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Special Technology Supplement

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Hinkley gets green light but could still face hurdles

UK Business and Energy Secretary, Greg Clark, said Hinkley would be the "first of a wave of new nuclear plants" in Britain

The UK's first nuclear power plant in a generation has received the final go ahead from the government but obstacles could still remain. **Junior Isles**

The planned Hinkley Point C could still face financial, legal and technical obstacles, despite receiving the final go ahead from the UK government last month.

Just six weeks after the news that it would delay approval in order to carry out a review of the project, Prime Minister Theresa May gave Hinkley C her blessing in September after stipulating additional contract terms.

The new clauses are designed to enhance security and ensure that the power station cannot change hands without the UK government's agreement. The government also said there would be other "significant new safeguards for future foreign investment in critical infrastructure", including the state taking a special share in all new nuclear projects after Hinkley, giving it powers to veto ownership changes.

France's EDF, the project's developer, and China's China General Nuclear CGN, which is providing £6 billion in funding, both made clear they did not regard the new safeguards as any obstacle to their plans for Bradwell. CGN is expected to submit its Hualong One reactor design to begin UK safety checks within months.

Reacting to the news, John Sauven, Greenpeace Executive Director said: "This decision is unlikely to be the grand finale to this summer's political soap opera. There are still huge outstanding financial, legal and technical obstacles that can't be brushed under the carpet. There might be months or even years of wrangling over these issues."

Greenpeace cited technical issues that have been discovered in the reactor vessel and highlighted the poor financial state of EDF.

Notably, it said: "There are several outstanding legal cases that muddy the waters considerably." There is still the pending Austrian State Aid case that may not be resolved for years. Greenpeace said that, in addition to a possible new State Aid case against France, there are two outstanding French cases of the EDF board attempting to overturn the Final Investment Decision (FID). Greenpeace also has a case against the Information Commissioner asking for the modelling on which the Hinkley decision was made initially to be made public.

Richard Black, director of the Energy and Climate Intelligence Unit (ECIU) also said challenges may well lie ahead.

"French trade unions don't like it, nor do some of the likely candidates for the French Presidential Election next year, EDF's finances are not the healthiest, and the French nuclear regulator is examining flaws in steel used for a similar reactor being built in France. So it may turn out not to be quite as 'final' as it looks now.

The project's proponents, however, remain confident. Greg Clark, the UK Business and Energy Secretary, said Hinkley would be the "first of a wave of new nuclear plants" in Britain, while Jean-Bernard Lévy, chairman of EDF, said it marked "the relaunch of nuclear in Europe".

Speaking at the World Nuclear Association Symposium just after the announcement, CEO of EDF Energy Vincent de Rivaz said: "We understood why the new government took the time to look at the project to study all its component parts… the review confirmed again the robustness of

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Businesses back clean energy at NYC Climate Week

Businesses demonstrated their support for climate action, announcing commitments to make better use of better energy, cleaner, smarter energy at this year's Climate Week NYC in New York, USA.

The announcements came from The Climate Group's two leading corporate energy campaigns: RE100, the global initiative run in partnership with CDP that works with companies committed to transitioning to 100 per cent renewable power across all their operations; and EP100, a new global initiative run in partnership with the Global Alliance for Energy Productivity that works with businesses committed to doubling their energy productivity.

During the opening ceremony Bank of America said that it would be joining RE100. As well as reducing emissions in its own operations, Bank of America for the first time announced quantitative goals to address emissions in its supply chain.

"These new commitments build on our existing environmental strategy for both our operations as well as our business activities. This includes our $125 billion environmental business initiative, which is providing much needed capital to catalyse greater investments in clean energy and other low-carbon projects. Overall, we have provided more than $53 billion dollars to sustainable business activities since 2007," said Andrew Plepler, Global Environmental, Social and Governance executive at Bank of America.

"We're joining RE100 to help keep these critical issues at the forefront of the business agenda, recognising the role of the private sector in addressing challenges associated with climate change. Together we can accelerate the transition to a more sustainable and low carbon economy."

Apple also said that it would join the RE100 campaign and announced the completion of a new 50 MW solar project in Arizona and new renewable energy commitments from its manufacturing partners.

RE100 signed up eight new members, including: Wells Fargo & Co.; Hewlett Packard Enterprise (HPE); cloud computing companies VMware Inc. and Rackspace Inc.; VF Corporation, owner of many apparel and footwear brands; global alcoholic beverage company Diageo; and Norway's largest financial services company DNB.

The EP100 campaign also welcomed several new members – Dalmia Cement, Mahindra Holiday and Resorts India, global energy efficiency technology provider Danfoss Group, and Chinese LED manufacturer Hongbo Group.

Despite EP100 being launched in recent months, the campaign already boasts corporate sign ups from India, China, Europe and the US.

Research shows that in the US alone, doubling energy productivity by 2030 could save as much as $327 billion every year in energy costs and add up to 1.3 million jobs to the economy, while carbon dioxide emissions would be cut by approximately 33 per cent.

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Hinkley Point C. The process has strengthened UK industrial strategy and governance."

The news met a mixed reaction. Trade unions and business groups generally welcomed the decision.

TUC General Secretary Frances O'Grady said: "We are pleased ministers have ended the uncertainty over Hinkley Point. This project will create thousands of quality jobs and apprenticeships."

Tony Ward, Head of Power & Utilities at consulting firm EY, commented: "Hinkley Point is a transformational infrastructure investment that will bring long-term employment for a highly-skilled workforce, stimulus for the UK's industrial supply chain and positive social and economic benefits for the South West region."

Ward: Hinkley Point is an infrastructure investment that will bring long-term employment

EDF has already announced several preferred British contractors. Named bidders for combined contracts of more than £1.3 billion include joint venture Balfour Beatty Bailey, Laing O'Rourke, and Weir Group.

Others, however, continue to question whether the deal is value for money.

Crucially, the subsidy deal remains unchanged, with EDF guaranteed to receive £92.50/MWh for electricity generated by the plant for 35 years. The guaranteed price was set in 2012 and indexed to inflation, meaning it is already close to £100/MWh.

The government said it estimated the subsidy cost for a typical household would be £12 a year by 2030, in 2012 money. The National Audit Office has said the lifetime subsidies could total £30 billion.

But at a cost of £18 billion, with funding from both France and China, cancelling the project would have led to severe political fallout.

David Elmes, Head of the Global Energy Research Network at Warwick Business School commented: "This is what being painted into a corner feels like… Hinkley Point locks UK bill payers into an expensive source of energy for decades to come.

"The UK's climate change commitments make it tough to provide electricity reliably at low emissions, but this deal was started a decade ago when we hoped the companies involved could deliver it on time and at a reasonable cost. The price UK bill payers are committing to through the government is now double and the start date has slipped at least eight years.

■ General Electric (GE) has confirmed its $1.9 billion contract to supply two 1770 MW Arabelle steam turbines, generators, and other equipment to Hinkley Point C. GE, which acquired the contract and capability when it purchased the power assets of France's Alstom last year, had already been doing early engineering work on the project.

Renewables lead as electricity sector investments hit record high

Electricity sector investment continues to grow, led by renewable generation, even as global investment in energy falls.

Junior Isles

Global investment in electricity generating capacity, networks and storage reached a record $680 billion in 2015, up 4 per cent on the previous year, according to a recent report by the International Energy Agency (IEA).

According to the new report, *World Energy Investment 2016* (*WEI 2016*), the record investment came even as global energy investment fell 8 per cent in 2015.

In its first-ever detailed analysis of investment across the global energy system, the IEA noted that a drop in oil and gas upstream spending outweighed continued robust investment in renewables, electricity networks and energy efficiency.

Electricity's share of total energy supply investment rose to 42 per cent in 2015, compared with less than 40 per cent during the past five years. This trend, says the IEA, partly reflects the rising role of electricity in total energy consumption, but also underlying cost and activity changes in both power and fossil fuel supply.

The IEA says there has been a major shift in investment towards low-carbon sources. Investment in fossil fuel generation fell by nearly $10 billion in 2015 to $111 billion – its lowest level since 2008. Meanwhile, at $288 billion in 2015, or over 40 per cent of the total, the report says that renewables "are firmly established" as the largest source of power investment.

Rapid cost deflation in wind and solar PV, technology progress and more widespread deployment have led to a 40 per cent jump in capacity additions and a one-third increase in annualised output since 2011, states the *WEI 2016*. Notably, the IEA said the investment in renewables-based capacity generates more than enough electricity to cover global electricity demand growth in 2015.

Speaking at the launch of the report in London, UK, in September, IEA Executive Director Fatih Birol said: "The bulk of the good news comes from renewables. Renewables accounted for more than 70 per cent of all power [generation] investments, led by wind. This shows renewables are becoming more and more economic and the returns are stronger."

Birol noted, however, that the strong growth in renewables presents some challenges in terms of their intermittency and how the increasing share can be integrated into the system. "Here batteries are very important," he said.

The *WEI 2016* calculates that grid-scale battery investment was 10 times higher in 2015 than in 2010, although it comprised only 0.4 per cent of networks spending. Electricity network investment reached a new record of over $260 billion. Some 55 per cent of spending on transmission and distribution was to meet new demand, 35 per cent to upgrade ageing assets and 10 per cent to integrate renewables.

The IEA will follow up this analysis of the energy sector in 2015 with the release of its annual *World Energy Outlook 2016* in November.

See Energy Industry Data on Page 11

Paris Climate Agreement inches towards ratification

The Paris Climate Change Agreement has been bolstered by news that the USA and China (which together account for some 38 per cent of global emissions) will formally ratify the accord. The two countries made their announcement on the eve of the G20 summit in Hangzhou, China, in September.

Brazil, which accounts for around 2.5 per cent of global emissions, has also committed. Up until these commitments, only 24 countries representing 1.08 per cent of emissions had formally ratified the accord.

However, there is still some way to go before the required 55 countries, accounting for 55 per cent of global emissions, sign up to bring the Agreement into force.

India resisted pressure from the US and China at the G20 summit to ratify the Paris climate deal this year. India and several other countries believe they cannot ratify the deal due to various legal impediments, said Aravind Panagariya, head of NITI (National Institution for Transforming India) Aayog, India's representative at the summit. "There is no deadline to my mind but we will make submissions of progress."

The easiest way to reach the goal would be if the EU's 28 member states, with a 12.08 per cent share of emissions, ratified the agreement soon.

