Combustion plant with a CCUS demonstration; and

Continued on Page 2

Australia goes against the climate change tide

Australia's decision to scrap its carbon tax is likely to cause dismay among its G20 partners who are working towards a global climate deal in Paris next year.

The Senate recently voted 39 to 32 to axe the AU\$24.15 (\$22.60) tax per metric ton of carbon dioxide that was introduced by the centre-left Labour government in July 2012.

Prime Minister Tony Abbott's conservative coalition government rose to power last year on the promise of getting rid of the tax, assuring voters that removing it would reduce household electricity bills. He plans to replace the measure with a taxpayer-financed AU\$2.55 billion (\$2.40 billion) fund to pay industry incentives to use cleaner energy.

Under the scheme known as Direct Action, the government would give grants to companies who invest in measures to curb emissions in order to help Australia meet its existing

target of cutting emissions by 5 per cent by 2020.

The OECD, however, says such schemes are not effective. Clive Palmer, leader of the Palmer United Party (PUP) labelled it a "waste of money" and has warned that his senators will block the policy in the new upper house.

Abbott, who insists he believes in climate change science, said: "The tax that you voted to get rid of is finally gone: a useless, destructive tax which damaged jobs, which hurt families' cost of living and which didn't actually help the environment."

Opposition leader Bill Shorten lashed out at Abbott after the vote, calling him an "environmental vandal".

He argued: "Tony Abbott has made Australia the first country in the world to reverse action on climate change. History will judge Tony Abbott very harshly for refusing to believe in

genuine action on climate change. Tony Abbott is sleepwalking Australia into an environmental and economic disaster."

Some observers argue that Australia should, as current holder of the G20 presidency, be seeking to influence the global debate on climate change. Just as other countries are looking to put in place their own carbon taxes, they say, Australia is voting to scrap it.

Tim Stephens, associate law professor at the University of Sydney, said: "By scrapping carbon pricing Australia risks isolation at future climate change negotiations as it will not be able to prove to others it will be able to cut its own emissions."

Removal of the carbon tax could leave power generators – the country's largest emitters of carbon dioxide – billions of dollars better off while giving the largest power retailers additional ability to offer deeper

price discounts.

"Energy retailers will see a fall in costs," UBS analyst David Leitch said. "The issue is how much will they pass on? Let the free market work that out," he said.

Australia is one of the world's worst greenhouse gas emitters per capita, largely because of its heavy reliance on the nation's vast reserves of cheap coal for electricity.

Scrapping the levy will result in the country's two greenest power generators – Snowy Hydro and Hydro Tasmania – emerging as the biggest losers. The Tasmanian producer was likely to halt exports to Victoria as the flow of electricity to the mainland from Tasmania was expected to be reversed.

According to Dr Hugh Saddler of consultant Pitt & Sherry this would enhance the position of the brown coal generators in supplying the Victorian market and also Tasmania.

Kerry: "two countries with the largest emission of greenhouse gases in the world have come together"

Continued from Page 1

Shengli Oilfield (SINOPEC) and the University of Kentucky agreed to cooperate on a large—one million tons of CO₂ per year—CCUS demonstration (post-combustion capture and algae).

While collaboration on CCUS between China and the US is not new, the MOUs bring US-China partnerships to another level by pairing US projects with similar projects in China so companies and research institutions can share information. Such collaboration could help spur CCUS innovation in both countries and accelerate the demonstration and early deployment phase of CCUS globally.

Forbes stated: “Everyone wants to know when power plants equipped with CCUS technology will start providing electricity for people. The unsatisfying answer is that it depends on the success of the first tranche of large-scale CCUS projects, as well as how serious governments are about tackling climate change.

“Many are looking to the United States and China for answers to these questions, as the two countries are furthest along with their own CCUS development.”

According to the Global CCS Institute, there are 65 CCS projects in various stages of planning and construction worldwide, with seven already operating. The US leads global development, with 19 of these large-scale projects. China comes in second with 12 projects.

As the only technology able to remove CO₂ from coal and gas fired plants, as well as from some industrial process, the deployment of CCS/CCUS is seen as essential in the fight against climate change.

“As temperatures continue to rise,



Lima will host COP20 in December

communities around the globe are feeling the effects of climate change in the form of sea level rise, extreme weather, and heat waves. CCUS will only be able to contribute towards a low-carbon world if demonstration and deployment is accelerated,” states the WRI.

In December this year Lima, Peru, will host the 20th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC - COP 20), during which a draft text will be produced for a decision at the Paris convention. The COP 20 will focus on four key areas – Adaptation, Climate Finance, Mitigation and Technology.

The first ever United Nations Environment Assembly (UNEA), held in Nairobi, Kenya, in June, had a keen focus on the upcoming COP 20 and on the wider Sustainable Development Goals (SDGs). June also saw the creation of a zero draft on the SDGs, with 17 potential goals. This number will most likely be reduced to 10 or less in Peru.

At last month's G77+China summit in Bolivia, the Peruvian President Ollanta Humala Tasso met with the UN's Secretary General Ban Ki-moon to discuss his country's hosting of the COP 20 and to reiterate Peru's commitment to climate change.



EU funding boost for CCS

Carbon capture and storage technology may finally start making some headway in Europe following the announcement of EU funding for a large-scale project. **Junior Isles**

EU climate change chief, Connie Hedegaard, says the funding of Europe's first large scale carbon capture and storage power plant would help the technology “make a substantial step forward” in Europe and shed light on the true potential of carbon capture and storage (CCS) in fighting global warming.

Drax, the operator of Britain's biggest power station, has secured up to €300 million (£238m) of European Union funding to build a power plant whose carbon dioxide emissions will be captured and transported by pipeline for permanent storage under the North Sea.

The new plant, called White Rose, is a joint venture between Drax, Alstom and BOC. It will be built on land next to Drax's existing power station near Selby in Yorkshire and will capture

90 per cent of the power station's CO₂ emissions.

White Rose applied for funding from the European New Entrants Reserve (NER) 300 programme a year ago. NER300 is a fund set up by the European Commission to encourage low-carbon energy projects.

The award to White Rose is one of 19 projects across the EU to receive total funding of €1 billion. The NER programme is designed to encourage private investment in green energy programmes.

Hedegaard said: “With these first-of-a-kind projects, we will help protect the climate and make Europe less energy dependent. The €1 billion we are awarding today will leverage some additional €900 million of private investment.”

The Association of UK Coal

Importers (CoalImp) welcomed the announcement. It stated: “For the UK to continue to benefit from the world's most abundant and low cost fuel, it must take a leadership role with CCS.”

Some, however, have questioned the time it has taken for the EU to grant funding for CCS projects.

“This funding has come much later than anyone wanted it to,” said Jim Watson, Research Director at the UK Energy Research Centre. He said the EU had originally hoped to have at least a dozen plants running by 2020.

CCS was once seen as a silver bullet in the fight against climate change but commercialisation has been slow. Some governments in the EU have shied away from the technology because of its complexity and the significant amount of up-front funding

that is required to get projects going.

Hedegaard acknowledged there were still many reservations about the technology. “If you go back five years, people thought ‘if only we had CCS, then it can solve almost anything.’ It is an expensive technology, it is also very energy consuming to equip plants with CCS, so there are many challenges.”

■ The UK Department of Energy and Climate Change (DECC) has reversed its decision to exclude Drax Group from receiving an enhanced subsidy package to help fund the conversion of one of its coal-fired generating units to biomass. The U-turn follows a successful legal challenge by the operator of the UK's biggest power station to a decision by DECC in April to exclude it from receiving a £1.3 billion investment contract.

UK EMR approval will “unlock millions” in new investment

- Capacity market will help UK keep the lights on
- Scheme could result in windfall for nuclear

The European Commission's approval of the UK's Electricity Market Reform (EMR) package could unlock “millions of pounds of investment in energy” according to Energy UK, the trade association for the energy industry. Some observers, however, argue that it will have unintended outcomes.

Energy UK said in a statement: “The renewable Contracts for Difference will bring on new low carbon electricity generation at the lowest possible cost for customers. The switch to a low carbon economy will also be easier as the Capacity Market will make sure we have enough reliable providers of electricity to keep the lights on.”

Approval of the capacity market, however, has been met with dismay in some quarters. WWF said that the market as currently designed does not

represent value for money for consumers and poses a threat to the decarbonisation of the UK power sector.

The Department of Energy and Climate Change (DECC) said it intends to procure a total of 53.3 GW of capacity for the first capacity year in 2018/19 and that 50.8 GW will be auctioned in December of this year, with the balance to be contracted one year ahead of delivery in 2017. This capacity will be contracted through two competitive auctions – one held in December 2014 and another in late 2017.

WWF warns, however, that the government's plans could extend payments to old and polluting coal fired power stations until 2033, putting the UK's power sector decarbonisation goals at risk and potentially pushing up people's energy bills.

Jenny Banks, energy and climate

change specialist at WWF-UK said: “It's hard to believe that a country which has just reaffirmed its commitment to tackling climate change by choosing not to amend the fourth carbon budget is about to introduce a policy which could lock-in vast payments to its oldest and dirtiest power stations until the 2030s.”

In its fourth carbon budget last month the coalition government announced there will be no change to the greenhouse gas emissions targets, which were agreed three years ago. The budget effectively commits the UK to a 50 per cent cut in greenhouse gases, compared with 1990 levels, by 2025.

Some also argue that the capacity scheme could result in unintended windfalls for some operators.

Most industry experts assumed that the capacity mechanism – the cost of

which will be passed to the consumer – was designed to ensure that the many gas-fired power stations threatened with closure would be kept open.

But DECC now admits the scheme will be open to all forms of generation including nuclear, which has low operating costs and therefore could undercut its competitors in the auction to be run by the National Grid.

All but one of the UK's nuclear power plants are owned by large French state-owned utility EDF, whose UK nuclear portfolio includes seven ageing plants due to be closed by 2024.

Cornwall Energy, a power industry consultant, estimates that successful bids by EDF using all seven of its existing plants could be worth £223 million in the 2018-19 financial year and £818 million in total by 2023.

Coal crisis threatens India

India's thermal coal power plant sector is reeling under acute coal shortages. Late last month more than a quarter of the 100 coal-based power plants monitored by Central Electrical Authority (CEA) were reported as having stocks of less than four days.

According to government data, as many as 46 of India's 100 coal-fired power stations have coal stocks of less than seven days. As many as 28 of them have coal stocks of less than four days

and some just two days.

India's power sector, which is heavily reliant on coal, has long struggled with coal supply and power supplies are especially strained now as hot summer temperatures pushes up demand.

Below-normal monsoon rainfall has also reduced generation by hydroelectric plants. However, if monsoon rains pick up, it could further disrupt coal supply efforts as rain leads to decline in mine production.

In a letter to India's Power Ministry, Arup Roy Choudhury, Chairman of NTPC Ltd., India's biggest power company, said: “With the ensuing monsoon, it will become more difficult to replenish the coal stock and in case of even small disruption, the total power generation at these stations will be adversely affected.”

According to Press Trust of India, the country's power, coal and renewable energy minister, Piyush Goyal, said

“corrective” action is being taken to raise coal supplies.

“We are increasing the (coal) crushing capacity, increasing (the number of) washeries in mining areas. We have also appealed to the Environment Ministry to allow us to mine additional fuel wherever there are possibilities,” Goyal told reporters.

Power utilities have also been advised to use imported coal wherever necessary.



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US financing supports Chilean solar plans

The Chilean government faces a fine balance between energy security, growing demand and environmental needs.

Siân Crampsie

Financing has been put in place enabling two major new solar power projects in Chile to move forward.

SunEdison has closed \$155 million of non-recourse debt financing with the Overseas Private Investment Corporation (OPIC), the Inter-American Development Bank (IDB) and Chilean commercial bank CorpBanca for the Maria Elena photovoltaic (PV) plant, while First Solar has received board approval from OPIC and the International Finance Corporation (IFC) for financing to support the 141 MW Luz del Norte PV plant.

The deals were announced after a

visit to the USA by Chilean President Michelle Bachelet, during which US President Barack Obama said that he was keen to deepen ties with Chile and help the South American nation transition to a clean energy economy.

Bachelet is under pressure to reduce the cost of energy in Chile, which relies heavily on fuel imports. Representatives from the country's rapidly expanding industrial sector said last month that electricity costs in Chile were among the highest in the world and had risen by 193 per cent over the last ten years.

SunEdison is planning to build a 73 MW PV plant in the Antofagasta region. The plant will sell its energy

on the spot market, making it one of the largest solar PV merchant plants in Latin America. The project is expected to start operating this year.

First Solar's plant in the Atacama Desert will be the largest PV plant in Latin America. OPIC has approved a loan of up to \$230 million and the IFC board up to \$60 million.

SunEdison said that the Maria Elena project marked a milestone for solar energy. "This power plant demonstrates that photovoltaic solar energy can compete with traditional energy sources and win. It is an international benchmark for the development of solar energy," said Jose Perez, president, Europe, Middle East, Africa and

Latin America for SunEdison.

The Chilean government's National Energy Strategy includes expansion of the country's renewable energy capacity to 20 per cent of its total generated power by 2025. OPIC President and CEO Elizabeth Littlefield said that the country has an "unrivaled" potential for solar power.

The Chilean government has been criticised for favouring renewable energy and natural gas projects over coal and hydropower, which would be a cheaper option, according to Chile's Metallurgical and Metal-Mechanics Industries Association, or Asimet.

Asimet says that the marginal cost of electricity for large companies

connected to the SIC power grid, which serves most of Chile, has not fallen below \$100/MWh over the past three years, and it averaged \$246/MWh in June 2013.

Earlier this year Chile's Energy Ministry cancelled plans for a 2750 MW hydropower project in Patagonia on environmental grounds.

■ The European Investment Bank has announced a €150 million loan to Banco Santander Chile for financing projects that contribute to climate change mitigation and large and medium-scale renewable energy projects in particular. The loan is being granted under the Facility for Energy Sustainability and Security of Supply (ESF).



■ Pemex selects CHP partner ■ Reform legislation sent to Senate

Investment in Mexico's energy sector is preparing to ramp up in the wake of the country's efforts to reform elements of its oil, gas and power sectors.

National power company CFE is planning to offer \$2.8 billion in natural gas and electricity infrastructure project contracts this year, while oil giant Pemex is to invest \$650 million in a new cogeneration plant.

The reforms were pushed through by President Enrique Peña Nieto last year in order to encourage private sector investment in the energy sector and boost economic growth in Mexico.

CFE's projects include two combined cycle power plants, two natural gas pipelines and an electricity transmission project. Companies such as Sempra Energy, Kepeco and GDF Suez are widely expected to bid for the projects, which will undergo an international public tender process.

Pemex said last month it had selected a consortium made up of Invenery Clean Power, Enesa Energia and Mexichem to be its partner in the development of the Cactus cogeneration project in the southeastern state of Tabasco. The 530 MWe plant will start up in 2018, according to Pemex.

Senate committees in Mexico recently approved a set of secondary laws designed to implement Nieto's reforms. The overhaul will end Pemex's monopoly and reverse a decade of falling oil and gas output, as well as provide a framework for private companies to sell electricity on the open market.

The four bills will be passed to the Senate and then the lower house of Congress for approval.

CFE is planning to issue tender documents for the 928 MW Norte III and the 714 MW Guaymas II combined

cycle power plants. Winning bidders will be announced in December.

The Huasteca-Monterrey transmission line will cover 432 km crossing northern Tamaulipas and Nuevo Leon states and include two substations. It is set to cost about \$257 million, and the winning bid will be announced in November.

CFE is also planning a 423 km natural gas pipeline to bring fuel from southern Texas to northern Chihuahua and Durango states. The project is likely to cost \$650 million and the winning bidder will be announced in October.

■ Gamesa has signed a deal to supply 100 MW of wind turbines to a large, unnamed utility. The Spanish firm will provide 50 of its G97-2.0 MW turbines for a project located in central Mexico. Delivery will take place in the first quarter of 2015.

Americas wind sector is "growth engine"

New deal announcements in the North and South American wind markets point to a growing confidence in the sector.

EDF Renewable Energy, Vestas and Gamesa are seeing success in both regions, while Siemens recently announced that it had reached 10 GW of installed wind power capacity in the Americas.

The German firm said that the Americas wind market had been its "major growth engine" over the last few years, accounting for up to 50 per cent of its annual installation numbers over the last decade.

Last month Gamesa signed a deal with EDP Renováveis (EDPR) to supply 95 wind turbines for the 190 MW Waverly wind farm in Kansas, while EDF Renewable Energy signed a firm order with Vestas for 450 MW of wind capacity for projects in New Mexico and Kansas.