Commenting on the US and China news Jennifer Morgan, Executive Director, Greenpeace International said: "Less than a year after the adoption of the Paris Agreement, under the Chinese Presidency leadership, the G20 has moved forward key issues for tackling climate change. Countries now need to react to the strong call from the G20 to formally join and ratify the Paris Agreement as soon as possible, so that this Agreement can enter into force this year.

"This is an additional signal of the global shift toward a clean energy economy and away from the fossil fuel era."

The International Energy Agency (IEA) recently warned, however, that investments in renewables would need to triple to meet targets agreed at last year's Paris climate talks, even as costs in the sector fall rapidly.

"We are seeing real action in dollar terms but it is not yet enough," said IEA Executive Director Fatih Birol, as the agency launched its first annual report on global energy investments.

"It makes me happy that the numbers show governments can change the direction of investment. But we need to triple efforts to meet the Paris targets."

According to a new World Energy Council (WEC) report: 'Variable Renewables Integration in Electricity Systems 2016 - How to get it right', renewables, including hydro, now account for over 30 per cent of the total global installed power generation capacity and 23 per cent of total global electricity production.

The report published by the WEC in partnership with CESI S.p.A., draws from 32 country case studies, representing about 90 per cent of installed wind and solar capacity worldwide.

Christoph Frei, Secretary General, World Energy Council, said: "We are beyond the tipping point of grand energy transition. Implementing technically and economically sound, stable policies supported by clear carbon price signals will enable this transition and take us a step closer to meeting the climate aspirations agreed at COP21."

Transmission operations at centre of ABB review

Plans for ABB's power transmission operations, which could be worth as much as $18 billion separately, look set to be central to a new strategy expected to be unveiled shortly.

In mid-September the Swiss engineering group announced the sale of its global high-voltage cable business with a total value of €836 million ($934 million) to NKT Cables.

NKT Cables designs, manufactures and supplies power cables for low-, medium- and high-voltage solutions mainly in the alternating current (AC) area. It has major production facilities in Europe and China as well as sales offices around the world.

ABB said its high-voltage cable technology and manufacturing as well as service footprint is highly complementary with NKT Cables' activities, making the combined business ideally suited to serve the rising global demand for long-distance power transmission cable systems.

Announcing the sale, ABB CEO Ulrich Spiesshofer said: "We are combining two strong cable portfolios rooted in a shared Nordic heritage that will be more competitive on a larger scale under NKT Cables' ownership, while maintaining access to supply through a long-term strategic partnership."

Claudio Facchin, President of ABB's Power Grids division added: "As part of the strategic partnership, ABB and NKT Cables will work together on future projects to access market opportunities in areas like sub-sea interconnections and direct current (DC) transmission links. This transaction will simplify and focus the Power Grids portfolio."

ABB says the combination of its "niche cable system business with the strength of NKT Cables" is a key element of its 'Next Level strategy'. The power transmission business is part of its Power Grids division, which is currently undergoing a strategic review.

Just ahead of the announcement Cevian Capital – the largest European activist investing fund – called for ABB to separate the unit to reduce complexity and boost the value of shareholders holdings. Cevian also argued that there were no overlaps with other parts of ABB's business.

But the news that ABB will sell its high voltage cable system business, which represents a small part of the power grids division, suggests it is seeking a streamlining of the business, as opposed to a complete separation.

Speaking to the *Financial Times*, an ABB spokesman said that "all options are still open" for the power grids division. Last year the division, which combines power generation, transmission and distribution operations, reported revenues of $12 billion.

Offshore wind strategy targets 86 GW

- Plans outlined for offshore wind support
- Renewables generation continues rise

Siân Crampsie

The US government has called for major investment in the offshore wind energy sector to enable the installation of 86 GW of new capacity.

The Obama Administration has published the National Offshore Wind Strategy, outlining plans for supporting the construction of offshore wind farms over the next five years.

The strategy is a key part of President Barack Obama's Climate Action Plan, and follows the publication of the Wind Vision roadmap in 2015 by the Department of Energy (DOE).

That document indicated that the country could reach 86 GW of installed capacity by 2050.

The USA's first offshore wind farm, at Block Island, Massachusetts, has just been completed. The US government believes that this 30 MW project will not only prove the viability of offshore wind in the USA, but also inform future projects.

The National Offshore Wind Strategy details the current status of offshore wind in the USA, and outlines plans for reducing deployment costs and timelines.

"[The] collaborative strategic plan is part of a long-term commitment to support innovation that enables widespread offshore wind deployment and shows how offshore wind will benefit our country with new jobs, less pollution, and a more diversified electricity mix," US Energy Secretary Ernest Moniz said in a statement.

The strategy outlines 30 specific actions that DOE and the Department of the Interior (DOI) can take over the next five years to address key challenges facing the industry.

The actions will be implemented in three strategic areas such as reducing technical costs and risks; supporting effective stewardship; and improving the market conditions for investment in offshore wind energy.

Data from the US Energy Information Administration (EIA) shows that renewable energy is continuing to grow in the USA, largely thanks to the construction of new, large-scale solar and wind projects.

EIA believes that non-hydro renewable energy will increase to over ten per cent of electric generation in the US next year, and to triple by 2020, from 4.2 per cent in 2010.

Electricity generation in the US has gone down 2.5 per cent this year, with coal-fired power down 20 per cent, while wind and solar power have increased by 23 per cent and 31 per cent respectively, EIA reported in August.

Attitudes towards renewable energy and climate change are also changing, according to a new survey.

The Energy Policy Institute at the University of Chicago (EPIC) and The Associated Press-NORC Center for Public Affairs Research conducted a new survey on the willingness of Americans to pay for government policies aiming at tackling climate change, and found that 65 per cent of Americans believe climate change should be addressed by the government.

The survey also found that 57 per cent of the sample declared that they would pay at least $1 more on their electric bill every month for climate action – 29 per cent of which would pay $20 a month, and 20 per cent said they would pay $50.

Michael Greenstone, the director of EPIC said: "I think what this says is that quietly there is developing a change in peoples' attitudes with respect to paying for climate policy... I found it striking that one in five households were willing to pay $50 a month."

The poll also found that one quarter of Americans believe that the US will achieve its targets under the Paris Agreement, while eight in ten say that the country should still try to reach the goals.

Chinese investors target South America

Chinese energy companies are targeting Brazilian asset sales in a bid to make strong headway into the growing South American power markets.

China Three Gorges Corp and State Grid Corp of China are bidding for a major stake in Brazil's fourth largest energy generator, Santo Antonio Energia SA, which is developing a 3150 MW hydropower plant on the Madeira River.

Their move follows State Grid Corp's recent purchase of a stake in CPFL Energia, Brazil's largest private electricity firm.

China Three Gorges Corp and State Grid Corp of China are bidding alongside Canada's Brookfield Asset Management Inc for 28.6 per cent of shares in Santo Antonio. They view Brazil as a key market due to the size of the economy, strong trade ties, growing energy demand, and rich hydro and wind energy resources.

The country could also serve as a springboard for investment in other South American countries.

Last month China International Water & Electric and China Three Gorges Corporation signed a contract with Bolivia's ENDE for the construction of a 600 MW hydropower complex in the eastern province of Santa Cruz.

China's Eximbank will provide financing for the $1 billion project. Bolivian President Evo Morales has called for the construction of a further eight hydro plants in Santa Cruz.

Last month State Grid agreed to the $1.8 billion purchase of a 23.6 per cent stake in CPFL, adding to its existing 23 per cent stake in the utility, which distributes power in the south and southeast of Brazil.

- Brazil has ratified the Paris Agreement on climate change, its government announced last month. The country emits about 2.5 per cent of the world's carbon dioxide and other polluting gases, according to United Nations data, and has committed to cutting emissions by 37 per cent over 2005 levels by 2025.

Renewable concerns down under

■ State-led programmes could increase national cost of renewable projects ■ ARENA faces budget cuts

Syed Ali

Businesses have hit out at a plan for ambitious new renewable energy targets in the Australian state of Victoria, warning that it could increase the costs of renewable projects under the national scheme and further distort the electricity market.

The Business Council of Australia warned that Victoria's renewable energy target (VRET) of 25 per cent by 2020 and 40 per cent by 2025, would ultimately add to the cost of the country's overall renewable energy target.

The organisation is concerned about the impact on existing electricity generation in the state, which relies heavily on burning brown coal in the Latrobe Valley.

"State-based energy targets, such as the VRET, only serve to increase the cost of renewable energy projects that are being built under the national scheme and further distort Australia's electricity markets," said a submission by the Business Council. "Renewable energy targets are expensive tools to reduce Australia's emissions."

The warnings have been echoed by the Australian Energy Council, which represents 21 electricity and downstream gas businesses, and the Minerals Council.

Australia is heavily reliant on coal, and data released in September revealed that its emissions have been increasing steadily. Energy combustion emissions covered by CEDEX accounting for 83 per cent of the country's total energy combustion emissions has steadily increased in the two years following the removal of the carbon price.

For the first time since then, however, emissions fell in June 2016. It is a trend that renewable energy proponents hope will continue despite opposition from parts of the business sector and political pressure.

At the end of August Australia's renewable energy sector voiced its concern over a bill set to be introduced to Parliament, which involves a A$1 billion cut to the Australian Renewable Energy Agency's (ARENA) grants funding.

Clean Energy Council Chief Executive Kane Thornton said: "While we understand the government is looking for savings, slashing grant funding for renewable energy massively undermines the industry's efforts to meet our national emissions reduction targets, as well as the 2020 Renewable Energy Target (RET) and beyond."

Queensland is expecting a job boom from its solar energy projects but ARENA says hopes are dimmed by the funding cuts.

In September, ARENA announced that it awarded support to 12 solar power projects with a combined capacity of 482 MW that will unlock more than $1 billion of investment.

The agency will provide $91.7 million to six plants in Queensland, five in New South Wales and one in Western Australia following a competitive tender, it said.

The selected projects are expected to triple Australia's large-scale solar capacity to 720 MW from 240 MW.

Sri Lanka prepares to tackle energy shortage

Syed Ali

Sri Lanka's energy regulator has approved the Ceylon Electricity Board's Least Cost Long Term Generation Expansion Plan (LCLTGEP) 2015-2034 as part of its plan to tackle a looming power shortage.

The Public Utilities Commission of Sri Lanka (PUCSL) has said that power plants listed in the LCLTGEP for the period of 2017-2020 must be built to prevent a potential power shortage in 2018 and beyond due to non-operation of hydro power plants during drought conditions.