Both deals form part of master supply agreements.

In addition, EDF Renewable Energy said it has bought a 96 per cent stake in the 175 MW Pilot Hill wind project in Illinois, USA. The project will consist of GE and Vestas wind turbines and will sell its output to Microsoft Corporation.

Siemens reached the 10 GW installation milestone with the commissioning of the 38th wind turbine at the South Kent wind power project in Ontario, Canada, in June. With a rating of 270 MW, South Kent is one of the largest wind projects in Canada.

Siemens has installed over 5600 wind turbines in Canada, the USA, Peru, Chile and Brazil.

■ The developers of the Cape Wind offshore wind farm have received a \$150 million conditional loan guarantee from the US Department of Energy (DOE). The project will be the USA's first commercial scale offshore project. It will consist of 130 Siemens 3.6 MW wind turbines. Construction could start at the end of 2014.

Auction will boost Brazil solar

Brazil could auction as much as 500 MW of solar photovoltaic (PV) capacity in a reserve capacity auction slated for October, according to market analysts IHS Technology.

The auction is part of Brazil's plan to auction 3.5 GW of solar PV capacity through 2018 and is expected to kick-start the growth of the technology in Latin America, as well as help Brazil to balance its hydropower-dependent electricity system.

Solar power has yet to make its mark in Brazil because of the competitive

cost of wind. However, the plan by the Brazilian Electricity Regulatory Agency (Aneel) to hold separate categories for different technologies in the auction will benefit solar.

Exactly how much capacity will be awarded at the auction has not yet been disclosed, but IHS expects about 500 MW to be available for PV projects in the first round. The ceiling price for the 20-year power purchase agreement (PPA) for bids is likely to be set at approximately R\$250/MWh, or \$112/MWh.

"Bids will be highly competitive," said Josefin Berg, senior analyst for solar demand at IHS. "We expect bid prices to fall to less than R\$200 per MWh, in line with offers from previous Brazil auctions where solar failed to compete with wind."

In light of the new announcements, IHS has increased its installation forecast for the country, and predicts that the annual installed solar generating capacity for Brazil will rise to 1023 MW in 2018, up from 167 MW in 2013.





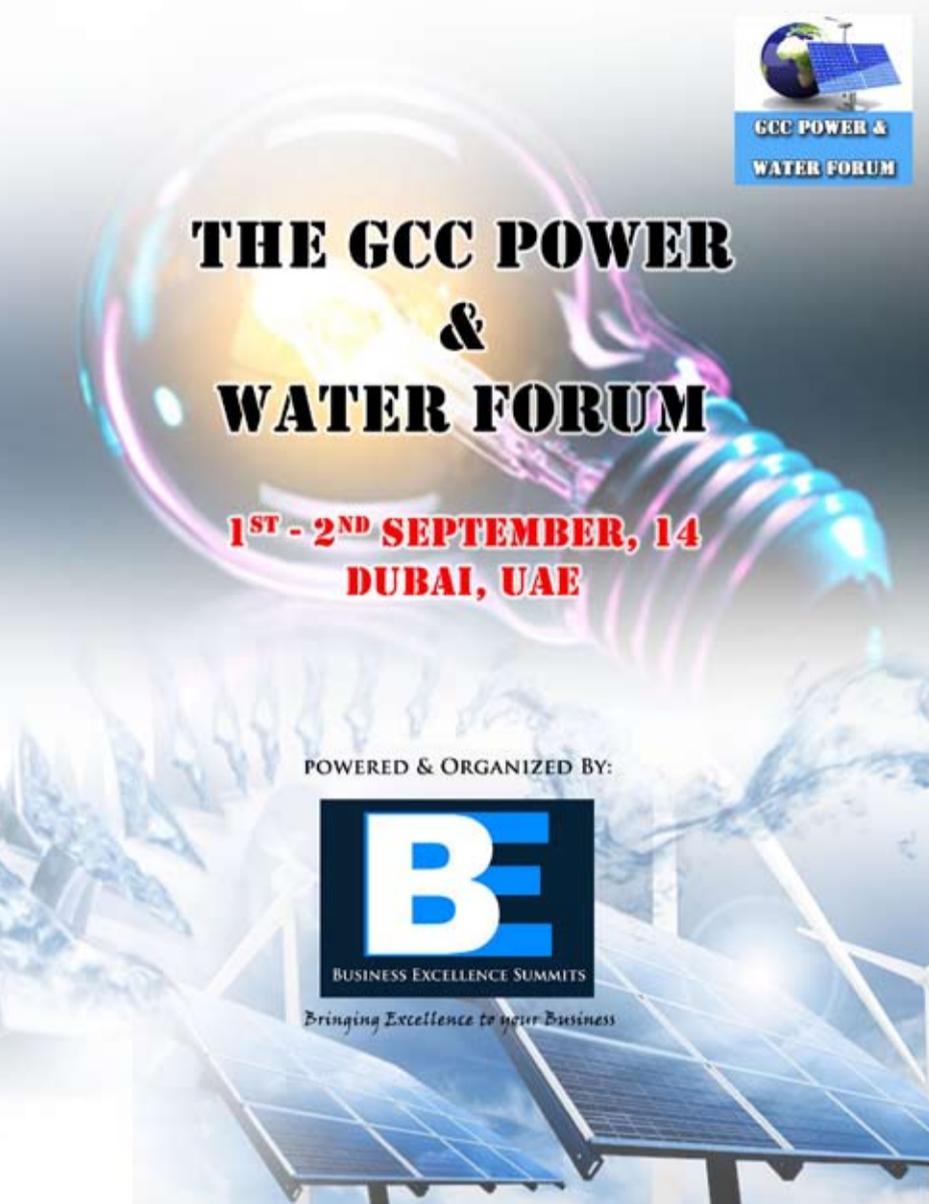
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India gets solar back on track

A new tender for 1500 MW of solar capacity signals that India is getting its solar mission back on track, says Syed Ali.

Following delays and trade disputes, India appears to be getting the Jawaharlal Nehru National Solar Mission (JNNSM) back on track.

The ministry of new and renewable energy (MNRE) last month issued guidelines for setting up 1500 MW of solar power plants, the largest tender issued till now.

It has also selected NTPC Vidyut Vyapar Nigam (NVVN) to expedite the phase and meet the mission's targets. NVVN is the trading arm of the nation's largest thermal power producer, NTPC. It was responsible for carrying out the very first bidding of the JNNSM, in 2010.

During the first bidding solar power rates fell down from Rs17/kWh to Rs10-12/kWh unit and has subsequently come down to Rs 6.5-7 a unit.

In this new phase, NVVN will also bundle the solar power generated with cheaper conventional power and sell at an average rate.

"We are hopeful that during this bidding, the rate would come down to at least Rs5 a unit. There are now serious players in the sector, expected to bid aggressively," said Tarun Kapoor, joint secretary, MNRE. He said the tender process would take off as soon as consultations with the stakeholders

concluded, most likely by the end of August.

The government is also hopeful of achieving grid parity, that is solar power at the same cost as conventional power, by 2017, earlier than the previous target of 2022.

The bidding, part of the second batch of phase-II of JNNSM, aims to achieve a capacity addition of 10 000 MW by 2017. The second phase, however, was delayed by more than a year, due to a dispute at the World Trade Organisation over the Mission's domestic content requirement guidelines and dumping charges by Indian manufacturers on solar cells from China, US,

Malaysia and Taiwan.

India's solar sector received a boost last month, as the government appeared to soften its stance in the dumping dispute. At the start of July the Power Ministry said it might look at dropping the proposal to levy anti-dumping duty on imported solar power equipment on the grounds that the current manufacturing capacity is not sufficient to meet the requirements of electricity generating firms in the sector.

Meanwhile last month also saw BHEL firm-up renewed plans to take a major role in renewable energy, especially solar energy. It said it wants

to play a significant role in establishing ultra mega solar photovoltaic plants of 1000 MW each.

There appears to be renewed interest in India's clean energy sector. In early July Goldman Sachs Group Inc., the Asian Development Bank (ADB) and the South Asia Clean Energy Fund announced they have invested \$140 million (Rs.836 crore) in independent power producer ReNew Power Ventures Pvt. Ltd.

ReNew Power said the total equity investment in the firm has reached \$390 million and will help it to more than double its project portfolio from 460 MW to 1000 MW by 2015.

Indonesia prepares to plug power shortfall as coal plant meets delays

Indonesia is taking steps to plug a potential capacity shortfall as one of its largest proposed coal fired plants faces delays.

The nation's first and largest public-private partnership project, the 2000 MW Batang coal-fired power plant in Central Java, faced another delay, prompting its operator, Bhimasena Power Indonesia, to declare *force majeure* on 8 July 2014, according to a statement from Adaro Power.

Adaro Power, the country's second-largest coal miner, owns a 34 per cent stake in Bhimasena Power Indonesia (BPI). J-Power and Itochu, both Japanese firms, own a 34 per cent and a 32 per cent interest in the consortium, respectively.

According to Adaro, the difficulties in acquiring land for the project remained the biggest hurdle.

The Batang power plant, which was

awarded to BPI in 2011, was originally scheduled to begin construction in 2012 and was slated for commercial operation by the end of 2016. Under the current scenario, the power plant may now not commence commercial operation until 2019 at the earliest.

Jarman, the director general for electricity at the Ministry of Energy and Mineral Resources, said the government is aware of the situation and is preparing a series of mitigation measures.

Jarman said the government was planning to build several power plants with a total capacity of 2000 MW to meet the shortfall. It also plans to expand the Cirebon coal-fired power plant in West Java, doubling its generating capacity to 2000 MW.

Stepping up efforts in renewables will also help plug the deficit. Last month, the Asian Development Bank said it is allocating a loan of up to \$50 million

to finance the development and exploration phase of the Rantau Dedap geothermal project in South Sumatra.

"This innovative loan demonstrates the depth of ADB support for deploying clean energy technologies that can significantly displace coal and oil-fired power," Lazeena Rahman, investment specialist at Manila-based ADB, said in a statement.

ADB says that Indonesia has the potential to produce 29 000 MW from geothermal sources but less than 5 per cent of this potential has been developed.

In a separate development Armstrong Asset Management, a Singapore-based fund, last month agreed to invest up to \$22.5 million to develop and operate a hydropower plant owned by Nusa Konstruksi Enjiniring, as part of an effort to develop alternate sources of energy outside of fossil fuels.

In a separate announcement He Jiankun, director of the Low Carbon Energy Lab under Tsinghua University, said there is an urgent need for China to reform its energy structure.

According to a recent report from research and consulting firm GlobalData, China's says renewable energy sources are expected to account for more than 20 per cent of the country's total electricity generation by 2020. Renewable generating capacity increased from 27.8 GW in 2001 to 183 GW in 2013.

growth, China is now the world's largest energy producer and consumer.

Wu warns, however, that if not controlled, China's energy demand will surge to 5.3 billion tonnes of coal equivalent in 2020 and seven billion tonnes in 2030.

Central government is attempting to wean China off its reliance on coal. The finance ministry's head researcher recently noted that upcoming reform of the resource tax is expected to increase the price of coal, electricity and other resources.

China faces difficult energy revolution

China faces a tough task in attempting to revolutionise how it produces and consumes energy, experts said at a symposium in Beijing in July.

As an emerging economy experiencing rapid growth, China has to strike a balance between satisfying its huge energy demand and safeguarding the environment in order to make its growth sustainable, said Wu Yuetao, a researcher from government think tank the China Centre for International Economic Exchanges.

After a decade of industrialisation and

Financial support for Vietnam's power sector

- Japanese funding for Vinh Tan 4
- Denmark supports green growth strategy

| Syed Ali

International investors are playing a central role in helping Vietnam develop its power sector.

Under a Memorandum of Understanding (MoU) signed in late June, Thai firm EGAT International Company (EGATi) said it would invest \$1.26 billion to construct a 1200 MW thermal power plant in Hai Lang district, Quảng Trị Province.

Under the MoU signed between Deputy Director of the Energy Department from the Ministry of Trade and Industry Le Tuan Phong and EGATi's Chairman Thana Putarungsi on 24 June 2014, turbine 1 and 2 of the plant are expected to be operational by 2021 with an annual production of 7.25 billion kWh.

It was one of two investments in similar plants announced in the last six weeks. Following the EGATi MoU, Electricity of Vietnam group (EVN) said it is to receive more than \$338.2 million from Japanese banks to build the Vinh Tan 4 thermal power plant in the central province of Binh Thuan.

More than \$202.9 million of the 17-year loan will come from the Japan Bank of International Cooperation,

while the rest will be provided by the Bank of Tokyo-Mitsubishi.

Construction of the two-turbine 1200 MW plant, being built by the EVN Power Generation Company 3, started on 9 March this year.

Japanese financing is also helping the country expand its renewables generating sector. Japan International Co-operation Agency is providing Yen5.9 billion (\$57.8 million) for expansion of the Thac Mo hydropower, which began last month.

Renewables such as hydro, wind and solar are set to play a more important role in the country's generating mix. A national action plan on green growth was launched on July 2 by the Ministry of Planning and Investment (MoPI) with assistance from the UN Development Programme.

The action plan aims to realise the National Strategy on Green Growth by 2020 with a vision to 2050, which was approved by the Prime Minister on September 25, 2012 with a total capital of \$30 billion.

In July Denmark said it would provide \$90 million in official development assistance (ODA) to Vietnam over 2014-2015 and not limit ODA funding for Vietnamese enterprises.

UK opens new shale gas licensing round

Opening up new areas of the UK for shale gas exploration will heighten the debate over fracking in the UK.

Siân Crampsie

The Institute of Chemical Engineers (IChemE) has called for a “balanced and factual” debate on shale gas extraction as the UK government prepared to launch the 14th onshore licensing round for onshore oil and gas.

Professor Geoff Maitland, President of IChemE said last month that the potential benefits of shale gas to the UK’s economy, energy security and environment was being put at risk by a collective failure of politicians, the energy sector and opponents of ‘fracking’ to present a long-term vision of UK energy policy.

His comments came as the UK government prepared to invite companies to bid for the right to exploit onshore gas and oil reserves in new areas of the country.

The new licensing round is likely to further fuel the debate in the country on shale gas extraction and hydraulic fracturing, or fracking, the horizontal drilling technique used to extract shale gas reserves from underground.

Maitland called for all stakeholders to engage in a balanced and factual debate that considers short and long-term issues.

He said: “The shale gas debate in the UK has been presented very poorly with a series of piecemeal arguments providing headlines and often little substance and fact.

“There are many valid concerns and a huge amount of potential to be gained from exploiting shale gas. However, from government the argument often sways from security of supply, to household bills, to compensation, and back again.

“On the other side of the argument,

‘nimbyism’ and unsubstantiated fears endeavour to close down the potential of shale gas despite the advantages it can bring to the whole country.”

Last month environmental group Greenpeace claimed a victory when a planning committee in West Sussex rejected an application by energy firm Celtique Energy to explore for oil and gas at Wisborough Green.

Greenpeace has also organised a legal blockade to Celtique’s plans, with local landowners joining forces to use trespassing laws to prevent the energy firm from drilling under their land.

The government has already announced plans to alter trespassing laws to make it easier for energy firms to drill. Government-commissioned reports indicate that as many as 2880 wells could be drilled in the new license areas.

Greenpeace said that the new licens-

ing round would enter communities into a “fracking postcode lottery” and that shale gas operators had yet to prove they could operate safely.

One of the areas expected to attract the most interest are the Bowland Basin in northern England. Current estimates suggest there may be 1300 trillion cubic feet (tcf) of shale gas present in the north of England alone, which compares to total UK annual gas consumption of around 3 tcf.

Further estimates indicate shale gas could heat the equivalent of 20 million homes and provide around a third of all of the UK’s gas consumption within the next decade or so. In economic terms, shale gas could attract investment of £33 billion and create over 64 000 jobs.

“For government, in particular, it’s important that they present a clear roadmap of what shale gas means to

the country’s future, and how they are going to address legitimate concerns,” said Maitland. “The roadmap needs to include major issues like the climate change benefits and how substitution of gas for coal will contribute to meeting the UK’s carbon mitigation targets – which is often forgotten about in the debate.”

“This new licensing round is all about focusing on the extraction of gas and oil at commercial rates in order to replace the UK’s growing dependency on imports and help balance the decline of the North Sea,” said Ken Cronin of the UK Onshore Oil Operators Group (UKOOG).