Under CEB's plan around 1275 MW of power would be added to the national grid during the next four years. Failure to implement those power plants on time will result in country-wide power shortages in years 2018/2019, warned PUCSL Director General Damitha Kumarasinghe.

Sri Lanka also intends to significantly increase the share of renewable energy generation by the end of the next decade.

At the end of August the Sri Lankan Cabinet of Ministers approved a 'Battle for Solar energy' programme.

The programme aims to encourage the small consumers to install rooftop solar panels and will pay them for any excess energy exported to the grid. With this new programme, government expects that at least 20 per cent of such consumers will produce electricity on their own.

Deputy Minister of Power and Renewable Energy Ajith P. Perera said that, for excess energy exported to the grid, the electricity board is ready to pay a feed-in tariff to rooftop solar generators. The scheme will be implemented in stages and the first stage will cover Northern, Southern and Eastern Provinces.

Sri Lanka currently generates 50 per cent of its electricity from renewables and aims to ramp this up to 60 per cent by 2020 and 70 per cent by 2030. To achieve this target, 600 MW of wind and 3000 MW of solar plants will be built within the next 10 years.

Climate goals call for over $7 trillion investment

Asian economies, including India and China, require more than $7 trillion investment to meet the stated ambition to limit global warming to 2°C, a new report said recently.

The report, *'Investing for the Climate in Asia'*, concludes that $7.7 trillion in investment between 2014 and 2035 in renewable energy and energy efficiency is needed to meet the combined electricity demands of China, India, Japan and Southeast Asia.

Including an analysis of 36 banks, 30 investors and 24 insurers, it reviews the disclosure of leading domestic financial institutions across the Asia Pacific region in an attempt to accurately determine the region's response to climate change.

The report has been produced to also provide insight into emerging and future trends for investment and lending activity.

Some 31 per cent of the institutions analysed in the new report factored climate change risk into their financing operations. Over a quarter of the banks analysed referred to climate change factors as a reason to limit financing, and 81 per cent disclosed their policy on responsible lending.

Commenting on the report, Emma Herd, CEO of the Investor Group on Climate Change (IGCC), said: "The finance sector has recognised the opportunity and is gearing up fast.

"While it's clear that progress is uneven and gaps remain, such as a need for greater focus on climate risk in investing, progress over the past two to three years has been remarkable. There's no doubt that a great transition is on."

Batteries find a home after EFR tender

Plans to install 200 MW of energy storage capacity will make for a more efficient and flexible grid, says National Grid.

Siân Crampsie

The results of National Grid's first enhanced frequency response (EFR) tender show the growing importance of energy storage in the grid, experts say.

Energy storage can enhance the flexibility of the electricity grid and will be needed more as renewable energy capacity grows. However, its use in electricity grids has so far been limited largely because of a lack of regulatory clarity governing their use.

National Grid's tender will result in the construction of eight large-scale energy storage projects with a combined capacity of 200 MW. The storage projects will be capable of responding very quickly (in less than 1 second) to system volatility.

National Grid has described the tender results as "an exciting new chapter for the industry". It said that its enhanced ability to control variations in frequency almost immediately will result in reduced costs of approximately £200 million as well as streamline its services.

The four-year contracts will enable National Grid to assess the value of energy storage on a widespread commercial basis for the first time.

"This is a pivotal moment for the UK's energy industry," said Edward Humphries, energy storage specialist in the energy and infrastructure practice of law firm Orrick. "EFR is the first foray into a market-based mechanism for remunerating energy storage, and its outcomes could render it the first step towards a major shift in the UK's energy supply.

"Technological advances are constantly opening up new and better ways of storing energy. While the sector is still in its infancy, the technology exists to build a real strength in energy storage in the UK and EFR is a much-needed trigger for exploring this further."

Energy advisory firm Regen SW forecasts that the energy storage market could grow to 10 GW over the next 15-20 years, and that the applications of the technology will evolve with time.

Johnny Gowdy, Regen SW Director, commented: "Energy storage is developing rapidly and the flexibility it provides can reduce the need for expensive new energy generation projects. However, developers and investors face an unsolved 'Rubik Cube' of technologies, regulatory frameworks, revenues and costs.

"In the short-term, battery storage projects will tend to focus on rapid response services to support the network. As costs fall, storage will play a key role in providing reserves of energy to balance supply and demand and could become ubiquitous in our homes, workplaces and in transport."

E.On and EDF were among the companies to win EFR bids. E.On said it would install a 10 MW lithium ion battery in Sheffield and said that the contract was "an important recognition of the enormous potential battery solutions bear".

EDF will install a 49 MW battery system at its West Burton power plant. Other contract winners include Vattenfall, which will deliver 22 MW of storage capacity at a Welsh wind farm, Low Carbon, and RES.

National Grid said that the tender was highly competitive, with more than 1300 MW of offers received, most of them battery projects. The total cost of the EFR round was £65.95 million, with an average price of £9.44/MW of EFR/h.

UK behind on renewable heat, transport

- Government warned on 2020 targets
- May commits to Paris deal

The UK government has been warned that the country is likely to miss its 2020 renewable energy target.

The Energy and Climate Change Committee (ECCC) says that although the UK is on track to meet its obligations on renewable electricity generation, it is behind on heat and transport.

The UK has a target of providing 15 per cent of its energy needs from renewables, with sub-targets of 30 per cent in electricity, 12 per cent in heat and ten per cent in transport by 2020.

"The experts we spoke to were clear: the UK will miss its 2020 renewable energy targets without major policy improvements," said Angus MacNeil, Energy and Climate Change Committee Chair. "Failing to meet these would damage the UK's reputation for climate change leadership. The government must take urgent action on heat and transport to renew its efforts on decarbonisation."

Following its vote to leave the EU earlier this year, the UK's obligations towards the 2020 targets are unclear. However the ECCC said that failure to recommit to or meet the targets would undermine confidence in the UK's clean energy economy.

Last month Prime Minister Theresa May sought to reassure investors by committing to ratify the Paris climate agreement. The move was widely welcomed by business groups and environmental groups alike.

"We warmly welcome the news that the government has committed to ratify the Paris Climate Change agreement," said Rhian Kelly, CBI Infrastructure Director. "This is an exciting moment, and another step on the path towards a global low carbon future.

"Having also committed to reducing emissions in the UK in line with the 5th Carbon Budget, business looks forward to working with the government to develop a clear and credible plan to meet this ambition."

Mohamed Adow, Christian Aid's Senior Climate Change Advisor, said: "A leading group of governments including the UK is rapidly bringing the Paris Agreement into life. There has been unprecedented political momentum across the globe towards getting the Paris Agreement ratified and it will likely now come into force by the end of the year.

"Led by both vulnerable developing countries, as well as the USA and China, the UK was in danger of falling behind. But this commitment shows the Prime Minister is keen to ensure the UK builds on its good work in Paris to secure the agreement and is determined to stay in the leading pack."

Vattenfall hits record low with wind tender

Vattenfall has won a Danish offshore wind tender with a record-setting bid of €60/MWh, 20 per cent lower than the previous record set by Dong Energy.

The Swedish firm submitted bids for two sites in the Danish Near Shore Wind (DNS) tender at the beginning of September and said that its success demonstrated that it had been able to reduce the costs of offshore wind faster than expected.

Vattenfall says it will move forward with the development of the two sites, which will total 350 MW of capacity, and for which it still requires government approval.

In July, Dong set a new record low for the price of offshore wind energy in a tender to develop the Borssele I and II projects in the Dutch Zeeland zone.

The Netherlands' Minister of Economic Affairs awarded the concession to build the two 350 MW wind farms to Dong, which won the bid with an average bid strike price of €72.70/MWh excluding transmission costs.

Including the cost of the grid connections, the price for the two projects is €87/MWh.

Vattenfall has been able to undercut this partly because of the location of the wind farms, which are in close proximity to the shore in the Danish North Sea, leading to lower costs for foundations and transportation.

Separately, Siemens announced that it will provide the turbines and an innovative gravity jacket foundation concept at an offshore wind pilot project in northern Denmark.

Nissum Bredning Vindmøllelaug and Jysk Energi earlier this year won the contract to develop the 28 MW pilot project, which will be a test bed for new technologies and integrated design processes that can help to reduce the costs of offshore wind farms.

The project will be the first installation of Siemens' SWT-7.0-154 wind turbine. The turbines will be grid connected using a new cable and turbine concept with a 66 kV voltage.

Record low bids submitted for Abu Dhabi project

■ Renewables cheapest option in several markets ■ Abu Dhabi bids beat Chile bids

Siân Crampsie

Abu Dhabi could expand its Sweihan solar power project to over 1 GW after record low bids were submitted last month.

Abu Dhabi Water and Electricity Authority's procurement arm received six bids for the upcoming 350 MW solar photovoltaic (PV) plant in Sweihan, with the lowest bid at 2.42 cents/kWh coming from an Asian consortium. A local firm bid second-lowest at 2.53 cents/kWh, according to reports.

The bids are lower than the last record-low bids received earlier this year for solar projects in Chile. However the Asian consortium reportedly submitted a second offer, proposing to expand the plant to 1170 MW at 2.3 cents/kWh, local media reported.

The bids are a further indication of the falling costs of renewable energy in markets around the world, and renewables are already the cheapest option in a number of markets around the world, according to research by Carbon Tracker Initiative.

A new sensitivity analysis of power generation costs by Carbon Tracker Initiative shows that renewable power generation costs are already lower on average worldwide than those of fossil fuels and clean energy plants will become even more cost-competitive by 2020.

The firm compared the power-generation costs of four new-build coal, gas, wind and solar plants. The paper applies a Levelized Cost of Electricity (LCOE) sensitivity analysis across three scenarios: the 2016 reference case scenario, an updated 2016 scenario and a 2020, 2˚C pathway setting, where investment decisions take into account decarbonisation trends.

"Policy-makers and investors really need to question out-dated assumptions on technology costs that do not factor in the direction of travel post-Paris. Planning for business-as-usual load factors and lifetimes for new coal and gas plants is a recipe for stranded assets," said Carbon Tracker's head of research James Leaton.

The LCOE study shows that reduced load factors and shorter lifetimes for coal and gas plants in a world that is decarbonising, significantly undermine plant economics. Few models to date have factored in this kind of dynamic when calculating future LCOE.

Meanwhile, the combination of lower cost capital with cheaper technology for solar and wind improves the relative competitive position of renewables.