“The fact that the onshore oil and gas industry is one of the heaviest regulated industries in the UK and acts as an exemplar for the rest of Europe should be seen as a positive sign by all new investors.”

Offshore wind growth slows



Offshore wind remains the fastest growing power sector in Europe in spite of a contraction in installations in the first half of 2014.

The European Wind Energy Association (EWEA) says that there are 16 offshore wind farms under construction in Europe with a total capacity of 4.9 GW. Growth was lower in the first half of the year than in the same period last year and EWEA believes the trend may continue into 2015 and 2016.

Total installed offshore wind capacity in Europe is now 7343 MW in 73 wind farms across 11 countries. In the first six months of the year, a total of 224 wind turbines were fully connected to the grid in three European

countries: Belgium, Germany and Britain, amounting to 781 MW. Belgium connected 47 wind turbines to the grid in the first half of 2014 and installed a further 30 turbines.

In Germany 30 offshore turbines with a total capacity of 108 MW were connected to the grid in the first six months of this year, according to data from Deutscher WindGuard. In addition, 126 turbines with a total capacity of 542.7 MW were also installed during that timeframe, along with 158 foundations. Overall, Germany now has 146 offshore wind turbines on the grid with a capacity of 628.3 MW.

“To ensure healthy growth in the latter part of the decade... the industry

must be given longer-term visibility. An ambitious deal on the 2030 Climate and Energy package by the EU’s Heads of State in October would send the right signal, making their decision particularly important for the offshore wind sector,” said Justin Wilkes, Deputy Chief Executive Officer of EWEA.

■ Siemens has installed the platforms for the SylWin1 and HelWin2 offshore grid connections in the North Sea. Together the two links will feed around 1.5 GW of wind energy into the German grid when they are commissioned in late 2014 and early 2015. Siemens is altogether building five offshore grid connections for German-Dutch grid operator TenneT.

Commission backs down over new German law

The European Commission has approved Germany’s new Renewable Energy Act (EEG), bringing an end to fears that it would reject the legislation on the ground of state aid rules.

In late June the German government locked horns with the Commission over the new EEG, which aims to help Germany achieve its transition to renewable energy in an affordable way. With the Commission’s approval, the EEG will now come into force at the beginning of August.

The Commission had expressed concern over unequal treatment of households and industry in the new EEG, and also said that extending a surcharge that helps to fund renewable energy subsidies to imported electricity would violate internal electricity market rules.

However the Commission concluded in July that the EEG would help the EU to reach its environmental and energy objectives without distorting the single market.

The new law trims the subsidies for new green power plants and spreads the surcharge that has funded these subsidies more equally among businesses. Many companies had previously been exempted from the surcharge because they operate in

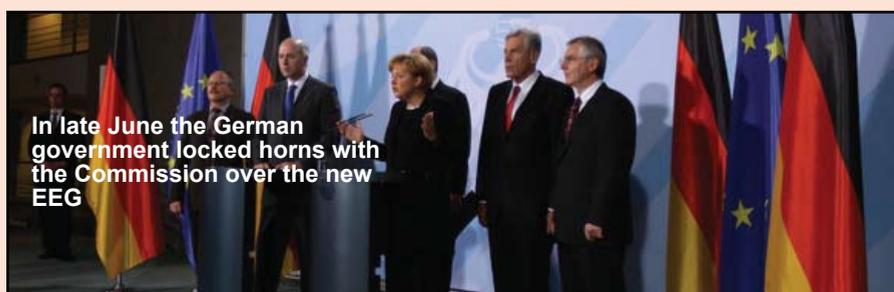
energy-hungry industries or decided to build their own power plants.

Under the new EEG, producers of renewable electricity will be obliged to sell on the market. They will obtain support in the form of market premiums paid on top of the market price for electricity. Until 31 December 2016 the market premiums will be determined by reference to administratively set reference values. The Commission therefore approved support to renewable electricity until 31 December 2016.

The law also calls for a pilot tender programme for ground-mounted solar installations that will determine the level of the premiums and allocation of aid to tender participants. As of 2017, tenders are to be generalised but a new law will be required to introduce them.

Small installations (below 100 kW) will continue to benefit from feed-in tariffs and are not obliged to sell on the market. This part of the EEG 2014 was therefore approved by the Commission for 10 years.

Germany plans to generate up to 60 per cent of its electricity from renewable sources by 2035. Its annual budget for the support of renewable electricity is estimated at some €20 billion.



In late June the German government locked horns with the Commission over the new EEG

Renewables on line in South Africa

■ AfDB finances XiNa Solar One ■ Iberdrola, Globeleq commission wind sites

Siân Crampsie

South Africa has started up some of the first key renewable energy projects to have been awarded under its renewable energies programme.

Iberdrola Ingenieria y Construccion announced that it has completed construction of two wind farms in the Western Cape and Northern Cape provinces, while Globeleq has officially inaugurated a 138 MW wind farm – one of the largest in Africa – in Eastern Cape province.

The projects were awarded under the first round of tendering in South Africa's renewable energy programme for independent power producers, which aims to add 3725 MW of wind, solar

photovoltaic and concentrating solar power to South Africa's energy mix.

In June, the African Development Bank (AfDB) said it would help to finance the XiNa Solar One concentrated solar power (CSP) plant, which was awarded to Abengoa under the third round of tenders in South Africa.

Iberdrola says that it is also close to completing the 96 MW Jasper solar photovoltaic (PV) plant, which was launched during round two of the renewable energy programme. The Jasper plant is the largest PV plant in Africa and was developed by Iberdrola in conjunction with Group Five on behalf of Jasper Power Company, in which US firm Solar Reserve owns a stake.

Iberdrola's two wind power projects

were built on a turnkey basis. The Noblesfontein facility has a capacity of 74 MW and is owned by Spanish firm Gestamp Wind and two South African partners: Shanduka and Sarge. The Klipheuwel wind farm has a capacity of 27 MW and is owned by South African firm Biotherm Energy.

Globeleq says that its Jeffrey's bay wind farm comprises sixty 80 m high turbines spread over 3700 ha. In May the firm and its international partners, which include Mainstream Renewable Power, unveiled the 50 MW De Aar and 50 MW Droogfontein solar photovoltaic plants in the Northern Cape. Also part of the government's programme, the two plants represented a combined investment of Rand 3 billion

(\$285 million).

"The completion of these facilities is the result of a truly global partnership with the government of South Africa and [state electricity company] Eskom and the private sector of developers, investors, lenders, constructors, suppliers and the local community," Globeleq CEO Mikael Karlsson said in a statement.

"It demonstrates significant support for independent private power producers in the region and indicates the sustainability of the renewable energy sector."

The AfDB has approved a senior loan of \$142 million, including a \$41.5 million concessional financing from the Clean Technology Fund, for the

100 MW XiNa Solar One CSP in Northern Cape province.

The plant is the first renewable energy independent power producer (IPP) and the first private sector Clean Technology Fund that the AfDB has financed in South Africa. This project will form the largest solar complex in Africa together with Abengoa's KaXu Solar One CSP that is currently under construction in the country.

The plant will be built at a cost of \$908 million using parabolic trough technology and a superheated steam cycle with a storage capacity of 1650 MWh (equivalent to approximately 5 hours full load storage), configured to partially cover the South African peak load demand.

Oman considers new IPP sites

■ Projects will add 2650 MW
■ Sur close to commissioning



The Oman Power and Water Procurement Company (OPWP) is preparing to issue a competitive tender for the construction of two new independent power producer (IPP) projects with a combined electricity generation capacity of 2650 MW.

A greenfield inland site in Ibbri in Dhahirah Governorate as well as a coastal site within Sohar Industrial Port Area are being considered by the Omani government for the two plants, which together would represent the single largest increase in Oman's power generation capacity to date.

The exact location of the projects will be confirmed during the next phase of the procurement process. OPWP has already issued a request for qualifications for parties interested in bidding for the projects, which will be fuelled by natural gas.

The successful bidder will secure a licence to develop, finance, design, engineer, construct, own, operate and maintain a pair of IPP projects planned at two different locations

with the Main Interconnected System (MIS), the electricity network that serves much of the northern half of Oman.

"The split of power capacities between the two sites and the choice of technologies to be used for delivering the required capacities will be determined by the bidders subject to the constraints that will be identified in the Request for Proposals (RFP). It is expected that these constraints will include a requirement that early power capacity is to be provided at the Ibbri site only," said OPWP in its advisory to interested developers.

With power demand growing annually at the rate of around 9 per cent, OPWP is keen for the new capacity to be fully commissioned and brought into operation by 1 April 2018.

OPWP said last month that the Sur IPP plant, currently the largest power project in Oman, is expected to be fully commissioned by the third quarter of 2014, adding 2000 MW to the sultanate's contracted capacity.

Renewables will take lion's share of power investments

Sjardin predicts "spectacular growth"



Market forecasts indicate that renewable energy investment is set to surge thanks to falling costs and favourable policies.

Siân Crampsie

Falling costs of wind turbines and solar modules are making renewable energy a more attractive option for power sector investments, according to Bloomberg New Energy Finance (BNEF).

The London-based research firm says that renewable energy may account for as much as two-thirds of the \$7.7 trillion in investment forecast for building new power plants globally by 2030.

The trend could mean that global carbon dioxide emissions could peak by the end of the next decade.

"What we are seeing is global CO₂ emissions on track to stop growing by the end of next decade, with the peak only pushed back because of fast-growing developing countries, which continue adding fossil fuel capacity as well as renewables," Michael Liebreich, chairman of BNEF's advisory board said.

Renewable energy plants are becoming more profitable in spite of governments' efforts to scale back on incentives. BNEF estimates that 5000 GW of power generation capacity will be added globally to 2030, with fossil

fuel's share falling from 64 per cent now to 46 per cent.

Solar power will top clean energy installations in every region over the next decade and a half, BNEF said in its latest report. Capacity will expand most in Asia, where new solar sites will exceed gas and coal combined.

"The period to 2030 is going to see spectacular growth in solar in this region, with nearly 800 GW of rooftop and utility-scale PV added," Milo Sjardin, BNEF's head of Asia Pacific. "This will be driven by economics, not subsidies, as our analysis suggests that solar will be fully competitive with other power sources by 2020."

Overall in Asia, BNEF forecasts that \$3.6 trillion will be invested to 2030 to meet rising energy demand, with the region accounting for more than half of net power capacity additions globally in that period. China is forecast to invest \$2 trillion to add a net 1.4 TW of new generating capacity to meet power demand that is double that of today.

Meanwhile in Japan much more modest growth means the country will invest just \$203 billion in new power generation capacity, with \$116 billion invested in rooftop solar.

India is forecast to see a quadrupling of its generation capacity, from 236 GW in 2013 to 887 GW in 2030, with 169 GW of the additions taking the form of utility-scale solar and 98 GW onshore wind. Hydro will see capacity boosted by 95 GW, coal by 155 GW and gas by 55 GW. Total investment to 2030 will be \$754 billion, with \$477 billion of that in renewables.

Globally, solar and wind power will increase their combined share of global generation to 16 per cent in 2030 compared with 3 per cent last year. Gas-fired generation will also grow because the fuel produces less pollution than coal and because supplies are abundant given shale gas discoveries in the past few years.

Coal-fired power plant capacity will fall in Europe and the Americas as tighter emissions rules start to bite. Coal capacity will only grow in Asia to support the region's quicker economic growth.

In all, about \$5.1 trillion of the total investment will be spent on renewables including hydropower. Asia will account for \$2.5 trillion of that, the Americas \$816 billion and Europe \$967 billion. The Middle East and Africa will invest another \$818 billion.

HVDC: still making the critical links

This year marks the 60th anniversary of the commercialisation of high voltage direct current (HVDC) transmission. **Junior Isles** speaks to ABB's Claes Ryttoft about the key milestones during those years and the developments to come in the future.



Ryttoft: China has really pushed voltage levels from 500 kV to 800 kV and we now have technology that can go up to 1100 kV



In the field of high voltage transmission, 1954 was a historic year. A 98 km submarine cable transmitted power between Västervik on the Swedish mainland and Ygne on the island of Gotland. Known as the Gotland 1 HVDC link, it was the first commercial high voltage direct current (HVDC) transmission in the world. The link was rated at 20 MW, 100 kV and used mercury-arc converter valves in the converter station.

This year marks the 60th anniversary of the technology that was first introduced by ABB and continues to evolve

to meet the changing demands of global markets.

Commenting on those early days, Claes Ryttoft, Head of Technology for ABB Power Systems and Chief Technology Officer for the ABB Group, said: "Sixty years ago, the driver was subsea connection; there was no other way to do it and that's still the case today. The only way to transmit power to the island with reasonable losses over that distance was to use DC."

Subsea power transmission remained the main application for HVDC for many years. Certainly over the last 15-20 years connecting countries and regions, especially those separated by water, has been a big driver in Europe and the number of links continues to grow. HVDC links have been built for example, between France and the UK; Denmark-Norway, Norway and the Netherlands (NorNed); and around the Baltics, etc. Notably, at 580 km, the 700 MW ±450 kV NorNed link commissioned by ABB in 2008, is the world's longest undersea cable.

Over the years, the technology has been continually developed for use in other applications such as underground transmission and as an alternative to AC for transmitting power over long distances with low losses. It is also used for synchronisation of grids running at different frequencies. In Japan for example, DC is used to connect its 50 Hz and 60 Hz grids. The technology is also used in the US to connect its three unsynchronised AC networks.

"When grids are not synchronised, HVDC is an efficient way to transfer power between them. Networks like those in the US can be connected

using two back-to-back converters with no cable in between," noted Ryttoft.

An HVDC transmission system essentially consists of five main components: the converter; cable; semiconductor for switching; transformers and capacitors. ABB notes that it is the only company that produces all five elements in-house. Over the years there have been developments in each of these areas, which has expanded the HVDC market.

In the early days, the key challenge in HVDC transmission was the development of reliable and economic valves that could convert high voltage AC into high-voltage DC and vice versa. The breakthrough came in 1944 when it proved possible to operate a rectifier and an inverter in a laboratory at Ludvika with a DC load of 2000 kW at a voltage up to 60 kV using a high voltage mercury-arc valve.

Following the English Channel project in 1961, several HVDC transmissions using mercury-arc valves were built during the 1960s. These were Konti-Skan (Sweden-Denmark) Sakuma (Japan), the New Zealand transmission link and the Italy-Sardinia link.

The advent of semiconductors took HVDC technology into a new phase. Ryttoft commented: "There have been two distinct points in HVDC development during the last 60 years. The first was the replacement of mercury valves with thyristors during the 1970s."

One of the mercury-arc valves in the Gotland transmission was replaced in the spring of 1967 by a thyristor valve, the first in the world to be taken into commercial operation

for HVDC transmission. The use of such semiconductor valves made it possible to simplify the converter stations, and have therefore subsequently been used in all large HVDC transmission systems.

The second key technology development in the history of HVDC, says Ryttoft, was when ABB launched a transistor-based system in 1996. The development of semiconductor technology and power electronics resulted in the introduction of a new type of valve for the HVDC converters based on transistors (utilising Insulated-gate Bipolar Transistor, IGBT), called the Voltage Source Converter (VSC).

Known by ABB as HVDC Light, it allowed smaller systems in terms of footprint and can be utilised for a much more elaborate and fast control of the valves. "With the faster switching of transistors, you can control the voltage and current in a better way," said Ryttoft. One of the most important features compared to the classic (Line Commutated Converter, LCC) HVDC converter is its ability to not only control the real power flow (MW) but also the reactive power, i.e. the voltage level, at both connections.

The development has expanded the market for HVDC systems allowing it to be used for applications such as city in-feeds. This, along with the introduction of XLPE (Cross-linked polyethylene)-based plastic cables around the same time as ABB's Light technology made it easier to execute underground installations.

Ryttoft said: "The VSC-based, or Light system, has not replaced the thyristor-based system but exists alongside it for specific applications.

Special Technology Supplement

Some of the first projects we delivered in the 90s were for undergrounding. A thyristor can still handle much more current than a transistor but HVDC Light is growing from [initially] a small [power capacity transmission] system, to a larger system where it is increasingly competing with the Classic system. But we still see two distinct markets for each."

The continued development of the 'classic' thyristor-based technology is being driven by markets such as Brazil, China and India, which all have huge hydro resources far away from the load centres and need to transmit massive amounts of bulk power over long distances. Accordingly, there has been a quantum leap in voltage levels over the last 10-15 years.