"This analysis explains why renewables are already the cheapest option in a number of markets. This trend is only likely to spread as the growth of renewables undermines the economics of fossil fuels," said Paul Dowling, co-author of the report.

IPPs key to GCC future

Independent power producers (IPPs) will play a key role in the future of Gulf countries but they should be made a key part of market reforms, rather than just seen as a short term solution to capacity needs, according to a new report.

The latest Apicorp Energy Research published by Arab Petroleum Investments Corporation indicates that over the next five years, the private sector will add more than 20 GW of generating capacity in GCC countries.

IPPs will help Gulf countries to meet rising energy demand without placing a financial burden on governments, many of which are facing increasing deficits and lower budgets because of lower oil revenues.

However, with structural reforms in many Gulf states imminent, IPPs should be included in planned changes in order to avoid distortions and inefficiencies created by long-term power purchase agreements.

Estimating that GCC power capacity needs to expand at an average annual pace of 8 per cent between 2016 and 2020, Apicorp said to meet rising demand, the GCC will need to invest $85 billion to add 69 GW of new capacity over the next five years.

Highlighting that the region still relies on the single-buyer model where a state-owned entity is the only wholesale purchaser from power generating companies, Apicorp said the current market structure in the GCC has served IPPs well as governments assume most of the risks.

In addition, IPPs have numerous other advantages, including fast execution and a lower cost of capital compared with government-run projects.

Oman is leading efforts in the region to unbundle the power sector and privatise key assets. It will become the first GCC country to introduce spot trading in the electricity market by the end of the decade.

In Saudi Arabia, state utility Saudi Electricity Company (SEC) has recently announced plans to break-up into four independent power generating bodies and an independent transmission company by the end of 2016.

The single-buyer model is likely to remain, says Apicorp, but governments are likely to want to reduce risks associated with IPPs.

Toshiba and Uganda partner in geothermal development

Toshiba is to help Uganda develop its geothermal energy sector after signing a memorandum of understanding with the government.

The firm will collaborate with the Ministry of Energy and Mineral Development (MEMD) on power generation projects in the geothermal sector.

The collaboration will focus on the development and supply of major equipment for a geothermal power plant, framing operation and management guidelines, and cooperating in personnel development.

Toshiba will also provide services for the early construction phase of the plant as well as supply geothermal power generation equipment in the future.

Uganda Ministry of Energy and Mineral Development Permanent Secretary Dr Fred Kabagambe-Kaliisa said: "The development of Uganda's geothermal energy resources is in line with our energy policy objectives of increasing power generation capacity and diversifying our energy mix in order to achieve least-cost, affordable and stable energy supply.

Uganda has an estimated 500 MW of geothermal potential. It currently generates about 60 per cent of its power from hydropower. Fast economic growth is causing energy demand to grow at 10 per cent per year.

South Africa prepares for nuclear new build

South Africa is preparing to launch a request for Proposals (RFP) for a nuclear new build programme.

Energy Minister Tina Joemat-Pettersson told the country's parliament that the RFP would be issued at the end of September and would give an indication of the costs of nuclear energy.

The move has sparked debate in South Africa about the need for nuclear energy. The government has yet to formally adopt an updated Integrated Resource Plan, which gives projections on energy demand and plans the generation mix.

The last IRP was published in 2010 and calls for the construction of 9.6 GWe of new nuclear capacity, with the first reactor coming on-line in 2023. The government says it will provide an update by the end of the year.

The Nuclear Industry Association of South Africa (NIASA) welcomed the plans but called for transparency and an emphasis on localisation and local skills development.

"The nuclear project will not only support industry and create much needed employment, it will also create a platform upon which our economy can grow and develop. NIASA is committed to working with all stakeholders to ensure that the next nuclear build project is transparently and professionally managed through all phases of its development," said Knox Msebenzi, NIASA Managing Director.

The South African cabinet gave the Department of Energy permission to issue the RFP in December 2015. Five reactor vendors are expected to be invited to submit proposals: China's SNPTC, France's EDF/Areva, Russia's Rosatom, South Korea's Kepco, and the USA's Westinghouse. Proposals are to specify reactor design, the degree of localisation, financing and price.

Running circles around fuel costs

As the global market for coal moves from one based on fixed calorific value to a more flexible price versus quality market, there will be increasing opportunities for circulating fluidised bed (CFB) technology, especially in countries where coal is likely to remain an important part of the generation mix for decades to come. **Junior Isles**

The 2200 MWe Samcheok Green Power Plant, currently being commissioned in South Korea, is the most advanced CFB in the world

Despite the inexorable global shift to renewables, coal will continue to play a major role in power generation for years to come – especially in Asia, countries like Turkey, South Africa, Egypt parts of Eastern Europe, Middle East and South Amercia .

According to the International Energy Agency (IEA) World Energy Outlook 2015, global coal capacity additions will be just below 1150 GW between 2015 and 2040 under its New Policies Scenario (the WEO 2015 central scenario). In China, although renewables will account for 60 per cent of overall capacity additions, notably coal will account for almost a quarter of its gross additions, i.e. 383 GW out of a total 1650 GW. India meanwhile, will add 306 GW of new coal plants out of a total 888 GW.

Traditionally, pulverised coal (PC) boilers have been the technology of choice for coal fired generation, accounting for the vast majority of the market but according to Amec Foster Wheeler things are changing, with circulating fluidised bed (CFB) technology gaining ground.

Robert Giglio, Vice President of Strategy and Business Development, Amec Foster Wheeler said: "Ten years ago 95 per cent of utility-scale boilers were PC; CFBs weren't even in that market but in the next 10 years they will be chosen more and more for large coal plants. Right now CFBs represent about 10 per cent of the market and the expectation that this could grow to 30 per cent in the next 5-10 years is not unreasonable."

The two drivers behind the technology's adoption are the continuing scale-up in boiler size and fuel flexibility.

While CFBs have been around for more than 40 years, it is only over the last 10 years that their use in large utility power plants has grown strongly. As CFB boilers have reached sizes and efficiency levels never imagined, they are drawing an increasing amount of attention from utility power companies around the world.

Amec Foster Wheeler's CFB technology has been proven at increasing sizes, reaching the 200 MW utility size in the 1990s. Today, it has around 35 CFB units of over 200 MWe scale in operation or under construction capable of burning a wide range of fuels.

At the same time, the technology has been improved to raise boiler efficiency. The technological advance to once-through supercritical (OTSC) units was first demonstrated at the 460 MWe Łagisza plant in Poland, which entered commercial operation in 2009. Since its startup, the plant has operated on a range of bituminous coals and has demonstrated a lower heating value (LHV) net plant electrical efficiency of 43.3 per cent.

"The boiler we built in Poland was the first proof-of-concept for CFBs in big utility coal power plants," said Giglio.

Another supercritical CFB project was also recently completed in Russia. This 330 MWe CFB unit, designated Novocherkasskaya GRES No. 9, began commercial operation in July this year. The boiler, which is the first of its kind in the country, is capable of combusting a wide selection of fuels including anthracite, bituminous coal and coal slurry.

An even more impressive example of large-scale CFB technology is the 2200 MWe Green Power Plant currently under commissioning in Samcheok, South Korea. The Samcheok plant has four large 550 MWe Amec Foster Wheeler CFBs utilising ultra-supercritical steam conditions (257 bar[g], 603/603°C).

These CFBs are now the most advanced units in the world and are a far cry from the CFB boilers of the early days. CFBs were originally developed as a solution for industrial facilities with a need for steam and power combined with sources of unwanted by-products, such as waste bark, wood, plastic, cardboard, paper and sludges.

Over the last 20 years, Amec Foster Wheeler has broadened both fuel flexibility and unit size so much that many power companies have taken notice. Many now see CFBs as a way to produce low cost power from low quality fuels such as brown coals, lignites, and waste coals, as well as, high-energy, hard-to-burn fuels like anthracite and petroleum coke.

As the coal market has changed, this ability to burn a broad range of fuels – especially low quality coals – has seen CFB technology come

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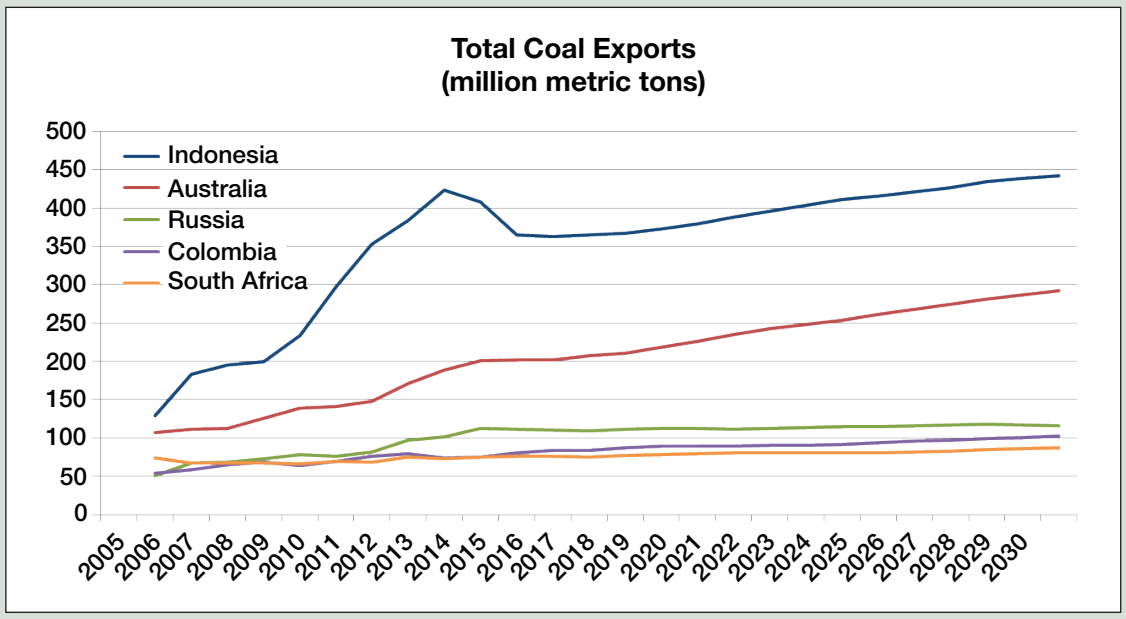


Global coal exports. Since 2005, Indonesian coal exports have grown faster than coal exports from all other countries combined. *Source: IHS*

into its own.

Conventional PC boilers have trouble accepting off-spec fuels due to their narrow fuel specs typically calling for heating values above 5500 kcal/kg, ash and moisture levels below 30-35 per cent, and volatilities above 20 per cent. Such a power plant with a narrow fuel spec could be competitively disadvantaged by a higher average fuel cost, limiting its dispatch and financial return. Fuel cost represents 70-80 per cent of a coal plant's running costs.

CFB technology, however, is capable of burning both the worst and best coals and lignites with heating values ranging from 1000 to 8500 kcal/kg, ash and moisture levels as high as 60 per cent, and volatilities down to 5 per cent. This fuel flexibility can deliver huge operating cost savings over the life of a power plant.

"There are many great examples of this," noted Giglio. "Cleco Power's Madison plant on the Gulf Coast [in the US] has a 600 MW CFB unit. They shop the market – they buy petcoke at huge discounts when the price is right. If coal prices drop, they buy coal. The plant has the highest capacity factor in their fleet and it's the first plant dispatched on the system because it's the cheapest to operate."

Citing the Samcheok project, he said: "The reason KOSPO built a CFB project as big and advanced as that plant, is exactly for the reasons we are talking about. Korea has very little indigenous energy resources and has to import all its coal, which could really hurt the economy when coal prices rise. So they're building the plant on the coast giving them the ability to buy the most economical fuels on the market, as opposed to building a PC and having to burn premium quality coal."

He added: "PCs can be designed to burn low quality coals and lignites. However, if they deviate from their narrow fuel range, boiler operational and maintenance issues rise significantly. A CFB greatly removes this fuel restriction giving plant owners the freedom to capture huge savings in fuel cost offered in the market today and in the future"

It is no coincidence, therefore, that the growing number of large, utility-scale CFB power plant references comes at a time that is seeing a declining quality in internationally traded coals.

During the last decade, the global coal trading market has seen some interesting trends. Most notably, since 2005, Indonesian coal exports have grown faster than coal exports from all other countries combined, nearly quadrupling to over 400 million metric tons over the last few years and projections show Indonesia maintaining its dominant position in the world's global coal market over the long term.

"Indonesia coal exports are going off the chart compared to other premium coal exporters such as Australia, Russia and South Africa, whose coal exports are flat," noted Giglio. "This is because Indonesia is selling its coal at deep discounts. Even after you factor in their lower heating values, you still end up with a big discount to a plant operating cost."

The primary driver for the ballooning of Indonesian coal trading is simple economics. Today about 50 per cent of Indonesian coal exports consists of high-moisture, sub-bituminous coals with gross-as-received (GAR) higher heating values ranging between 3900-4200 kcal/kg. Further, the best quality Indonesian coal reserves are expected to produce coals with average heating values no greater than 5200 kcal/kg (with economical washing levels). These heating values are well below the 6000 kcal/kg benchmark used in the international coal market for the last 50 years.

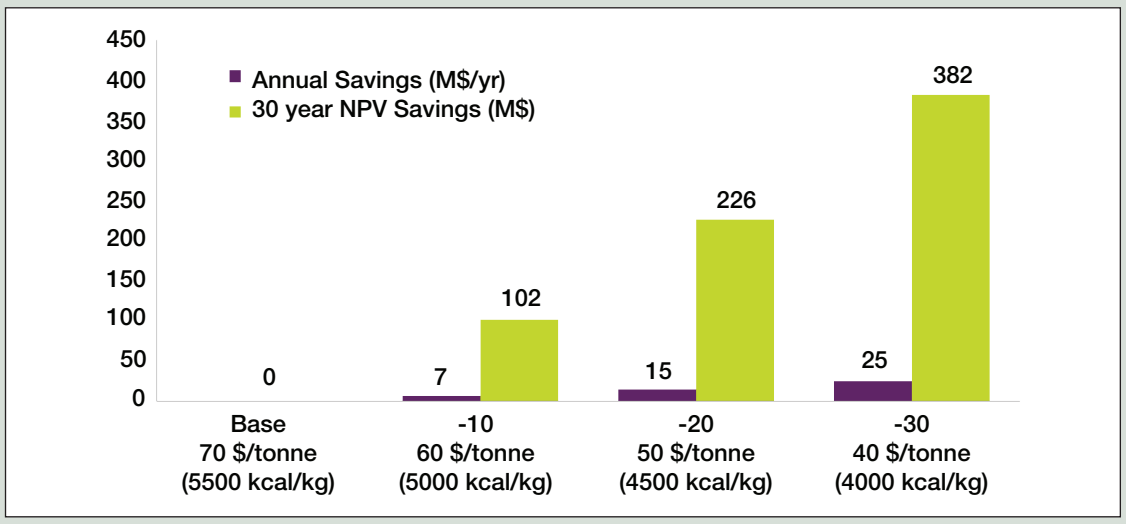
Even after accounting for the difference in heating value, on a comparative energy basis, since 2012 Indonesian coal prices have traded at a 15-40 per cent discount compared with premium coals. This goes straight to the bottom line of a power plant's balance sheet. Since fuel makes up 75-85 per cent of the operating cost of a large power plant, the economic benefits of using low quality fuels are hard to ignore.

Amec Foster Wheeler also notes that the steady decline in heating value of Indonesian export coals is a trend it expects to continue well into the future. Typically, as coal mines mature, mining operations move to lower quality coal seams. To save cost and reduce coal waste pile-up, mining companies will sell the higher ash and moisture fuels to the market at very attractive discounts which has been the driving trend behind the strongly growing low grade coal market.

Giglio notes: "We are seeing the growing use of low quality fuels in several domestic markets as well, where low quality coals and lignites play a major role in power production. For example, 38 per cent of Turkey's solid fuel power capacity utilises low quality lignite, sub-bituminous and waste coals, while in Germany and the US this number grows to 45 per cent and 49 per cent, respectively. Today, nearly all new-build coal projects in Turkey will solely utilise low quality Turkish lignite"

Better economics, lower fuel price volatility and higher fuel supply security is also driving the use of low rank coals, lignites and petroleum cokes for power production in India, China, Indonesia, Philippines, Australia, and South Africa. Further, the use of biomass for power production is growing in many countries as the world moves to reduce net carbon emissions and meet future global warming targets.

This trend is not expected to change anytime soon argues Giglio. Instead, he says, it looks to be a permanent shift toward a more flexible solid fuel market, where buyers and sellers will trade fuel quality for price, very similar to many other commodity and finished goods markets.

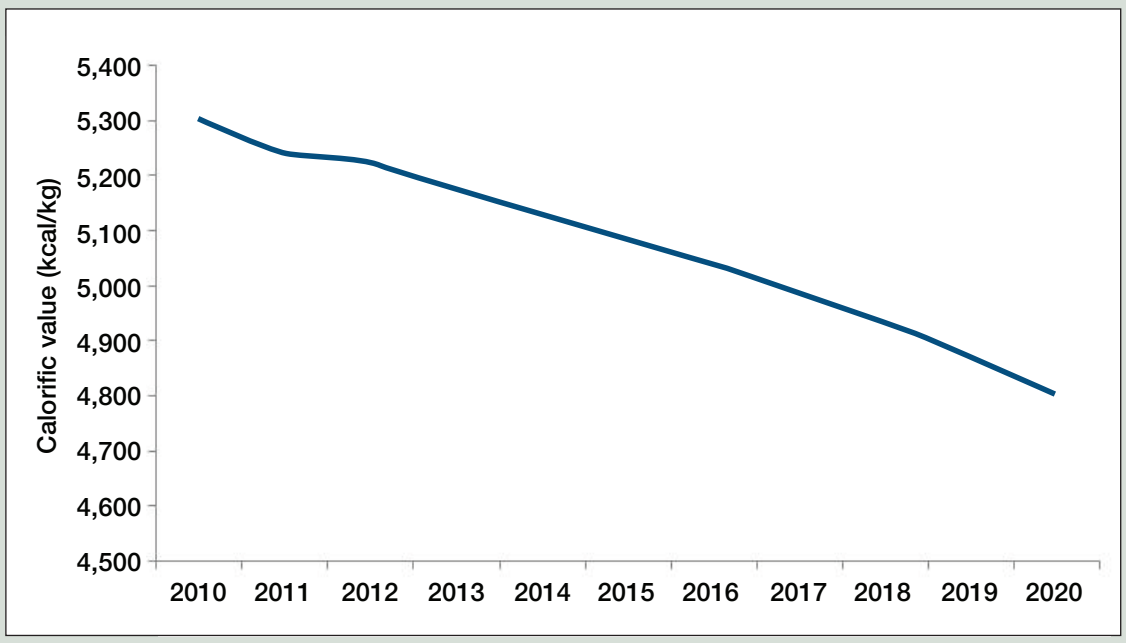


Savings in plant operating cost that can be realised for a 600 MWe coal plant by buying discounted lower quality fuels

In addition to fuel flexibility, CFBs also provide emission flexibility – an important consideration as emission regulations continue to tighten in nearly all countries. A CFB boiler can achieve low air emissions without post combustion SCR NOx and FGD SOx control saving significant plant construction and operating cost over the lifetime of the power plant. According to Amec Foster Wheeler's calculations, the CFB can deliver over four times the value to plant owners on life cycle cost as compared to PC boiler technology.

Economics are also improved by higher availability (when considering both planned and unplanned downtime) as a result of their ability to burn a wider range of fuels, argues Amec Foster Wheeler. The company's calculations show that plants with Amec Foster Wheeler CFBs had about a 5 per cent higher availability than the PC plants. This higher availability difference was maintained for even brown coals and lignites, which can translate to over a $250 million NPV gain in net income over the life of a 600 MWe power plant.