"Countries like China are pushing for higher and higher voltages," said Rytoft. "We are still trying to push this technology to higher voltage levels and more power transfer. Today we have links in operation with a capacity of 7 GW; China is targeting above 10 GW. China has really pushed voltage levels from 500 kV to 800 kV and we now have technology that can go up to 1100 kV."

Higher voltages are important not just for power throughput but also the distance over which that power can be transmitted. "This is why China wants higher voltages; the higher the voltage, the longer the distance you can go with acceptable losses. There will be some losses but they will always be lower than with AC."

Rytoft notes, however, that it is also possible to increase voltage levels and therefore reduce losses through the use of FACTS (Flexible AC transmission systems) technology. In most cases, over long distances he says it is more economic to use DC but notes that each project has to be taken on a case-by-case basis. "If you need to tap-off power at points along the line then you have to use AC but if you are going underground there is no choice other than DC."

While countries like China, India and Brazil are driving the construction of new lines with higher voltages, older grids in Europe will see an increasingly use for HVDC systems as a way of sending more power down existing transmission routes. As some countries struggle to gain approval to build more overhead lines, this could see existing overhead lines being converted to DC.

Germany is a case in point. As it makes its energy transition away from nuclear, the country has decided to use HVDC technology for transmitting wind power from the north to the south.

"Part of the reason," says Rytoft, "is that if they want to increase AC voltage, then they have to increase insulation distances i.e. the tower heights. This would mean a difficult fight with every community they want to pass. Instead they will keep the existing towers and convert the AC lines to



DC. This will allow them to transmit more power through the same infrastructure."

It is a similar story in Japan, which, having switched off its nuclear plants following the Fukushima disaster, needs more grid connections to transport new renewable capacity.

Certainly the massive increase in wind generation, especially in Europe, will increasingly become a big driver for HVDC. The UK will need to build more connections to transmit wind power from Scotland down to England. "The solution today is to build two cables, one on each side [of the country], that run underwater," noted Rytoft.

The UK, like France, Germany and Denmark has plans for huge amounts of offshore wind, which will provide more impetus to HVDC. While wind farms located not too far offshore would likely opt for AC, as projects move further out to sea DC will be the most economic choice for bringing that power back on land.

The need to connect offshore installations to land is, according to Rytoft, opening up some new markets, particularly for HVDC Light. For wind farms far from the coast, ABB sees HVDC Light as an ideal means to bring the power to shore.

The HVDC Light converter stations have a small station footprint and low weight a feature that is of particular importance in offshore applications. "A number of oil platforms off the Norwegian coast do not want to burn gas to generate their own electricity in order to avoid paying CO₂ fees. Instead they are going for electrification from onshore," he said.

ABB has several projects where it transfers power via a DC link to oil and gas fields in the North Sea. It completed the Troll A 1&2 in 2005, the world's first offshore transmission using HVDC Light technology. A second project, due for completion in 2015, is now under way to transmit power to the same platform owned by Statoil. Known as Troll A 3&4, it will provide a total of 100 MW to the platform to power two compressor drive systems.

ABB has also been responsible for the BorWin 1 link, connecting one of the world's most remote offshore wind farms to the German grid via a 400 MW HVDC Light transmission system.

With the increasing number of offshore wind farms and HVDC interconnections between European countries, the ultimate discussion in Europe is whether to join the transmission

highways to form a supergrid.

The joining of all these grids, in much the same way that has been done with the 400 kV AC networks during the 1960s and 70s, would have many benefits. Considering the restrictions on building new transmission lines, indeed the only way to transmit more power across Europe could be to transform the grid to a DC-based network. A DC grid would also pave the way for the efficient integration of renewable energy while improving the reliability and capability of existing AC grids.

Although this would be the ideal scenario, there are technical obstacles. It comes back to the inherent challenge of building a DC grid compared to an AC network.

There were two main reasons why AC became the dominant technology 100 years ago: firstly, the availability of an AC transformer, which allowed voltage levels to be changed, and secondly, the circuit breaker, which made it possible to protect the lines and build grids. There was no breaker for DC, and the equivalent of a transformer basically does not exist.

Existing mechanical HVDC breakers are capable of interrupting HVDC currents within several tens of milliseconds but are too slow to fulfil the

Fenno-Skan converter station: the Fenno-Skan 1 & 2 HVDC links connect Finland and Sweden. When it was commissioned in 1989 Fenno-Skan 1 was the longest submarine cable in the world and the first HVDC cable to operate at 400 kV voltage and a rated power of 500 MW

Advancing EU renewables and the single electricity market

Optimising the use of wind and solar and the general sharing of energy resources across Europe is a key driver for transmission system interconnection in the region.

Shifting renewable generation from where it is generated to where it is consumed is an issue all over Europe. For example in the UK, wave and wind power are in Scotland, in the north, whereas most of the demand is in the southeast. In Italy, the reverse is true: renewable generation is concentrated in the south, while demand is in the north. In Germany, nuclear

plants largely in the south are being replaced with wind in the north.

It is also an issue at the pan-European level. Transmission systems interconnection and its importance in creating a unified European electricity market was addressed at the Ventyx World conference hosted by ABB company, Ventyx, in Barcelona in May.

Delegates heard that the raft of climate change policies is in many ways acting against the formation of a single European energy market. Renewables can potentially cause the mar-

kets to separate from each other again, with renewables being trapped in zones.

For example, the UK has optimistic plans for new renewables but it is an island with limited interconnection with the continent. Essentially, much of the potential growth for renewables is stuck at the periphery [of the continent]. Transmission is key for connecting these renewable generating sources and creating a single market.

Interconnected transmission systems have also helped reduce the

overall reserve generating capacity across the bloc by allowing countries to share capacity. According to ENT-SO-E (the legally mandated body of electricity Transmission System Operators at the European level), long-term cross-border transmission projects of pan-European significance will help alleviate total annual generation operational costs by about 5 per cent. For higher generation costs that can be expected by 2020, this represents about €5 billion.

Indeed transmission system infrastructure is critical when considering

all the main planks of current European electricity policy in terms of the single market, tackling climate change and managing cost of electricity to consumers.

According to the EU's roadmap to 2050, the EU needs €40-140 billion for inter-regional expansion i.e. linking countries together on a large scale to deal with local bottlenecks and handle large power flows across countries. The roadmap also notes that another €10-40 billion would be required for adding offshore wind and other marine technologies.

Special Technology Supplement



The Troll A platform was the world's first offshore transmission using HVDC Light technology

requirements of a reliable HVDC grid. Attempts to build DC breakers over the last 100 years have enabled commercial DC breakers to be built that can break at full current but, until recently, 3 kV seemed to be the upper limit. Although semiconductor-based HVDC breakers easily overcome the limitations of operational speed and voltage, they generate large transfer losses – typically in the range of 30 per cent of the losses of a voltage source converter station.

The reason it is so hard to break DC compared to AC goes back to the fundamentals. As AC oscillates between positive and negative, the current passes through zero twice during a complete cycle. AC breakers are based on the ability to switch or break when the current passes through the zero point. This means it is possible to break the circuit when the energy level is at zero or at a minimum, thus avoiding a large arc.

With DC, there is no zero crossing. This means any breaking has to be done at full load, resulting in arcing. Rytoft compared the challenge of breaking an HVDC circuit to stopping a high-speed truck in a very short time – 30 times faster than the blink of an

eye – and taking care of the resulting dissipated energy.

In November 2012, ABB announced that it had solved the 100-year old electrical engineering puzzle. It developed a circuit breaker, which has a hybrid design that overcomes the obstacles of operational speed and voltage without generating large transfer losses.

The hybrid breaker essentially consists of three key elements: two power electronic breakers – one large and one small; and a mechanical breaker. ABB says the laboratory tests on the breaker have been successfully performed at currents of several thousand amps with a breaking sequence of around 5 ms.

With the new hybrid breaker concept verified, the next step is to implement a pilot to see it operate under real conditions. ABB says it is currently discussing potential pilots with utilities in different parts of the world.

“We see a lot of interest in the possibility of a DC grid; it’s an idea that has been discussed for many years. But there now has to be a standardisation process to really get it going. Today some grid owners are installing 220 kV lines while others are installing 300 kV or 400 kV, etc. We need to standardise on voltage levels and on the control interface. There is work going on in some organisations to do this but the standardisation discussion is hampering progress at the moment.”

While it works toward securing that all important first pilot for its hybrid DC breaker, ABB is continuing development of the breaker with a view to increasing voltage levels. “The technology works but it needs to be verified in real-life [conditions],” notes Rytoft.

Despite the impending success with developing an HVDC breaker, it may be some time, if ever, before the industry sees a true meshed DC grid. There is still no HVDC transformer and Rytoft sees no easy way around it.

“We can do DC-DC high voltage conversion but it would be very expensive. There might be a solution to change voltage levels but it’s more likely we will see a DC grid on one voltage level, which could then be connected to the AC grid at different points, regardless of which AC level is used at the different connection points.”

Whether DC grids ever become a reality or not, the hybrid breaker could

HVDC: a key role in ENTSO-E’s network development plan

The idea of Trans-European Networks (TEN) emerged at the end of the 1980s in conjunction with the proposed Single Market.

The first HVDC transmission system to be implemented as part of the European Union’s TEN initiative was a 500 MW HVDC link installed between Italy and Greece in 2001. The Italian and Greek power utilities, Enel and PPC own the link, which interconnects their respective electric power networks.

The link represented an important stage in the development of DC subsea cable systems, reaching previously untried water depths for a power cable (1000 m), and at the time some of the highest voltage and power ratings in a subsea power system.

More than 40 HVDC links representing some 13 000 km of routes, mostly undersea and located in North, West, Central and South Europe, are identified in ENTSO-E’s Ten Year Network Development Plan (TYNDP) 2012.

ENTSO-E is due to release its next TYNDP in December 2014. Its 2012 TYNDP, however, identifies the need to invest €104 billion in the refurbishment or construction of roughly 52 300 km of extra high voltage power lines clustered into 100 investment projects across Europe. Some €23 billion of the investment total is for subsea cables.

Eighty per cent of the identified 100 bottlenecks are related to the direct or indirect integration of renewable energy sources (RES) such as wind and solar power. Such massive development of RES is the main driver behind larger, more volatile power flows, over longer distances across Europe.

The TYNDP 2012 includes six Regional Investment Plans and a System Outlook and Adequacy Forecast (SOAF) alongside the Europe-wide development plan which formed the core of the first TYNDP in 2010.

It says the commissioning of projects of pan-European significance could result in CO₂ savings of 170 MtCO₂, of which 150 MtCO₂ results from the connection of renewable generation technology and 20 MtCO₂ which stem from savings due to further market integration.

The plan also notes that extending the grid by only 1.3 per cent a year enables the addition of 3 per cent generation capacity and the reliable integration of 125 GW of renewable energy sources. For less than €2/MWh of end-users’ electricity bills over the decade, the TYNDP 2012 proposed investments allows the EU energy and climate goals to be achieved in the most efficient and secure way.

still have other uses. Plans for the large-scale use of embedded VSC-HVDC transmission in point-to-point overhead lines have been proposed in Germany under the so-called *Netzentwicklungsplan* (NEP – Network Development Plan). As new generation from remote sites such as renewable sources drive the case for VSC-HVDC systems in the areas of active power transmission and reactive power compensation the hybrid HVDC breaker can provide the additional benefit of interrupting HVDC line faults.

In the meantime, development will continue in the areas of cables and semiconductors. One key issue for all suppliers is to reduce the footprint of installations. One way of achieving this is to increase the semiconductors voltage levels.

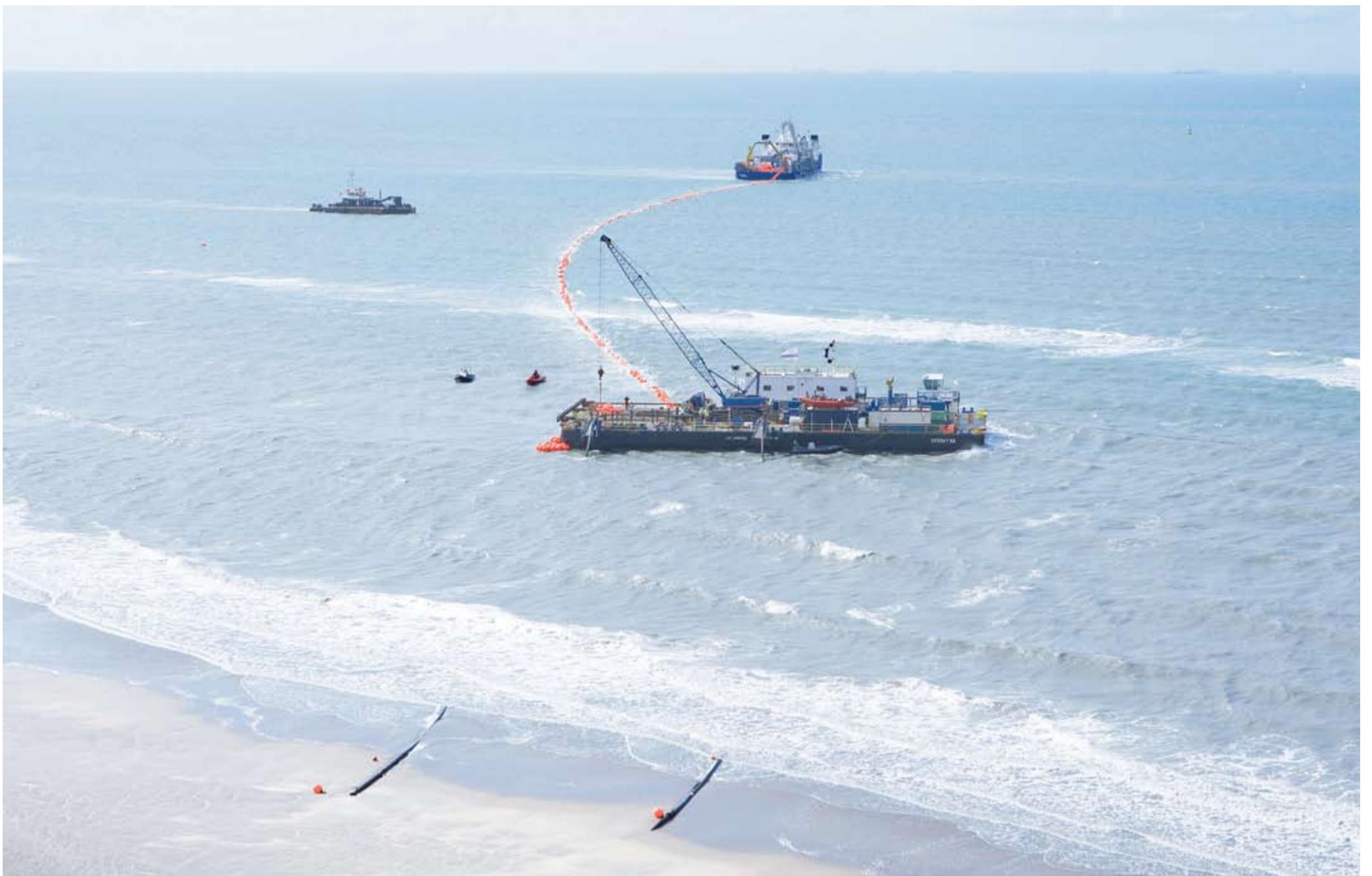
Rytoft explained: “Each cell in a converter that uses thyristor technology may deliver 6, 7 or 8 kV. For Light we are at about 3 or 4 kV per cell. Work is continuously ongoing to increase the voltage per cell.”

In terms of cables, customers continue to look for higher voltage levels. In the mid-90s XLPE cables started at voltage levels of 80 kV; today levels are at 320 kV, which corresponds to about 1 GW in terms of power transfer capability. The ability to go to higher voltages will allow more power to be transmitted through subsea cables.

Such ongoing developments will see HVDC continue to make a steady evolution. The technology has come a long way over the last 60 years and with the possibility of key breakthroughs on the horizon, the next 60 years could be equally as interesting.

Laboratory tests on the HVDC breaker have been successfully performed at currents of several thousand amps with a breaking sequence of around 5 ms





Electricity across borders?

Certainly.

Demand for reliable power continues to rise and so does the quest to integrate clean renewable energies. These trends are encouraging countries to install cross-border power links to improve power security and balance demand and supply. ABB is leading the way with HVDC and HVDC Light® systems, enabling grid interconnections and facilitating the transmission of electricity beyond borders through overhead lines, underground and underwater cables with minimal environmental impact. ABB's HVDC Light technology is also being used for offshore links to wind farms and oil and gas platforms. www.abb.com/hvdc

Power and productivity
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Italian acquisition adds new string to Westinghouse bow

- Nuclear firm ventures into oil and gas
- Developing 'seismic' AP1000 option

Westinghouse is venturing into the oil and gas business in a move that the nuclear firm hopes will help to balance its business.