A CFB's ability to burn a broad range of fuels is due to its flameless, low-temperature combustion process at the heart of the technology. Unlike conventional PC or oil/gas boilers,



There has been a steady decline in the average gross heating value of Indonesian coal exports – a trend that is expected to continue into the future. *Source: Banpu PCL*

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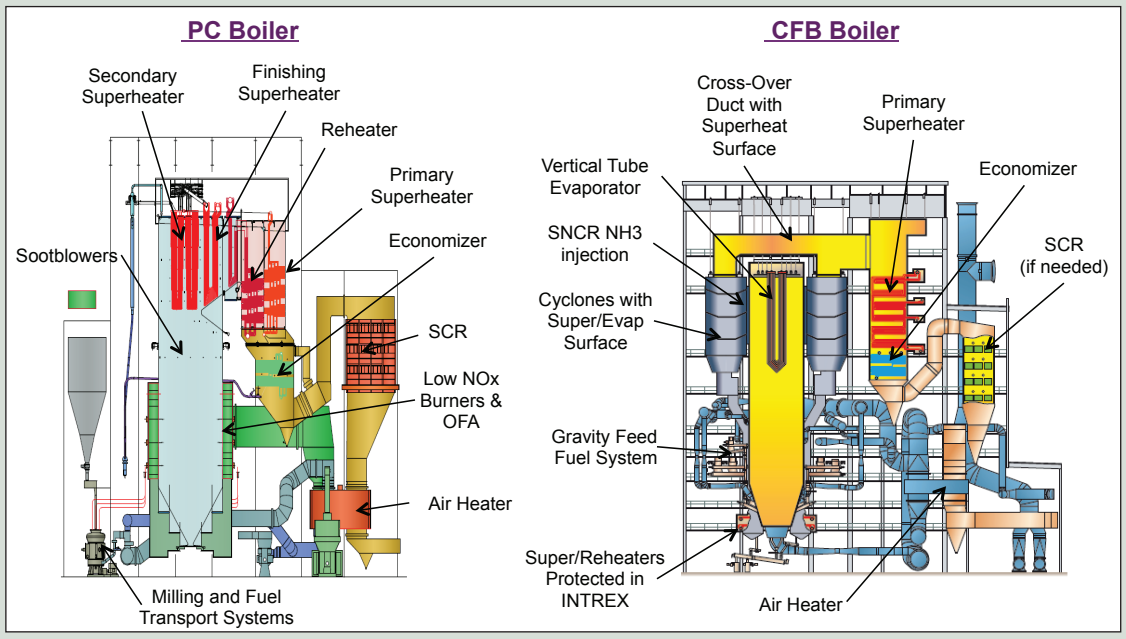

PC vs. CFB boiler design feature comparison

instead of an open flame, circulating solids are used to achieve high combustion and heat transfer efficiency to burn a wide range of fuels. The fuel's ash does not melt or soften, which allows the CFB to avoid the fouling and corrosion problems encountered in conventional boilers.

From an environmental aspect, the low temperature CFB combustion process minimises NOx formation and allows limestone to be fed directly into the furnace to capture SOx as the fuel burns. In most cases, a SCR and FGD are not needed for NOx and SOx control, dramatically reducing plant construction and operating cost and water consumption, while improving plant reliability and efficiency.

Since the fuel ash does not soften or melt in a CFB, the size of the furnace does not grow as much as PC boilers when firing lower quality fuels. In order to control fouling, slagging and corrosion, a PC furnace height typically increases by 45 per cent and its footprint by more than 60 per cent when firing low quality fuels such as high sodium lignite. With a CFB, boiler height increases by only 8 per cent and its footprint by only 20 per cent. This results in a smaller and lower cost CFB boiler as compared to the PC boiler for lower quality fuels.

Further, unlike a PC, a CFB does not need soot blowers to control the build-up of deposits and slag in the furnace since the circulating solids keep the furnace walls, panels and steam coils clean for efficient heat transfer.

Another important advantage of CFB boilers is their ability to withstand the corrosion that can occur when certain fuels are burned under high temperature and pressure. In a boiler, final superheat and reheat steam coils operate at the highest metal temperatures in the boiler making them the most vulnerable to corrosion and fouling attack.

In a PC or oil/gas boiler, these coils are hung from the furnace ceiling and are directly exposed to the slagging ash and corrosive gases (sodium and potassium chlorides) in the hot furnace flue gas. To cope with this undesirable situation, boiler designers use expensive high-grade alloys and recommend a high level of cleaning and maintenance for these coils.

This is avoided in Amec Foster Wheeler's CFBs by submerging these coils in hot solids, fluidised by clean air in heat exchanger compartments called INTREXs, protecting them from the corrosive flue gas. The bubbling hot solids efficiently conduct their heat to the steam contained in the coils and since the solids never melt or soften, fouling and corrosion of these coils are minimal.

Further, due to the high heat transfer rate of the solids (via conduction heat transfer), the final superheat and reheat coil sizes are many times smaller than the pendent and convective coils in PCs saving more capital and operating cost.

Looking forward, Giglio believes utility-scale CFBs will continue to operate with supercritical steam conditions and will be increasingly used in different parts of the world.

While some argue that countries should be moving away from burning coal, lignites and other high carbon fossil fuels, Giglio favours a more pragmatic approach.

"I think it's an important policy for countries that can afford to do that. "Electricity demand in mature economies like the US and Europe is not growing so strongly. They are seeing a green revolution, where old coal plant is being replaced with green renewables, which is good. But these countries can afford it.

"Different countries, however, have different goals and different levels of development. Going to countries like India and Vietnam, where coal is their lowest-cost option for large-scale power, and telling them they have to build more expensive and smaller scale renewables or [use] gas that they don't have, and then telling the people that [as a result] they won't get the power because they can't afford it, is very unfair.

"It's like forcing you to go into a car dealership where the only car offered for sale is an electric vehicle that you have to pay an extra €20 000 for… it's all about giving people choices that make sense to them."

By all predictions, coal will continue to be burned for some time to come. In this scenario, operators will be looking for technologies that can burn all types of coal while providing the type of environmental future-proofing that CFBs can provide without operators needing to make any changes to their plant.

Having reached a size where they offer a real alternative to PC boilers, equipment suppliers are likely to continue to look at how CFBs can bring more value to a power sector where flexibility is becoming increasingly important.

As Giglio summarised: "The technology is at a point where it has reached its apex in terms of advancement. Continuing to improve reliability and expanding the fuel range is really what our focus is."

Technology value points (M$)	PC	CFB	Comment
Boiler cost savings	60		Installed boiler cost saving of PC without SCR compared to CFB boiler, with both firing the same 4500 kcal/kg sub-bituminous Indonesian coal.Savings based on average $100/kWe discount for PC seen in market pricing over 2015-2016 period.
Fuel flexibility		156	NPV of fuel cost savings for CFB assuming average $10/tonne fuel cost discount over 30-year plant life due to CFBs ability to fire lower quality fuels. Based on $50/40/tonne (4500/4000 kcal/kg) coals.
SCR cost savings		36	NPV cost saving for avoiding SCR in CFB to achieve 200 mg/Nm^3 stack NOx emission. Based on a $40/kWe installed SCR cost for PC plus 30-year NPV of SCR operating expenses.
Post boiler FGD savings		39	NPV cost savings for avoiding post boiler FGD for CFB plant to achieve 400 mg/Nm^3 stack SO_2 emission. Based on $60/kWe installed seawater scrubber cost for PC plus 30 year NPV of FGD operating expenses.
Biomass co-firing		35	NPV of future CO_2 credits. Based on 10 per cent biomass co-firing in CFB and average $10/tonne for future CO_2 credit value over 30-year plant life.
Total value (M$)	**60**	**266**	

Once-through supercritical CFB technology was first demonstrated at the 460 MWe Łagisza plant in Poland

Pioneering CFB technology

The world's most advanced CFBs are coming on-line in 2016 and 2017—four 550 MWe ultra supercritical CFBs by Amec Foster Wheeler

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Korean Southern Power Company selected our most advanced supercritical CFBs to power its Green Power Project in Samcheok, South Korea

connected excellence in all we do

Areva seals Adwen's future

Areva is to sell its shares in Adwen to Gamesa as the Spanish firm nears completion of its merger with Siemens Wind Power.

Siân Crampsie

French engineering firm Areva says that a deal to sell its shares in Adwen to Gamesa will help it to focus its business on the nuclear fuel cycle.

Areva's board of directors has authorised the sale of the firm's 50 per cent stake in Adwen, an offshore wind turbine manufacturer, to Gamesa, which is currently undergoing a merger with Siemens Wind Power.

Gamesa said last month that it expected to hold an extraordinary general shareholders meeting this month [October] to approve the merger.

Areva will receive €60 million for its 50 per cent stake in Adwen, a joint venture firm it set up in 2015 with Spain's Gamesa. It expects to close the transaction in early 2017 following approval from competition authorities.

The French firm is reported to have entered talks with GE over the sale of Adwen. Newswire agency *Reuters* reported last month that the US giant made a non-binding offer for the offshore wind venture.

Areva held a three-month competitive bidding process to obtain and assess offers from third-party investors interested in Adwen, but said that the sale of its 50 per cent share to Gamesa would maximise the value of its shares and give Adwen a stable shareholder base.

Under the merger agreement between Gamesa and Siemens, Areva could have also divested 100 per cent of Adwen to a third party via a drag-along right for Gamesa's stake.

It also had a put option for Areva's 50 per cent stake and a call option for Gamesa's 50 per cent stake in Adwen.

Reuters reported that GE was interested in some of Adwen's technology and its French order book, but that it did not want to commit to taking over Adwen's operations in Germany nor to building new factories in France.

Adwen has received commitments from the French government that its 8 MW wind turbines will be used for French offshore projects on the condition that the turbines are built in France.

The merger between Gamesa and Siemens' wind power business will give rise to a leading global wind player with a worldwide installed base of 69 GW, an order backlog of €21 billion, revenue of €9.9 billion and adjusted EBIT of €915 million.

Siemens will receive newly issued shares of the combined company and will hold 59 per cent of the share capital while Gamesa's existing shareholders will hold 41 per cent.

Gamesa and Areva formed Adwen in 2015, with both companies investing around €200 million, in a bid to take advantage of growth in the offshore wind energy market.

ViZn and Ryan move creates new solar + storage team

- Venture targets large scale solar sector
- Strong growth forecast for solar + storage

ViZn Energy Systems and The Ryan Company are aiming to improve the economics of large-scale solar energy systems through a new strategic partnership.

The two companies have announced plans to target the commercial and industrial-scale solar power sector with an integrated solar + battery storage offering based on ViZn's flow battery technology.

According to Bloomberg New Energy Finance, the solar + storage sector will grow exponentially over the next few years and will reach $250 billion of total investment by 2040.

The partnership will use ViZn's zinc and iron chemistry-based flow battery energy storage systems and Ryan's experience in solar EPC integration. ViZn's batteries can perform both high-power and long-duration duties, enabling utilities to stack applications and incorporate multiple value streams.

"ViZn has a highly scalable, robust technology that can provide multiple lines of value for intermittent renewable assets," said Bill Hargett, Director of Business Development at The Ryan Company.