The company has agreed a deal to purchase Mangiarotti S.p.A., an Italy-based manufacturer of components for the nuclear, oil and gas industries. Terms of the deal have not been disclosed but the companies expect to complete the transaction this month.

Mangiarotti engineers, designs and manufactures a comprehensive line of products and has been "an important and long-term" Westinghouse supplier, according to Rick Gabbianelli, Westinghouse Senior Vice President of Global Strategy and Operations Support.

Adding the relatively short product cycles of the oil and gas sector to its business will help Westinghouse to balance out the longer lead times on nuclear items.

Gabbianelli added: "Incorporating

the depth of this company into our supply chain is another example of our unwavering commitment to make the strategic supply investments that will further improve our ability to serve our customers."

The acquisition of Mangiarotti will increase Westinghouse's manufacturing capacity for reactors, pressure vessels, modules and heat exchangers for nuclear power plants as well as become a broader global provider in all energy fields. Westinghouse says it will continue the operations of the Italian firm in the Monfalcone and Pannellia facilities in Italy.

A third facility in San Giorgio di Nogaro will be closed, according to media reports. Financial statements from 2011 and 2012 indicate that the Italian firm has been making losses.

Earlier Westinghouse announced that it is developing a specialised version of its AP1000 reactor power plant designed for use in seismically

active locations.

It is seeking review and approval of the design from the US Nuclear Regulatory Commission (NRC). "Customers in more active seismic environments have expressed a strong interest in incorporating this Westinghouse technology into their energy portfolios," said Jeff Benjamin, Westinghouse Senior Vice President, Nuclear Power Plants.

The specialised seismic design will incorporate a number of customised materials and reinforcements that will allow new units to be built in areas that have a higher seismic spectrum.

"Development of the specialised seismic option will broaden the AP1000 new-plant market and facilitate the growth of the AP1000 global fleet," Benjamin said. "It represents a new opportunity to bring the unsurpassed safety, environmental and economic benefits of our technology to more people worldwide."

Areva, Gamesa set for offshore venture

- 8 MW unit ready for 2021
- Samsung reviews business

Siân Crampsie

Areva and Gamesa are aiming to gain a 20 per cent share of the European offshore wind market by 2020 through their new partnership.

The two firms have signed a binding agreement to create a joint venture in the offshore wind sector that combines both firms' manufacturing expertise and technological ability. They are aiming to rival market leader Siemens and say that the joint venture already has a 2.8 GW pipeline.

Gamesa and Areva announced in January that they would start talks on the joint venture. The transaction is expected to be closed by the end of the year following approval from the French government and relevant competition authorities.

According to Areva, the new venture's ability to offer both partner's 5 MW platform will give it greater market flexibility and address market needs in different areas of Europe as well as take advantage of the Asian market, where forecasts indicate an installed capacity of 18 GW by 2020.

It will also benefit from Gamesa's track record in operations and maintenance in the wind sector, where it has 20 GW of inshore capacity under contract.

The joint venture will continue to

optimise both partners' 5 MW wind turbines as well as developing an 8 MW platform in order to address the market need for larger units and a reduced levelised cost of offshore wind energy. It will benefit from the recently won 1 GW pipeline in France's offshore Round 2, where the 8 MW turbine is set to be installed by 2021.

Existing committed customers in Europe, where installed offshore wind energy capacity is set to reach 25 GW in 2020, include Iberdrola and the GDF Suez-EDPR-Neoen Marine consortium.

Areva's contribution to the joint venture has been valued at €280 million, while Gamesa's is valued at €195 million. Areva's 2.8 GW pipeline is the offshore market's second largest and includes projects in Germany, France and the UK.

■ Samsung Heavy Industries has confirmed that it is carrying out a review of its business following speculation over its future in the offshore wind energy sector. The Korean firm has featured prominently in the development of the Fife Energy Park in Scotland, where it has created a 7 MW prototype wind turbine. A company spokesman told local reporters that Samsung is "currently developing our business strategy and are considering our future within the European offshore wind sector".

Aecom builds on leading position

Aecom is to create a new leader in the engineering design industry through the acquisition of rival URS.

The US firm has agreed a deal to buy URS for \$4 billion in cash and shares. Michael Burke, Aecom CEO, will lead the combined group and said that the deal would give the company the ability to reach "more clients in more industry end markets" with a wider range of services.

Aecom is the world's largest engineering design firm by revenues, and URS the third largest. The transaction would create a company with roughly double the turnover of WorleyParsons of Australia, the second largest in the industry.

The deal would also increase

Aecom's activities in the energy sector, where URS specialises.

URS has 50 000 employees worldwide and offers a range of project management, engineering and construction services in the power plant and electricity grid sectors. It also specialises in managing and disposing nuclear waste, and works on many government contracts in the US and the UK.

Its revenues were \$11 billion in 2013, roughly unchanged on 2012, but its earnings per share were down 21 per cent. Aecom has about 45 000 employees worldwide, offering a similar range of services to URS, for industries including transport, water, oil and gas and mining.

Michael Burke, Aecom CEO, will lead the combined group



Renewable sector considers new risks

Insurance firms are hoping to offer policies to UK renewable energy project developers from 2015 that would protect them against sudden changes to government subsidy schemes.

Brokers such as Willis are in discussions with insurers such as Lloyd's of London to piece together policies that could be offered to renewable energy companies, according to the *Financial Times*.

The move has been made in response to changes to government support schemes in a number of European countries, including Spain, which developers say endanger the viability of projects and harm confidence

in the sector.

Governments have made sudden changes to policy in order to reduce the fiscal burden of renewable energy and because the costs of renewable energy – solar energy in particular – have fallen in recent years.

Last month the High Court in London ruled that a group of solar energy companies could seek compensation from the government for making retrospective cuts to the feed-in tariff in 2011.

The 14 companies brought the case in 2012 after the High Court, the Court of Appeal and the Supreme Court ruled that the cuts to FITs were unlawful and unfair. Legal firm Prospect Law says

that the ruling could have implications for other European governments that have made, or are planning to make, cuts to subsidy schemes.

The UK government recently consulted on more planned changes to solar support mechanisms, including bringing an end to renewable obligation (RO) support for solar schemes larger than 5 MW from April 2015.

The proposal has brought new risks for solar energy developers, who are under pressure to build and complete large-scale projects by the end-March 2015 deadline. Finance firms are adding new caveats to funding deals as a result.

10 | Tenders, Bids & Contracts

Americas

Gas engines for Yucatan IPP

EPC contractor SEISA has ordered gas engine technology for a new combined heat and power (CHP) plant in Yucatan, Mexico.

SEISA is building the plant for Enerkin, the first independent power producer (IPP) in Yucatan. The CHP project will use three of GE's Jenbacher two-stage turbocharged J624 gas engine generator sets to produce 13.25 MWe and 6300 kg/h (13 800 pounds/h) of saturated steam.

Enerkin is a special purpose company formed by Proteinas y Oleicos and other companies based in Merida. The electric power produced by the new plant will power the partners' industrial plants with surplus energy being wheeled to CFE's grid.

The saturated steam produced from the engine exhaust will be used as process steam in the Proteinas y Oleicos manufacturing plant.

Enerkin's new plant is the first CHP project in Mexico to feature GE's Jenbacher J624 gas engines, and it also is the first EPC agreement between Enerkin and SEISA, a major international energy projects developer based in Monterrey.

Doosan wins Mejillones contract

Doosan Lentjes will supply flue gas desulphurisation (FGD) technology to the Mejillones coal fired power plant in Chile after parent company Doosan Heavy Industries & Construction signed a contract with Empresa Eléctrica Cochran (EEC).

The contract is part of a larger project being delivered by Posco E&C to extend the Mejillones plant by 500 MW. Its scope includes the engineering, manufacture and supply of FGD equipment plus advisory services of erection and commissioning.

Gamesa, Alstom sign Brazil contracts

Wind turbine manufacturers are making Brazil a priority market as developers in the country look to equip their latest projects.

Last month Gamesa and Alstom signed major new contracts for projects recently licensed under Brazil's wind energy auction system.

Gamesa signed contracts with Companhia de Energias Renováveis (CER) and Eletrosul for a total of 214 MW of capacity, while Alstom said it would deliver 355 MW of capacity to Renova Energia.

Gamesa's agreement with CER includes the manufacture, supply, transport, installation and commissioning of 83 G97-2.0 wind turbines, as well as the civil works at six wind farms in the Xique-Xique II complex in the state of Bahia. These projects were winners of the auction A5 organised in Brazil in 2013.

Its contract with Eletrosul calls for Gamesa to supply, transport, install and commission 24 G114-2.0 MW turbines at wind farms in the Cerro Chato complex, located in Santana do Livramento, in the state of Rio Grande do Sul in southern Brazil.

Alstom will provide Renova Energia with 127 wind turbines from its ECO 122, 110 and 100 ranges for the Umburanas complex in Bahia State. The order is part of an agreement signed by the companies in 2013, involving the supply of more than 440 wind turbines, for a minimum installed capacity of 1.5 GW. The agreement also includes operation and maintenance services, for over €1 billion.

Madawaska HVDC upgrade

Hydro-Québec has placed a \$35 million order with ABB to upgrade the Madawaska high voltage direct current (HVDC) transmission link.

The 350 MW link connects the grids of New Brunswick and Hydro Québec in southeastern Canada. The project scope includes installation of ABB's MACH control and protection system and the upgrade of the valves and valve cooling system.

The back-to-back converter station has been in operation for more than 25 years and the modernisation will improve grid reliability and reduce maintenance needs. The new station is scheduled to go into full operation in 2016.

Iberdrola, Gamesa sign San Marcos agreement

Iberdrola Ingeniería y Construcción and Gamesa have signed an agreement with Grupo Terra to build the San Marcos wind farm in Honduras.

The 50 MW wind farm will cost €62 million to build and will be equipped with 25 of Gamesa's G90 wind turbines. Iberdrola will be in charge of engineering, procurement, construction and commissioning of the project.

Asia-Pacific

Sarulla orders Toshiba STGs

Sarulla Operations has placed an order with Toshiba Corporation to supply three steam turbine generators for what will be one of the world's largest geothermal power plants.

Toshiba will supply three 60 MW steam turbine generators to the Sarulla project, which is under construction in Tapanali Utara in North Sumatra, Indonesia. The plant is being developed by a consortium of Itochu Corporation, Kyushu Electric Power Co. Inc., PT Medco Power Indonesia and Ormat International, while engineering, procurement and construction is being carried out by Hyundai Engineering and Construction (HDEC).

Toshiba will start to supply equipment to HDEC in July 2015, and the plant is scheduled to start operation in November 2016. Its output will account for approximately one per cent of Indonesia's total power generation.

NTPC renovates ESPs

NTPC has awarded Alstom and NASL a contract to renovate and modernise the electrostatic precipitators (ESPs) at the Talcher Super Thermal Power Plant in India.

Under the €13 million contract, Alstom and NASL will upgrade the ESPs at the plant's four 500 MW units. The work will reduce particulate emissions from the plant below 50 mg/Nm³.

The project is scheduled to be commissioned in 2018. The scope of the project includes engineering, supply, erection, commissioning and testing of new parallel passes installed for four ESPs, dry ash handling system for new passes and associated civil, mechanical and electrical works.

Gamesa consolidates in India

Gamesa has signed agreements with three independent power producers (IPPs) to provide 220 MW of wind energy capacity to projects in India.

In total, the company will install 110 of its G97-2.0 MW turbines in five wind farms in the states of Madhya Pradesh, Rajasthan and

Karnataka. The wind turbines are scheduled for delivery in March 2015 and Gamesa will handle the related O&M services of the wind farms in the long term.

Conergy to build Philippines PV plant

Conergy is to design and build a new 8 MW solar power plant in the Philippines, its second major contract in the Pacific archipelago.

Conergy will build the photovoltaic (PV) plant for RASLAG Group on Luzon Island, 50 km from Manila. Once connected in the fourth quarter of this year, the plant's 30 000 panels will produce enough electricity to supply 4800 local homes.

Conergy says that it will complete at least 30 MW of projects by the end of the year that qualify for renewable energy incentives in the Philippines.

Europe

Nordex equips Turkey projects

Nordex has received three contracts for the installation of its N117/2400 and the N117/3000 turbines in Turkey.

Erdem Holding has ordered seven of the N117/3000 turbines for the Odemis wind farm southeast of Izmir, while Edincik Enerji has ordered 11 N117/2400 turbines to expand the Edincik wind farm on the southern coast of the Marmara Sea.

The third contract is with Bursa Temiz Enerji to expand the 25 MW Bandirma III wind farm with seven N117/2400 turbines.

Areva to dismantle research reactors

Nuclear waste disposal company SVAFO has awarded Areva a contract to dismantle the R2-0 and R2 research reactors near Nyköping, Sweden.

With a capacity of 1 and 50 MW, respectively, these two reactors ended operations in 2005 following approximately 45 years of service. Areva will prepare a detailed project schedule and disassemble the two reactors.

This is the first dismantling project to take place in Sweden since the 1980s. Areva will measure the radiation level of the components and package them in the appropriate storage casks before returning them to the customer.

The work on site is expected to begin in the first half of 2015.

Siemens secures wind contract

Siemens Energy has secured an order to supply 36 MW of wind energy capacity to a project in Nordfriesland, northern Germany.

The company will supply 12 direct-drive wind turbines, 11 model SWT-3.0-113 and one model SWT-3.0-101 turbine for the Süderlügum publicly-operated wind farm. It will also be responsible for service and maintenance of the wind farm for 20 years.

The wind turbines will be equipped with Siemens' 'Reactive Power at No Wind' technology, enabling them to provide grid stabilisation services when the wind is not blowing. This reduces operating costs for the regional power supply grid while doing away with the need for phase shifters.

Reactive power compensation will also provide remuneration to the wind farm operator/owner.

GE wins Scottish wind farm

SSE Renewables has placed an order with GE for the supply of wind turbines for the Dunmaglass wind

farm near Inverness, Scotland.

GE will provide 33 of its 2.85-100 wind turbines for the 94 MW project, which will help Scotland to reach its renewable energy targets. The project was designed to meet strict parameters set by the local planning authority, including a maximum blade tip height of 120 m.

AMEC aids Dounreay decommissioning

Dounreay Site Restoration Limited (DSRL) has awarded AMEC a four-year framework contract for the decommissioning of the Dounreay nuclear research facility in Scotland.

AMEC will provide consultancy services including design, safety case preparation, environmental support, project management, specialist engineering, decommissioning studies, waste strategy and technical support.

"AMEC has been providing technical services to DSRL for a number of years and this new contract will allow us to significantly expand our services to a very important client as we continue to grow our nuclear business," said Clive White, President of AMEC's Clean Energy Europe business.

International

Kepeco to bid for Czech reactor

Korea Electric Power Corporation (Kepeco) is planning to place a bid for a \$10 billion nuclear power project in the Czech Republic.

Kepeco is likely to compete with bids from two other consortia: Westinghouse-Toshiba and AtomStroyExport-Skoda. Applications from bidders will be submitted to the Czech government in 2015.

The Czech Republic wants to build two reactors at Temelin, 130 km south of Prague.

Hyundai wins UAE EPC

Hyundai Engineering and Construction has won a \$987.9 million order in the United Arab Emirates after forming a consortium with Hyundai Engineering and Italy's Ansaldo.

The company said that it won the engineering, procurement and construction order issued by the Abu Dhabi Water and Electricity Authority to build a power generation and desalination plant in Mirfa, which is 110 km southwest of Abu Dhabi. Construction is expected to take 30.5 months.

Hyundai E&C will receive \$715 million from its 72.4 per cent stake of the order, while Hyundai Engineering will collect \$79 million.

SEC orders transformers

Saudi Electricity Company (SEC) has placed an order with ABB for the supply of transformers for two new combined cycle power plants.

Under the \$78 million order, ABB will deliver generator step-up (GSU) transformers, power transformers and station service transformers for the two new plants, which will boost transmission capacity around the capital, Riyadh, and surrounding areas of the Central Region.

BHI to deliver Rabigh II HRSGs

BHI Co, Ltd., a licensee of Foster Wheeler's Global Power Group, has won an order for the design and supply of six heat recovery steam generators (HRSGs) for the 2100 MW Rabigh II combined cycle power plant in Saudi Arabia.

BHI will design and supply the six HRSGs, which will be coupled to six SGT6-5000F Siemens gas turbines firing natural gas and oil.



Oil

Crude prices cope with political crises

- Iraq forecasts crude exports to average 2.6 million b/d despite the violence
- Middle East crude expected to continue to dominate international markets

David Gregory

July proved to be a month of global tension with the downing of Malaysia flight MH17 over eastern Ukraine; the consolidation of territory in Iraq and Syria by the Islamic State (formerly ISIS); war between Israel and Hamas in the Gaza Strip; and a new outbreak of violence between rival factions in Libya for control of the airport in Tripoli.

Through it all, oil markets reflected political events and concern for future supply. Meanwhile crude oil production in the US continued to increase during July and refinery throughput saw a boost due to rising domestic demand.

West Texas Intermediate (WTI) sold at more than \$103/b in mid-July compared to around \$106/b in mid-June and Brent sold at around \$107/b compared to \$114/b in mid-June, with the June prices reflecting market

concern over events in Iraq.

"After surging to a nine-month high of more than \$115/b for Brent on 19 June in the wake of the ISIS offensive in Iraq, oil prices quickly retraced their gains in late June and early July, with Brent slipping below \$108/b and the Brent futures curve flipping into contango [a situation where the futures price (or forward price) of a commodity is higher than the expected spot price], indicative of a more relaxed, well-supplied market," the International Energy Agency said in its July *Oil Market Report*.

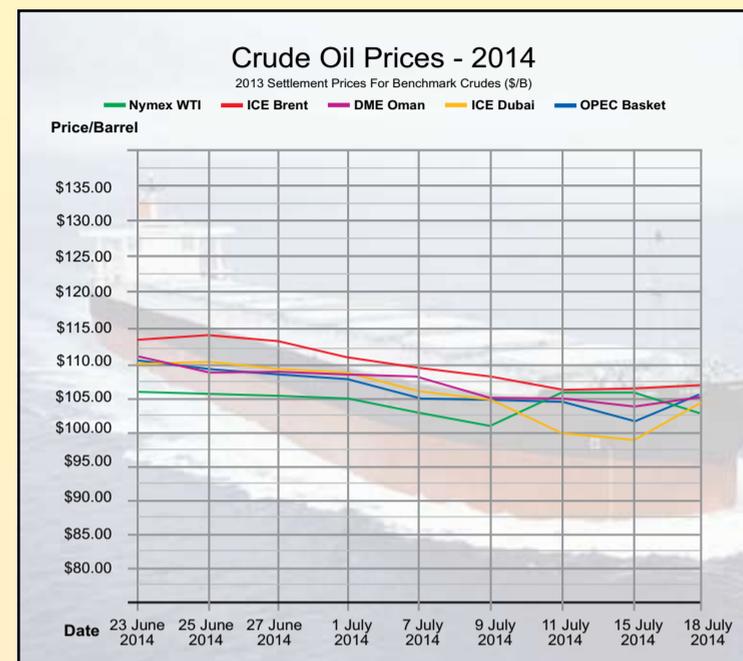
"On the supply front, markets appear to have taken comfort in Iraq's ability so far to maintain stable levels of exports and production in the midst of a brutal sectarian conflict," the IEA said.

The IEA said that global demand growth is expected to accelerate to 1.4 million b/d in 2015, from 1.2 million b/d in 2014.

According to the IEA, total world demand for crude averaged 91.4 million b/d in 2013, and is projected to average 92.7 million b/d in 2014 and 94.1 million b/d in 2015. Non-OECD countries will account for most growth demand, according to the IEA. Non-OECD demand averaged 45.4 million b/d in 2013, and will rise to 46.7 million b/d in 2014 and 48.2 million b/d in 2015.

Most non-OECD supply will come from North America, the agency said, rising from 17.2 million b/d in 2013 to 18.5 million b/d in 2014 and 19.3 million b/d in 2015. Opec is expected to supply 29.9 million b/d in 2014 and 29.8 million b/d in 2015.

Libyan oil failed to return to the market during July in the volumes the government had hoped. Libya produced as much as 1.5 million bpd in early 2013 prior to the seizure of oil fields and infrastructure by disparate militias, workers and protestors. In



late July production was reported at less than 600 000 b/d and only a few tankers had been loaded for export.

Iraqi officials forecast crude exports to average 2.6 million b/d in July despite the violence raging through much of central and western Iraq, where ISIS continued to seize territory. Iraq's southern oil industry has so far remained unaffected by the fighting. Oil fields south of Baghdad and the oil export terminals in the Persian Gulf continue to work, providing some assurance to oil markets.

Iraq's northern export pipeline through Turkey has been out of operation since March and much of it is now under the control of ISIS. But the KRG is exporting crude to Turkey through a new pipeline in its territory and has loaded four tankers at the Turkish port of Ceyhan in an attempt to sell its crude. Only one had been sold by late July due to threats of re-

prisals from Baghdad for any entity purchasing the crude.

Middle East crude is expected to continue to dominate international markets, but analysts note that energy demand in the region is expected to rise as well. Some countries that are now energy exporters are likely to become energy importers during the next decade.

Crude oil production in the US will continue to rise, but until now it appears unlikely that the US government will lift restrictions on oil exports.

In the July issue of its monthly *Short-Term Energy Outlook* the US Energy Information Administration (EIA) reported that US crude production averaged 7.4 million b/d in 2013 and will average 8.5 million in 2014 and 9.3 million in 2015. This compares to production of 9.6 million b/d in 1970, the highest production level reached by the US.

Gas

Egypt struggles to meet gas demand

Egypt's energy subsidy system has left it owing billions of dollars to the companies that produce natural gas. The new government knows things cannot continue as they have and last month took the drastic step of reducing government subsidies that annually sap billions of dollars from the budget.

Mark Goetz

Egypt's growing demand for energy has reached breaking point.

For more than a year Egypt has been looking for a way to import natural gas – and this is in a country where gas reserves are estimated at 77 trillion cubic feet (2182 billion cubic metres).

Despite many rounds of talks with potential gas suppliers and other Arab countries keen to help, Egypt has yet to reach agreement on the installation of infrastructure needed to import gas.

Cairo is stuck. Its subsidy system has left it owing billions of dollars to the companies that produce natural gas. The absence of payment for gas delivered to Egypt's grid leaves the foreign companies reluctant to invest more towards exploration and development, which is essential if they are to produce more gas and address the growing demand.

Last month the country's newly elected president, Abdul Fattah al-Sisi, the former field marshal and minister of defense who ousted Mohammed Mursi from the presidency in July 2013, took the drastic step of reducing government subsidies that annually sap billions of dollars from the budget.

President Sisi is reported to have taken the step – one long avoided by Egypt's previous rulers – when the new fiscal budget showed an allocation of more than \$19 billion for energy subsidies. The cut in subsidies, and subsequent increase in domestic energy prices, is designed to reduce energy subsidies to only \$14 billion for the next fiscal year.

Under the new price scenario, power generation companies will pay \$3.00/million Btu, fertilizer and petrochemical companies will pay \$5.40/million Btu, industries such as steel,

copper and aluminium will pay \$7.00/million Btu, and cement companies will pay \$8.00/million Btu (which is close to the normal price of natural gas in Europe).

Fuel prices were increased by up to 78 per cent, while electricity prices are also set to rise over the course of several years.

The new president and his new government know clearly that Egypt's energy system cannot continue as it has. Subsidies are wrecking the economy and preventing any economic growth. While higher energy prices will impact the poorer segments of the population and raise costs for Egyptian industry, Sisi really has no other choice.

However, efforts are being made to meet demand, which is especially high in summer. Cairo is making an effort to pay bills and arrange deals for the import of LNG. Arab countries that

support Sisi's government – Saudi Arabia, Kuwait and the UAE – are providing billions in financial assistance and energy supplies.

Egypt owes the international energy producers operating in the country around \$6 billion, but it has met with them and arranged a schedule to pay the debts, although it will take years.

Talks that began earlier this year with Norway's Hoegh LNG for the installation of a floating storage and regasification unit (FSRU) at Ain Sukhna in the Gulf of Suez have fallen through and Cairo is now attempting to arrange a deal with Exxcelerate of the US to provide the infrastructure.

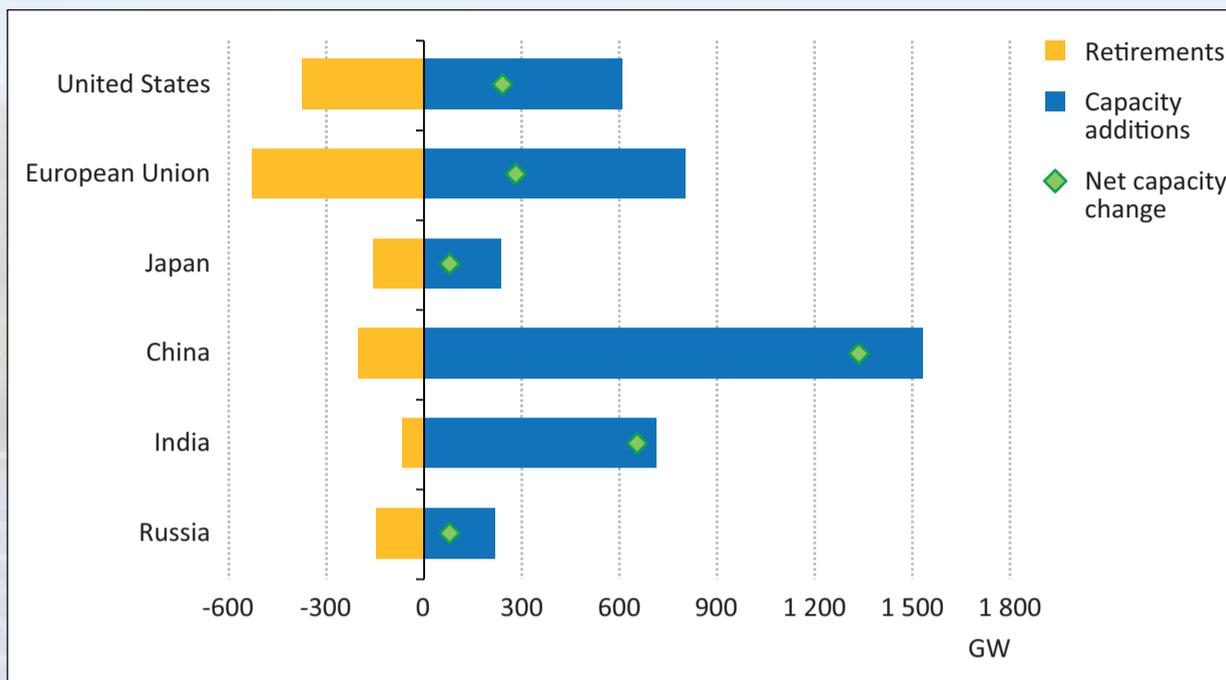
During his first trip abroad as president, Sisi was in Algeria and managed a deal for the Algerians to supply LNG to Egypt – but the FSRU must first be in place before deliveries can begin, and that may take some time.

Earlier this summer, Cairo agreed a

deal that will see BP invest some \$10 billion in its hydrocarbon assets in Egypt over the next five years with a view to boosting production. BP's resources in Egypt are reported to hold an estimated 5 tcf (142 bcm) of gas. The company produces around 1.2 million cubic feet per day (34 000 m³/day).

Furthermore, talks are underway to import natural gas from the Leviathan and Tamar gas fields offshore Israel to supply Egypt's two LNG plants on the Mediterranean coast. These would initially be business-to-business agreements between the partners in the Israeli fields – Noble Energy of the US and Israel's Delek Group – and facility operators Union Fenosa Gas and BG and its partner Petronas. However, those deals, which could be concluded by the end of the year, would need the approval of the Egyptian and Israeli governments.

Power generation gross capacity additions and retirements by selected region in the New Policies Scenario



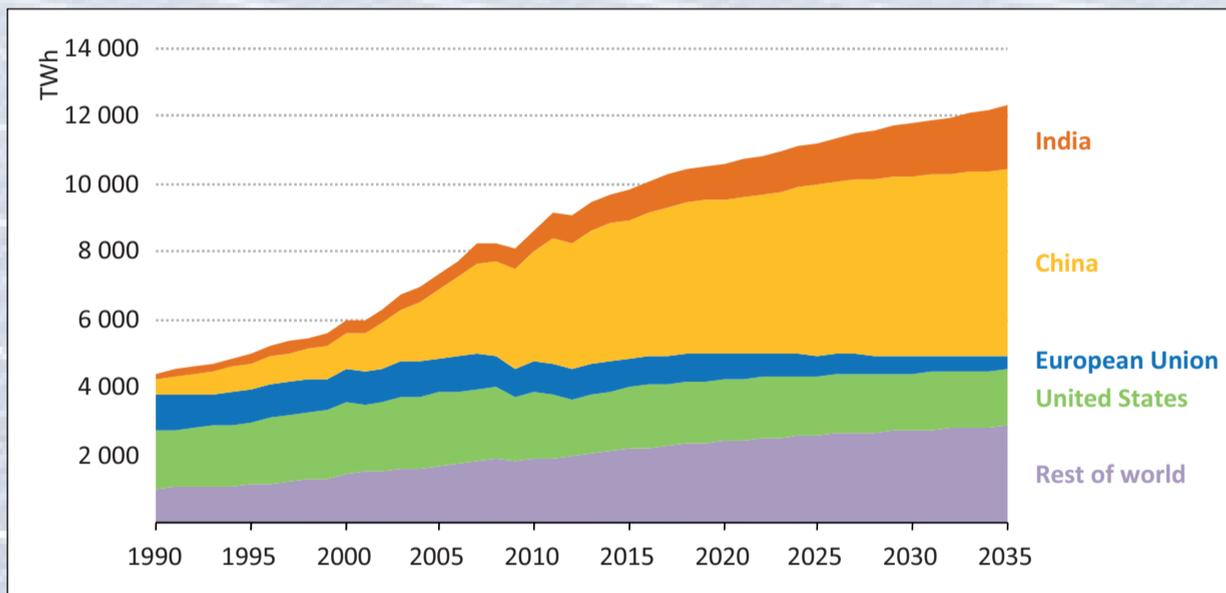
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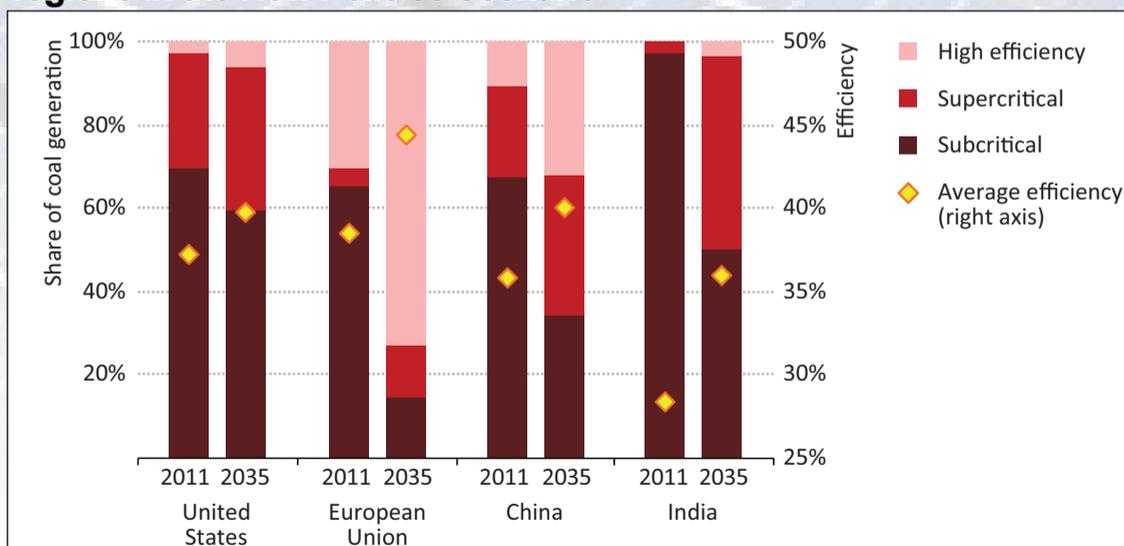
World Energy Outlook 2013 © IEA/OECD, Page 180, Fig 5.6

Coal fired power generation by region in the New Policies Scenario



World Energy Outlook 2013 © IEA/OECD, Page 182, Fig 5.8

Share of coal fired power generation by technology and average efficiency in selected regions in the New Policies Scenario



World Energy Outlook 2013 © IEA/OECD, Page 183, Fig 5.9

Plugging the leaks

A key issue facing Europe and its emissions trading scheme is carbon leakage. While it is clear that agreement must be reached to prevent carbon leakage on a global scale, EU legislators also need to consider the impact of proposals by the US Environmental Protection Agency to cut carbon emissions from its power plants.