"We believe that solar power producers are increasingly looking for ways to provide a more dynamic and flexible dispatch profile to the grid, and ViZn Energy has the product and ability to make this happen."

Within the strategic partnership, The Ryan Company and ViZn will provide a comprehensive battery storage system for utility solar power plants that seek improved economics based on ViZn Energy's capacity to address load shifting and fast frequency response power management services.

Uniper lists

E.On has completed the planned spin-off of subsidiary Uniper with a successful listing on the Frankfurt stock exchange.

The listing is the conclusion of an ambitious restructuring of E.On's business that started in 2015 in response to a radical shift in the trading environment for electricity utilities.

E.On said that the move would enable both E.On and Uniper to "fully focus" on their business activities.

"E.On and Uniper now have every opportunity to be successful with their clear focus on their respective segments of the energy industry," said E.On CEO Johannes Teyssen. "They can now develop without compromises and serve the needs of their respective customers.

"This strategy is the right way forward for E.On, for Uniper and for the customers, shareholders and employees of both companies. The new and the classical energy worlds are so fundamentally different that they each require a totally different entrepreneurial approach."

After the listing last month, shares in Uniper initially rose before falling back to €10.75 per share, valuing the company at €3.9 billion. Teyssen said he expected the share price to fluctuate initially.

E.On hived off its conventional power plant business into Uniper because of falling energy prices and a rise in the use of renewable energy. E.On will now focus on renewables, networks and energy services.

RWE has carried out a similar restructuring, forming a new subsidiary for its renewables, grids and retail businesses called Innogy. It will float a 10 per cent stake in the new company later this year.

Wind service firms join forces

Deutsche Windtechnik and OutSmart are planning to merge their businesses to broaden their offerings to the European wind energy sector.

Deutsche Windtechnik, an independent specialist in wind turbine maintenance, will acquire 70 per cent of the shares of OutSmart, which focuses on offshore operations management and management services.

The move will enable the firms to support customers "as a strong and independent service partner throughout the entire life cycle of wind energy projects" as well as continue to tailor their services to individual customers' needs.

OutSmart's range of services in the offshore wind farm management field includes technical and commercial management, 24/7 remote monitoring, HSEQ management, data analysis and reporting. Effective immediately, OutSmart will be able to draw upon the expertise of the entire Deutsche Windtechnik group in the areas of consultancy and project support, the firms said in a statement.

- Rovco, a new subsea company dedicated to the offshore energy industry, has been launched in the UK. Rovco will focus on underwater integrity, remotely operated vehicles (ROVs), surveying and subsea services for both oil and gas and renewables sectors, and has already secured its first contract with the UK Marine Trust.

Americas

Denton builds smart power

Wärtsilä has signed a major contract to supply a 225 MW Smart Power Generation plant to Denton Municipal Electric, a locally utility in Denton, Texas, USA.

The plant will provide balancing power to the community, which is moving towards a green, low emissions power system. Wärtsilä's scope of delivery is engineering and equipment (EEQ), it said.

The power plant will include twelve 18-cylinder Wärtsilä 50SG engines operating on natural gas. The equipment will be delivered during the second half of 2017, and the plant is scheduled to begin commercial operations in July 2018.

The City of Denton is a leader in integrating renewable energy to its power system. Under its Renewable Denton plan, it is aiming to source 70 per cent of its energy from renewables by early 2019.

Powin selected for CA energy storage

Southern California Edison (SCE) has selected Powin Energy to build a 2 MW/8 MWh energy storage system to provide critical grid support and capacity services.

Powin's project will be powered by over 8 MWh of LFP Li-ion battery cells and controlled by the company's patented Battery Pack Operating System (bp-OS). It is being installed at Powin Energy's 5000 square-foot facility in California's Irvine Business District.

Powin Energy's project will be able to provide 2.0 MW of power for over four continuous hours, thus providing a reliable and continuous source of energy to serve peak demand events. In addition, the project will supply regulation and flexible capacity support as needed and depending upon the market.

Asia-Pacific

GE boosts ageing wind farms

GE Renewable Energy has secured five-year digital wind farm service contracts for two wind farms in Japan.

The US firm says that it expects an improvement of up to five per cent in the annual energy production (AEP) of the 30 MW Shirama wind farm, owned by Kinden Corporation. A second contract, signed with Kandenko, is expected to deliver up to two per cent higher AEP for the 22 MW Chosi project, a twelve-year-old wind farm near Tokyo.

Using GE's Prognostics and PowerUp Services software applications, the sites will implement a turbine performance enhancement strategy that involves, among other adjustments, fine tuning the pitch angle according to their real-world operating conditions. The resulting data will help the team analyse current and historical performance, plus it will help predict the remaining useful life of key components in the aging machines.

Thailand to install Asia's tallest wind turbines

Gamesa has secured a contract to install the tallest wind turbines in Asia at a 67.5 MW wind farm in Thailand.

The Spanish wind turbine firm will provide 18 of its G114-2.0 MW turbines and 15 of its G114-2.1 MW units for the Sarahnlom wind farm that is being built by the developer PowerChina ZhongNan in the province of Nakhon Ratchasima, in central Thailand.

All of the turbines at this wind complex will be equipped with 153 m -tall towers. Factoring in its 56 m blades, they will reach a total height from ground to blade tip of around 210 m.

The turbines will be supplied during the first quarter of 2017 and commissioned the following quarter. In addition, Gamesa will maintain the complex for the next 10 years.

Punjab invites Taunsa bidders

The Punjab Power Development Board (PPDB) has invited Expressions of Interest (EOIs) for the prequalification of sponsors to develop the 135 MW Taunsa hydropower project in Pakistan.

The Taunsa hydropower project will be built adjacent to the existing Taunsa Barrage on the Indus River, in Muzaffargarh district, which is about 120 km from Multan.

The project would be developed by the private sector as an Independent Power Producer (IPP) project. The PPDB has set 20 October 2016 as the last date for submission of responses.

Valmet to supply its first WTE boiler plant to China

Valmet and Zibo Green Energy New Energy Co., Ltd. have signed a contract for the delivery of a solid recovered fuel (SRF)-fired boiler for a new power plant in the city of Zibo, in China's Shandong province.

The waste to energy (WTE) plant will supply energy to the national grid. Valmet's delivery includes a CYMIC boiler island from fuel silo to boiler outlet.

The boiler will use circulating fluidised bed (CFB) technology. The steam capacity of the new plant will be 108 MW and the plant's electricity production capacity will be approximately 35 MW.

Installation is scheduled to begin in February 2017. Heat and power production will start by the end of 2017.

GE power island powers Jeju Island

GE has announced the first order of its power plant island solution in Asia with a $140 million contract from Korea Midland Power Company (Komipo).

GE will provide the full suite of equipment, controls and maintenance parts for a 250 MW combined cycle power plant located in Jeju Island, Korea. The order includes two 6F.03 gas turbines, steam turbines and HRSGs, in addition to four generators.

GE's power plant island solution has been enabled by the firm's acquisition of Alstom and of Doosan's Engineering & Construction HRSG business.

Europe

AMEC wins Tees CFB order

Tecnicas Reunidas SA and Samsung C&T EC UK have awarded Amec Foster Wheeler a contract to design and supply a circulating fluidised bed (CFB) steam generator for the Tees Renewable Energy Plant, in Teesside, UK.

Owned by MGT Teesside Limited, the 299 MW power plant will be completed in 2020 and will operate solely on biomass fuel.

Amec Foster Wheeler will design and supply the 299 MWe (gross) unit for the power plant as well as auxiliary equipment and onsite technical advisory services for construction and supervisory services for commissioning.

MGT Teesside Limited has also awarded a long-term service agreement contract to Amec Foster Wheeler for boiler maintenance. In August, it awarded Pöyry the technical owner's engineer services contract for the project.

Jacobs on board at Hinkley Point C

Jacobs Engineering is to provide EDF Energy with project management services for the building and civil work on the main construction site, including the marine works, at the Hinkley Point C nuclear power station project in Somerset, United Kingdom.

Jacobs is building a global centre of nuclear expertise in the UK and sees the potential of leveraging this UK-based knowledge and expertise to support projects internationally.

EDF Energy is planning to build two new nuclear plants in Somerset, southwest England, adding over 3200 MW of capacity to the grid.

Borås orders Valmet boiler

Valmet is to supply a biofuel-fired power plant and related flue gas cleaning and condensing systems to Borås Energi och Miljö's new energy and environmental centre in Sobacken, Borås, Sweden.

Valmet's delivery scope includes a 120 MW biofuel-fired HYBEX boiler utilising bubbling fluidised bed (BFB) technology. The combination of controlled combustion temperature, low excess air and 'staged' combustion provides the favourable conditions for meeting strict environmental requirements.

The fuel used will be various types of biomass, including forest residue, bark and wood chips. The delivery will also include flue gas cleaning and condensing systems.

Installation works are scheduled to begin in July, 2017. Heat production is scheduled to start in 2019.

ABB upgrades substation

ABB has won an order worth around $35 million from German transmission system operator TransnetBW to upgrade a substation in Offenburg, in the southwest German state of Baden-Wuerttemberg.

The existing 220 kV air-insulated switchgear (AIS) substation will be replaced by a compact 380 kV GIS substation, increasing transmission capacity and flexibility. The upgraded substations will be part of a transmission network that plays an important role in European power trading, since it is integrated into the national and European grid via numerous interconnectors.

As part of the order, ABB will design, supply and install a turnkey 380 kV indoor GIS system including the auxiliary equipment and also connect the substation to the 380 kV network and build a new terminal tower.

Siemens to upgrade Dong assets

Dong Energy has awarded Siemens a contract to upgrade the existing central Infrastructure Control System (ICS) on its offshore wind farms.

The contract covers hardware and services necessary for upgrading the existing central ICS.

This includes upgrading hardware and configurations as well as the central software. Peripheral equipment hardware and software are not part of the procurement.

The purpose is to upgrade the existing wind farm SCADA solution from the original provider of the SCADA system.

Existing ICS systems must be upgraded to most recent versions to comply with utility best practice within wind farm operations, Dong Energy said.

International

GE wins powerships order

GE is to supply 16 transformers to Karpowership for installation on four large-scale floating power plants.

Karpowership's portfolio includes the world's largest powerships, capable of generating 486 MW. The powerships can be rapidly deployed around the world to meet urgent needs for energy.

GE has already delivered 16 power transformers with an installed capacity of 1.5 GW for Karpowership under a contract signed in 2015. The latest order will bring that capacity to 2.5 GW, GE said.