Philipp Ruf

One of the key criticisms of regional climate policies is the potential loss of industrial competitiveness relative to countries that do not have comparable policies in place. Therefore, it is possible that production, and hence emissions, may simply be relocated to regions or countries with no comparable climate policies.

On a global scale, this climate policy would have caused no abatement of emissions, but simply a relocation from one country to another. The scientific community came up with the term carbon leakage to describe the phenomenon.

To address the potential competitive disadvantage for industrial installations covered by the EU emissions trading system (ETS) relative to third countries, and to prevent the relocation of industries to countries outside the EU, the legislator decided that installations exposed to carbon leakage should receive a higher share of free allocation in the third trading period.

In the second trading period, free allocation was handed out to industrial installations based on historic emissions (so-called "grandfathering"). There was no explicit provision for carbon leakage-exposed production – for all installations, the same rules applied.

The allocation methodology in the EU ETS changed significantly from the second to the third trading period. As the amount of free allocation decreases in the course of the third trading period, the shortfall between emissions and free allocation – the amount of allowances a company has to buy on the market in order to comply with the EU ETS – increases, if the production and, consequently, the emissions of a company, is stable. Therefore, the risk of carbon leakage increases over time as it becomes more and more expensive for companies to comply with the system.

In order to tackle this problem, EU legislators created a special free allocation methodology for all sectors and sub-sectors deemed to be exposed to a significant risk of carbon leakage. To keep track of these sec-

tors and sub-sectors, in 2009 the European Commission created a list of all respective sectors/sub-sectors.

To determine the sectors/sub-sectors exposed to a significant risk of carbon leakage, an assessment based on a certain methodology and criteria was done.

The installations that produce carbon leakage in exposed sectors/sub-sectors would receive free allowances for 100 per cent of the product-specific benchmark throughout the third trading period (excluding the application of the cross-sectoral reduction factor). Industrial installations not included in the list would receive only 80 per cent in 2013 and a linearly reduced share every year to reach 30 per cent in 2020. Since the benchmarks are based on the most efficient

installations, it might even be that some installations on the carbon leakage list do not receive all allowances they need for free.

However, the list adopted in 2009 is applicable for 2013-2014 only. Therefore, a new list has to be adopted for 2015-2019.

Regarding assumptions, the assessment of the first carbon leakage list was based on an average carbon price of €30/tonne. This price was derived from the impact assessment accompanying the EU 2020 climate and energy package.

The assessment of the indirect costs was based on a union-wide average emission factor for electricity of 0.465 tonnes CO₂/MWh. For the auctioning factor, an industry-wide value of 75 per cent was applied.

Regarding countries considered as third countries, only Norway, Iceland and Switzerland made an international commitment comparable with the EU and are therefore not considered as third countries. These three countries together did not represent a decisive share of global production in the carbon leakage-exposed sectors/sub-sectors.

Along with the proposal of the 2030 Framework for Climate and Energy Policy, the Commission disclosed in January 2014 information on the next carbon leakage list.

The Commission said it intended to make no changes to the criteria or existing assumptions regarding which sectors/sub-sectors are subject to a significant risk of carbon leakage.

On 5 May 2014, the Commission then published a draft version of the second carbon leakage list for discussion in the Climate Change Committee (CCC).

The new list is based on the same general assumptions as the first list. In particular, the assumed carbon price is €30/tonne. Consequently, the sectors/sub-sectors deemed to be ex-

How the US carbon reduction proposal may impact the EU

On June 2, 2014, the US Environmental Protection Agency (EPA) outlined a plan to cut carbon pollution from power plants. The plan could have a number of effects on the EU.

The EPA's proposal builds on action already being taken in the US to address the risks of climate change. The proposed legislation mentions cap and trade as a compliance measure, and allows longer time periods for multi-state approaches, such as the Californian cap and trade system or the Regional Greenhouse Gas Initiative (RGGI) system, the system currently in place on the east coast.

The announcement provided the long-awaited signal that America is committed to tackling its greenhouse gas (GHG) emissions. A cap and trade system will put a mandatory emissions cap in place for big emitters while providing flexibility in how they comply (i.e. the ability to trade). Such systems reward innovation, efficiency, and early action when it comes to environmental protection, while providing strict accountability.

The move to tackle GHG emissions makes great economic sense for the US – if the world follows it. With its abundant resources of shale gas, the US has access to cheap and cleaner energy (when compared with coal). As such the US is in a strong position. Especially if a globally high price on GHG emissions is agreed on at the Conference of the Parties (COP) on Climate Change conference 2015 in Paris, where an international GHG treaty is scheduled to be signed.

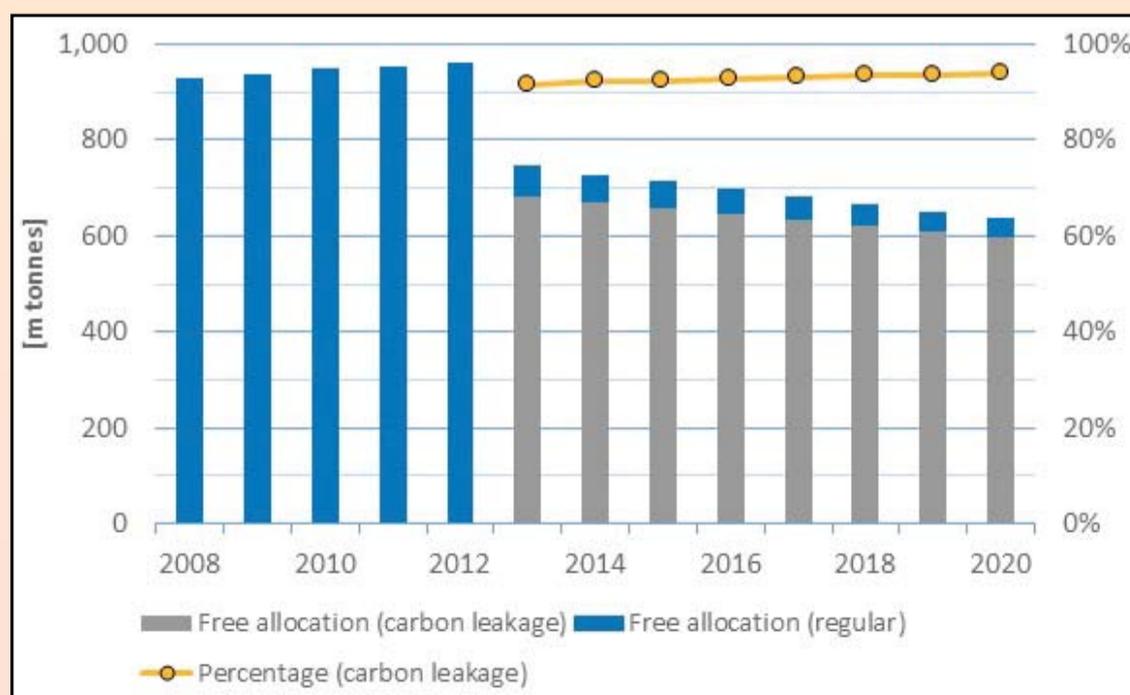
The EPA announcement may have a number of effects on the EU.

Firstly, if ambitious global climate change targets are agreed they might trigger a further rise in the EU targets, resulting in higher CO₂ prices.

Secondly, if companies in the EU and the US face the same price for emitting CO₂, the risk of carbon leakage (relocation of companies due to high carbon costs in one part of the world) between these regions would vanish.

Thirdly and interestingly, if the risk of carbon leakage is reduced in Europe (because there is a global carbon price), companies may actually receive fewer free allowances as they currently get an increased allowance in order to avoid carbon leakage.

Distribution of industrial free allocation in regular and carbon leakage allocation – 2015-2020 volumes based on the assumptions that methodology, indicators, criteria and current assumptions are untouched



posed to carbon leakage did not change significantly. A first analysis revealed that some small sectors/sub-sectors dropped off the list while other minor sectors/sub-sectors were added. However, an exact comparison is difficult as codes and naming of sectors/sub-sectors were changed.

On July 9, 2014, the CCC finally agreed on the second carbon leakage list, without any amendments to the Commission's proposal. After the approval of the CCC, a three-month scrutiny period starts for the European Parliament to object to the CCC decision. After the three month and given that the Parliament does not object, the list will automatically come into force – enactment is expected in mid-October.

The debate on the EU 2030 framework on energy and climate policies is still in its infancy. As a result, a decision on carbon leakage post-2020 has yet to be hammered out. On the executive side of the EU, the commission proposed in January in its 2030 framework Q&A "to continue the system of free allocation after 2020 if other major economies do not take comparable climate action".

On the industry side, EU ETS market participants are asking for the post-2020 carbon leakage discussion to be part of the debate on EU ETS reform (e.g. Market Stability Reserve, MSR). For instance, the International Emissions Trading Association (IETA) members state that "by the time MSR is adopted, political commitment on a proposal to tackle the issue of competitiveness needs to be provided".

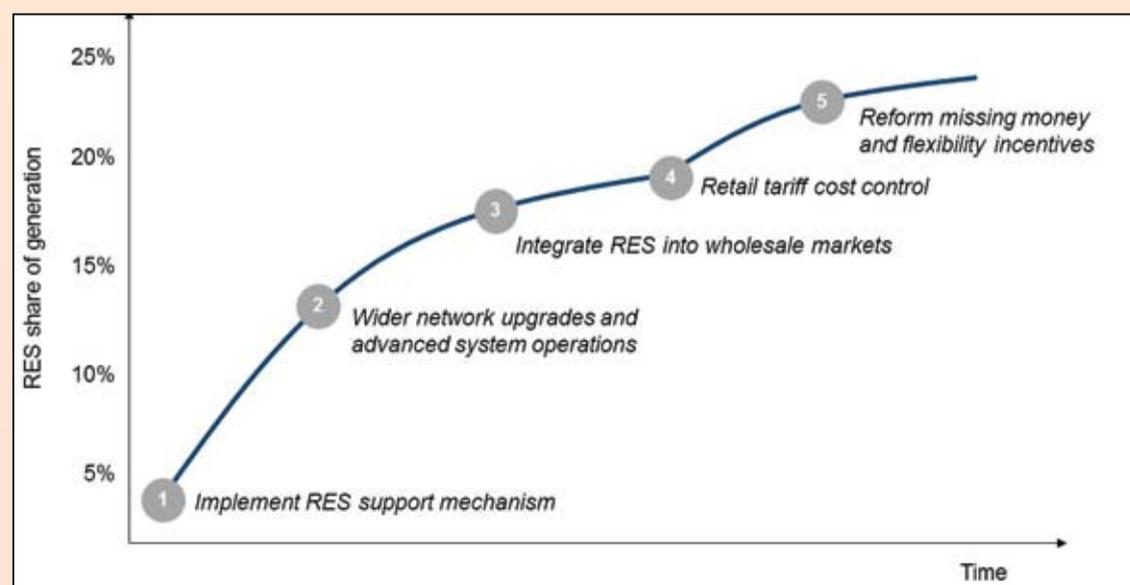
However, what is clear is that agreement must be reached to prevent carbon leakage on a global scale, while retaining the competitiveness of industry in the EU.

Philipp Ruf is Lead Analyst, EU Carbon Markets, at ICIS.

Renewables integration in mature markets

As renewables deployment reaches saturation in a number of European markets, the challenges of integration are becoming increasingly far-reaching. Peter Sherry from Baringa Partners explores some of the key challenges foremost in the minds of policy makers.

The level and nature of the challenges changes as renewables penetration increases over time



Governments across Europe are putting policies in place to address the widely acknowledged energy 'trilemma' – encouraging sustainability and ensuring security of supply while maintaining affordability for consumers.

Renewable and low carbon forms of generation clearly have a vital role to play in the sustainability effort, given that decarbonisation of the electricity sector can act as a catalyst for action in other key carbon-intensive sectors such as heat and transport.

Of the renewable technologies, the key focus for deployment in the 2020 timeframe is wind and solar generation. The intermittency and unpredictability of wind and solar forms of renewable energy poses new challenges for the electricity system, and responding to these challenges is increasingly a focus for policy makers and regulators across Europe.

Renewables penetration imposes new demands on the electricity system, particularly with respect to networks, flexibility, and on the ability of the Transmission System Operator (TSO) to manage the system to ensure security of supply in real-time. The level and nature of the challenges changes as renewables penetration increases over time. Some of the earlier challenges tend to be more localised, such as managing network constraints and the need for network upgrades, as well as the impacts on system operation.

As penetration increases, affordability starts to become more of a concern, leading to calls for renewable generators to be properly integrated into wholesale markets in order to increase the efficiency of balancing the system (potentially alongside tariff reform or the introduction of competition for support). Broader wholesale market reforms may be required at higher levels of renewables penetration, to deal with the perceived 'missing money' problem for thermal generators as well as to enhance incentives for much needed flexibility.

Two of the key challenges facing

renewables integration in mature European markets such as Germany, the UK and Ireland are the balancing challenge and flexibility incentives, and the 'missing money' problem.

Most market-based electricity systems contain a wholesale market in which buyers and sellers can trade power right up to a point close to real-time ('gate closure'), after which point the TSO centrally manages the system to ensure supply exactly matches demand on a second-by-second basis. Traditionally, balancing and reserve has been necessary to cover relatively small volumes (e.g. load or thermal generation prediction errors) or fault events of small probabilities (e.g. failure of the largest power station on the system). Taken together, this has meant that total reserve requirements have been small relative to the size of the total system peak load (typically 1 per cent to 3 per cent).

Increasing the amount of intermittent renewable generation brings a new challenge to system balancing, in that it causes unpredictable fluctuations in the generation fleet output. These fluctuations in renewable output have to be balanced, or 'mirrored', with other generation units or with some other source of flexibility (e.g. storage, demand side response and other smart solutions) to maintain system balance.

The uncertainty of wind and solar generation forecasting increases rapidly when the lead-time is prolonged – for example, the forecast error for wind production 24 hours ahead can be up to 25-30 per cent. This means that the combined wind and solar forecast error could correspond to around 100 GW in the EU power system in 2020.

The German experience is highly instructive in that it provides evidence for advanced renewable penetration in an electricity system large in size and with a high degree of interconnection. Renewables accounted for 23 per cent of generation in 2012 and the government expects penetration rate to exceed 35 per cent by 2020.

This translates into growing flexibility needs. Our analysis of generation data shows that the hourly variation of wind and solar generation exceeded 10 GW in 2012. Agora, a German research body, estimates that in 2020 there could be situations in which variable generation from wind and solar changes by 30 GW over a 4-hour period. In response, the need for reserve capacity has been estimated to nearly double from 7.4 GW in 2012 today to 14.3 GW in 2030, according to a study by the German Energy Agency (DENA).

The magnitude of this potential 'error' or imbalance is completely different to that traditionally faced by TSOs in managing the system. This not only means that a significant increase in flexibility is required, but it has caused a rethink on the extent of the residual TSO balancing role itself. While there will always be a coordination role for TSOs close to real-time, there is an increasing emphasis on 'balancing responsibility' for renewable generators. It is hoped that by providing strong incentives for self-balancing (e.g. by sharpening real-time balancing, or 'cash-out' prices), the market can come up with more innovative flexibility solutions than would be possible in a system with total reliance on a central entity.

In the longer term, high levels of renewables penetration may lead to a reduced incentive for investment in fossil fuel generation, due to the so-called 'missing money' problem. Renewable technologies such as wind and solar come in at the bottom of the merit order due to low or zero short-run marginal costs (as they do not incur fuel costs).

This has two effects on revenues for fossil fuel plant. Firstly, load factors are reduced over time as renewable generation displaces fossil fuel plant in the merit order, which means that fixed costs need to be recovered in a more limited number of running hours. Secondly, in periods of high wind or solar output the wholesale market price is lower, which can lead to downward pressure on average wholesale prices over time. Taken together, fossil fuel plants are exposed to an increased risk of under-recovery of fixed costs ('missing money'), which can lead to mothballing of existing plant as well as weakened incentives for new investment.

The existence or expectation of missing money has led to a push for the introduction of capacity mechanisms across many of the major European markets (e.g. UK, Germany, France). In theory, a capacity mechanism can tackle the missing money problem by providing a constant revenue stream for capacity, leaving less risk of under-recovery of fixed costs compared to a reliance on the energy market alone. However the design challenges should not be underestimated – the introduction of a capacity mechanism represents a major structural shift in any electricity market, and as such the need for harmonisation across Europe will become important.



Sherry: localised and technical challenges in the initial stages can become system-wide challenges later

A number of European member states either have capacity mechanisms in place at present (e.g. Spain, Ireland, Italy), or are developing proposals for the implementation of a capacity mechanism (e.g. GB, Germany, France). The need to intervene due to the impact of increasing renewables penetration is commonly cited as a key rationale.

For example, in Germany, high renewables penetration and lower electricity demand has led to a significant reduction in margins for fossil fuel plant. As a consequence, there have been increasing calls for the introduction of a capacity mechanism to underpin revenues for existing plant and avoid additional permanent closures. With the reforms to the renewable levies ('EEG') now completed, attention is now focused on ensuring security of supply, with a capacity mechanism among the policy options under consideration.

There is a similar situation in Britain, with a significant volume of existing fossil fuel plant currently mothballed due to low or zero margins available in the energy market. With capacity margins tightening in the near term due to closures under the Large Combustion Plant Directive (LCPD), and concern around long-term investment signals as renewables penetration increases, the UK Government has developed proposals for a GB capacity market. With the European Commission having recently approved the GB proposals under state aid rules, the first capacity auction is expected to take place as scheduled in late 2014 (for delivery in 2019).

As renewables penetration reaches maturity in European markets, the challenges of integration become more far-reaching. The often localised and technical challenges encountered in the initial stages of renewables deployment can become system-wide challenges later, with the potential to alter the entire architecture of the electricity market.

Two key challenges are foremost in the minds of policymakers in mature European markets – the need to address the 'missing money' problem for fossil fuel resources thus ensuring adequate capacity margins; and the need to ensure sufficient flexibility to manage the intermittency of renewable resources such as wind and solar. Given the long-term implications, it will be important that the policy responses developed across Europe support efficient renewables integration whilst not undermining continued market integration.

Ashalim: another tower of power

The completion of financing for a solar power tower project in Israel is another important milestone in the technology's deployment.

Junior Isles

The market for concentrated solar power (CSP) is forecasted to explode as costs continue to fall. According to a report released by Wintergreen Research, Inc earlier this year, the CSP market was worth \$1.3 billion in 2013 but is expected to reach \$53.7 billion by 2020.

Such high market expectations are driven by its attractiveness – it is a solar technology that can be built at utility scale and due to its thermal storage and hybridisation possibilities, can deliver firm and dispatchable electricity.

There are four main CSP technologies – parabolic trough, Stirling dish, concentrating linear Fresnel reflector, and solar power tower. Although parabolic troughs currently dominate the market, power towers are gaining ground due to their ability to generate high-pressure, high-temperature steam.

Following the startup in February of the world's largest CSP project, the 392 MW Ivanpah project in Southern California, work is about to begin on another major project.

Last month (July) Megalim Solar Power Ltd (Megalim) – a special purpose company formed by Alstom (25.05 per cent), BrightSource Energy (25.05 per cent), and NOY Infra-

the project off the ground. NOY is an Israel-based company with extensive local expertise. In addition to managing its own funds, it also has extensive links with other, predominantly Israeli, funds.

Steve Moss, Vice-President Alstom Steam Renewables commented: "They provide us with an excellent local partner. They have a deep knowledge of Israeli investors and institutions and are a very credible interlocker between government and financial institutions."

"As well as being a very credible fund, the chairman is an extremely experienced energy and construction professional. Having a real knowledge of what we're doing is very important when you're managing complex technology."

CSP is still a relatively new technology, with elements that are first-of-a-kind.

The project can essentially be divided into two parts – the solar field, which will be implemented by BrightSource, and the system for generating steam from the solar field and turning it into electricity, which will be under Alstom's responsibility. In addition to delivering all the major power plant equipment such as the solar power tower, steam generator, steam turbine, balance-of-plant, transformers and electrical systems inside the fence etc., Alstom will build and manage the project under a full engineering, procurement and construction (EPC) contract.

Ashalim will make use of the BrightSource CSP tower technology implemented at Ivanpah. More than 50 000 computer-controlled heliostats or mirrors in the Negev desert will track the sun in two axes and reflect sunlight to a special type of boiler known as a solar receiver steam generator (SRS) located at the top of a 240 m tower.

When the concentrated sunlight strikes the SRS, it heats water in the boiler to create superheated steam at a temperature in the region of 590°C and a pressure of 175 bar.

"One of the beauties of the power tower compared to parabolic trough technology," says Moss, "is that you can produce very high quality steam, like you would expect in a fossil plant."

One drawback of parabolic trough technology is that tubes at the focal point of the troughs have oil running through them at a temperature of just below 400°C. Above this temperature, however, the oil would start to breakdown. This limits steam temperature to around 400°C, thus resulting in

lower thermodynamic efficiency.

Moss noted: "With a power tower, the sky's the limit in terms of temperature and therefore we only have the normal engineering constraints of what the materials can withstand in terms of temperature and pressure."

This high-temperature steam is then piped from the boiler to a steam turbine-generator to produce electricity. The steam turbines for CSP are based on Alstom's standard machines that are used in a variety of fossil fuel applications. Moss noted, however, there are some specifics associated with CSP.

"CSP steam turbines have a more arduous duty than a coal or combined cycle plant in terms of frequency of starts and ramping up and down. There has therefore been some tailoring of the steam turbine to allow fast ramping up and down. As soon as the solar resource is available, you need to get the plant up to full power as soon as possible in order to get the maximum revenue from the plant."

The difference in operating duty is quite stark. A steam turbine in a coal fired plant would typically run for months without shutting down. A steam turbine used in a combined cycle peaking power plant could start up and shut down daily; an operator would, however, be given notice perhaps an hour ahead of when power will be needed. By contrast, Alstom says its machines for CSP plants would have to come on line in "fractions" of an hour.

Located on a 3.15 km² site in the Negev desert the Ashalim plant will have a strong solar resource and will generate electricity all-year round, sufficient to meet the needs of more than 120 000 homes.

"We will start generating in the morning when the sun comes up and run until it goes down in the evening," said Moss.

There is no requirement for energy storage at the plant but Alstom notes that this is an option for other future projects.

"All of the bids we are working on right now for solutions that we will deliver in the future will have storage," noted Moss. "We are actively preparing bids in South Africa and Morocco, which will both have energy storage. The future markets for CSP are largely, if not entirely, going to demand energy storage."

With financial close of the project completed, engineering activities have already started and Megalim was expected to issue the formal Notice to Proceed (NTP) by the end of July/early August. The project, which will employ about 1000 people

during the construction phase, is scheduled for completion in 2017.

Moss said: "Construction will start very early on. We will have to prepare a very large area of ground for the solar field. We are working from an early stage to ensure all the civil elements are in place so we can move quickly on construction of the tower."

The steam generator erection and placement at the top of the tower is seen as one of the most critical elements of the plant construction. "The power is not so different from a conventional power plant and the solar field itself is a progressive activity where you just keep erecting more heliostats. But the key point is the tower itself and the steam generator. That's the new part; the part that paces the project," explained Moss.

Construction is scheduled to last 34 months from the NTP. Meeting this schedule will require many of the construction activities of the plant's three main elements – the solar field, SRS and power island – to be executed in parallel. Its completion and start up in a little under three years will be important for the nascent CSP market.

Each project will help to bring the levelised cost of electricity (LCOE) closer to grid parity. As solar towers are only just beginning to be deployed, there is significant potential to reduce their capital costs and improve performance.

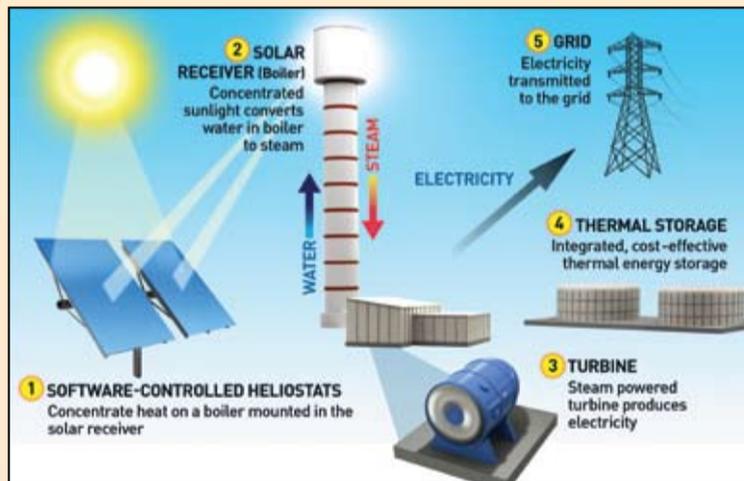
The US National Renewable Energy Laboratory (NREL) has estimated that by 2020 electricity could be produced from power towers for 5.47 ¢/kWh, down from around the current 12-15 ¢/kWh.

"Right now the CSP market is in the very early stages of development," said Moss, "and every project that comes to the market is important. They all add to demonstrating the important role that CSP can play in the fuel mix and that we have real bankable technology that governments, utilities and independent power producers can rely on. Ashalim is another very important brick in the building of that wall."

Each new project certainly builds confidence. Moss notes that Ashalim will help to educate and inform on projects in South Africa, Morocco and Chile and, a bit further down the line, Saudi Arabia with its ambitious plans.

He concluded: "Ashalim also provides continuity from the Ivanpah project. That project has been a great success and the technology will now flow through to Ashalim and combine with Alstom's power equipment technology and EPC experience."

Schematic of a solar tower power plant with thermal storage



At full capacity, Ivanpah's three solar towers produce a gross total of 392 MW of solar power. The project uses 173 500 of BrightSource's heliostats

structure & Energy Investment Fund (49.9 per cent) – obtained financing from the European Investment Bank and the Bank Hapoalim for the construction and operation of the Ashalim thermal solar power station in Israel. This key milestone follows the signature of a power purchase agreement between Megalim and the State of Israel in November 2013.

The 121 MW Ashalim CSP plant is Alstom's first solar thermal project with BrightSource and the involvement of NOY was crucial in getting





Junior Isles

From Rio to renewables

Germany may be able to teach England a thing or two on the football pitch but when it comes to energy policy to support renewables, the European Commission appear to favour the English approach to the game.

While Germany was busy conquering the footballing world in Rio last month, closer to home a battle with Brussels was not going so well. At the end of June Berlin and Brussels traded stern words as a row erupted over EU competition rules, which Germany claimed were scuppering reforms to its renewable energy programme.

The dispute related to the billions of euros of German public subsidies deployed to promote Germany's 'Energiewende', or energy transition, to a low carbon economy while protecting heavy industry from the costs.

Germany plans reduce CO₂ emissions by 80 per cent by 2050 and, following its decision to accelerate its exit from nuclear after the Fukushima accident, phase-out nuclear by 2022. The plan would see the country generate up to 45 per cent of its electricity from renewable sources by 2025 and 60 per cent by 2035.

The rapid move to renewables, however, is being supported by a

generous system of subsidies paid to renewables operators. These have been funded by surcharges that have resulted in German households having some of the highest electricity bills in Europe.

Germany's support for renewables and the reform of its 14 year-old Renewable Energy Act, however, looked like falling foul of EU competition rules. At the start of July the Bundestag voted in favour of the reform, which is at the heart of the Energiewende. Central to the reform is the elimination of the feed-in-tariff, which will be phased out entirely by 2018 and substituted with a bidding system.

For months the Commission had

been seen as a state-aid and therefore, incompatible with EU regulations. In particular, Brussels had raised concerns that the system is discriminatory and penalises consumers in order to help big industry. The Commission said the bill did not go far enough in treating heavy industry and private households equally.

Sigmar Gabriel, the German Vice-Chancellor and Energy Minister accused Europe's competition watchdog of trying to hold Germany "hostage" with unjustified and arbitrary demands. He also accused it of working "to destroy" both Germany's ambitious renewable energy push and the country's energy-hungry industry.

The Commission had been assessing the compliance of the new Renewable Energy Law (EEG) with EU law regarding the subsidies and exemptions for energy-intensive companies.

been assessing the compliance of the new Renewable Energy Law (EEG) with EU law regarding the subsidies and exemptions for energy-intensive companies. It argued that they could

Yet the stand-off between Germany and the Commission did not last long. Gabriel, with the support of Chancellor Angela Merkel – warning of job losses – exerted a huge amount of pressure in Brussels. A week before the EEG was due to come into effect on August 1st, the Commission conceded and rubber-stamped the new Law. It said: "The Commission has concluded that the EEG 2014 will further EU environmental and energy objectives without unduly distorting competition in the single market."

Joaquín Almunia, the Commission Vice-President in charge of competition policy, added: "The EEG 2014 paves the way for more market integration of renewables. In the medium term this should lead to lower costs for consumers. Also, the progressive opening up of tenders to operators located in other Member States is a very positive development for the internal energy market."

Just as in Rio, Germany had once again swept away the opposition.

For Spanish-born Almunia, the defeat was probably every bit as painful as his team's unexpected exit from the World Cup at the group stage.

England's World Cup campaign was even more dismal than Spain's; at least Spain won a game. Most would agree, however, that although England lacks the invention of Germany or even Spain on the football pitch, it certainly knows how to develop decarbonisation policies that both might admire.

On the same day the EC approved the EEG, it also concluded that the UK's Contracts for Difference (CfD) scheme is in line with EU state aid rules. In separate investigations, the Commission also found that public support worth £9.7 billion (€12.3 billion) to five offshore wind farms is in line with the state aid rules. The Commission found in particular that all projects support common EU objectives, such as the promotion of renewable energy and environmental protection, without unduly distorting competition in the Single Market.

In contrast to the barbed exchange of words before giving Germany the OK, Almunia seemed full of praise for the scheme.

"The UK Contracts for Difference encourage all renewable energy technologies producing electricity to compete against each other for support beyond 2016. It is a fine example of how to promote the decarbonisation of the economy with market-based

support mechanisms, at the lowest possible cost for consumers," he said.

The CfD scheme will run for 10 years starting in April 2015, with a budget of £15 billion. Selected individual projects will be able to receive support for up to 15 years.

Aid granted under the scheme will be paid out as a variable premium on top of a reference electricity (wholesale) price, and up to a pre-defined strike price, based on a CfD. Generators will earn money from selling their electricity into the market as usual. When the average wholesale price of electricity is below the strike price, generators will receive a top-up payment. In case of high wholesale electricity prices, revenues for the generator will be capped at the strike price to ensure that there is no over-compensation. In addition, as of 2016 no support will be paid in case of periods of negative prices longer than six hours.

The payments will be financed through a tax imposed on energy suppliers. To ensure that the tax does not discriminate against overseas generators, imported renewable electricity will not be subject to the tax. In the long run overseas generators will be allowed to compete for CfDs on the same terms as national generators.

Following the EC approval, the UK Department of Energy and Climate Change (DECC) released a draft version of the CfD budget notice that the Secretary of State will give to the EMR (Electricity Market Reform) Delivery Body ahead of the first allocation round in October 2014.

The department divided the first allocation round in two pots. The first, consisting of established technologies like onshore wind and solar, will be granted £50 million for the project commissioning from 2015/16 onwards. The second pot comprises technologies such as offshore wind, wave and tidal stream, which are less established. They will be granted £155 million for the project commissioning from 2016/17 onwards.

The administrative strike price for tidal and wave energy will be £305/MWh for the next five years. Offshore wind price will be reduced from £155/MWh to £140/MWh over the same period.

Not all are happy with the level of support, however. Leonie Greene, Head of External Affairs at the Solar Trade Association, commented: "The message the government is sending out today is clear. It is backing nuclear and other more expensive renewables over value for money solar."

"This is an absurd decision that will ultimately hit energy bill payers across Britain. Solar is already cheaper than offshore wind; it will soon be cheaper than onshore wind, and it stands a realistic chance of being cheaper than gas by the end of the decade. But this is only achievable with stable government support and a level playing field."

The REA's Chief Executive Dr Nina Skorupska said: "With many people struggling with their energy bills, cost-effectiveness is every bit as important, and DECC cannot say that this planned budget delivers value for money for the consumer. The best way to square the circle is by properly funding the cheaper technologies and introducing minima for all technologies."

As the saying goes: 'You can please all of the people some of the time, and you can please all of the people some of the time. But you can't please all of the people all of the time. Much like football really.'

Und ve could beat you at der penalties also!