GE will produce and deliver power transformers of 100 and 200 MVA and will ensure the deployment, field tests and replacement part provision works. The delivery of transformers is planned to be completed by the end of 2016.

Toshiba expands in Turkey

Toshiba Corporation has won an order to supply a flash steam turbine system and generator for Unit 2 of the Kizildere III geothermal power plant in Turkey.

Zorlu Energy, an independent power producer and member of Turkey's Zorlu Energy Group, will construct the plant in Kizildere, in the Aydin province of West Anatolia, Turkey.

Kizildere III Geothermal Power Plant Unit 2 is a 70 MW, high efficiency triple flash combined cycle geothermal power plant. It will integrate two systems: an approximately 50 700 kW flash steam generation system driven by steam under high pressure; plus an approximately 19 300 kW binary cycle power generation system that uses flash turbine exhaust steam to vaporise a working fluid with a lower boiling point and use it to drive a turbine.

GE signs Mass Energy O&M deal

GE has signed a multi-year agreement in Iraq to operate and maintain the 3 GW gas fired Basmaya power plant near Baghdad.

The Basmaya power plant is being developed in two phases and will provide enough power to meet the needs of over 600 000 households. Its power island will be based around eight GE 9FA gas turbines and four GE C7 steam turbines.

In addition to operating and maintaining the power plant, GE will apply its advanced digital industrial solutions to the project to predict equipment health and optimise asset management.

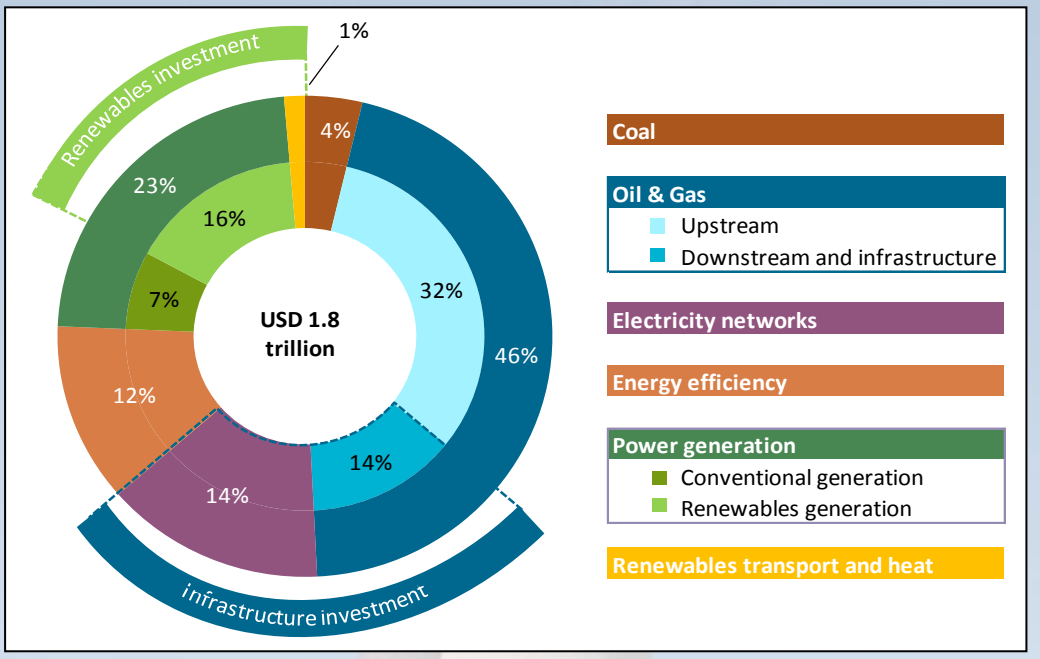
Aggreko powers Benin

Aggreko has won a bid to supply 100 MW of power to Benin.

The one-year contract will support the country's national grid with energy generated from ADDGAS – an add-on technology that substitutes a significant portion of diesel fuel with natural gas.

With an annual GDP growth of nearly six per cent and a rapidly expanding industrial sector, power demand across Benin is increasing exponentially. Aggreko expects to mobilise the 100 MW of capacity by the end of the year. It will also install specialist high voltage equipment as part of its turnkey offering.

Global energy investment in 2015



World Energy Investment 2016, © IEA/OECD, Figure 1.1 , page 22

For more information, please contact:

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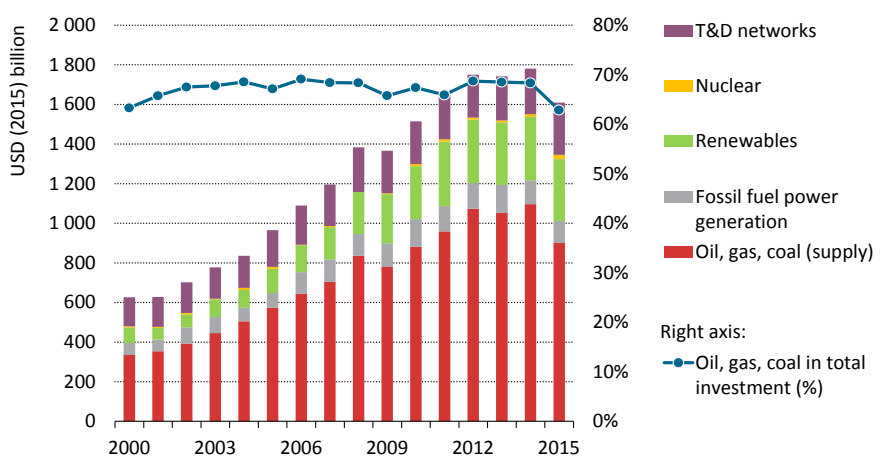
Email: bookshop@iea.org
website: www.iea.org

Global investment in energy supply over time

Figure 1.2 • **Global investment in energy supply over time**



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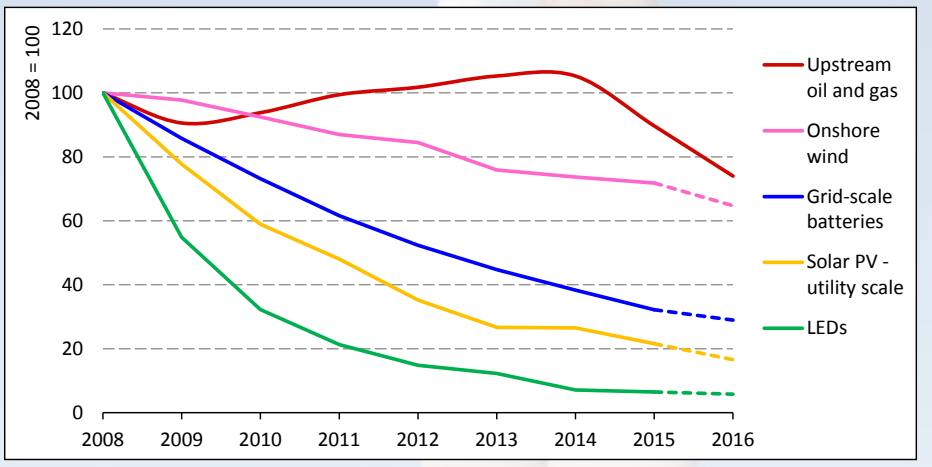
Cost developments across the energy spectrum



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Investment in fossil fuel and electricity supply by region

USD 2015 billion	Oil and gas		Coal	Power generation			Renewables transport and heat	Electricity networks	TOTAL
	Upstream	Downstream and infrastructure	Mining and infrastructure	Coal, gas and oil	Nuclear	Renewables			
OECD	**246**	**109**	**17**	**22**	**2**	**153**	**7**	**113**	**669**
Americas	193	62	6	7	0	52	1	58	380
United States	136	46	4	5	0	39	1	49	281
Europe	46	19	3	11	0	64	6	39	187
Asia Oceania	7	28	8	4	2	36	0	15	102
Japan	0	4	1	1	0	30	0	7	43
Non-OECD	**337**	**117**	**46**	**89**	**19**	**136**	**17**	**150**	**911**
Europe/Eurasia	67	23	6	3	5	2	0	16	122
Russia	44	18	5	2	5	1	0	9	83
Non-OECD Asia	87	30	36	73	15	110	1	108	459
China	51	9	26	43	15	90	15	66	315
India	7	4	7	18	0	10	0	20	66
Southeast Asia	22	11	3	11	0	7	0	10	64
Middle East	73	44	0	5	0	2	0	8	132
Africa	49	8	2	5	0	4	1	7	77
Latin America	61	13	1	1	0	17	1	11	107
Brazil	33	5	0	0	0	10	1	6	55
World	**583**	**249**	**68**	**111**	**21**	**288**	**25**	**262**	**1607**
European Union	15	17	2	9	0	56	3	39	141

World Energy Investment 2016, © IEA/OECD, Table 1.1 , page 25

Source: World Energy Investment 2016

Oil

Opec's role as robust oil market force comes to pass

- Opec set to cut production
- Market's "return to balance" will require a longer wait

David Gregory

Going into the informal gathering of Opec ministers on September 28, on the sidelines of the International Energy Forum in Algiers, there was little chance of squaring the circle that is global oversupply of crude oil. As *TEI Times* went to press there was every indication that Opec ministers, whose countries are producing crude oil flat out, would be inclined to cut production and risk market share in the face of Nigeria and Libya boosting production and stories that US shale oil producers are rounding up drilling rigs to put back in action.

Opec – or at least Saudi Arabia – once adhered to a production quota system that is unlikely to ever be in place again. Despite the cheap price of producing crude on the Arabian Peninsula, technological advances in drilling and extraction are a force to be reckoned with as long as prices don't fall below the $40-$50/b range. How prices would ever see $60/b or $70/b or exceed that at this point is a thing in the unknown. Some say only a catastrophe could ever put prices back where they were two years ago and if that should become the case, North American frackers would be out in force.

While the mostly single commodity economies of many Opec members rely on crude oil to survive – despite having been warned for years to diversify their economies – other parts of the world are examining the options and some are acting on them. Despite the fact that hydrocarbons are seen as the primary energy source for a long time to come, investment in the oil and gas upstream are for the moment slipping, according to the Paris-based International Energy Agency (IEA).

In a report released mid-September, it said global energy investment fell by 8 per cent in 2015, with a drop in oil and gas upstream spending outweighing continued robust investment in renewables, electricity networks and energy efficiency.

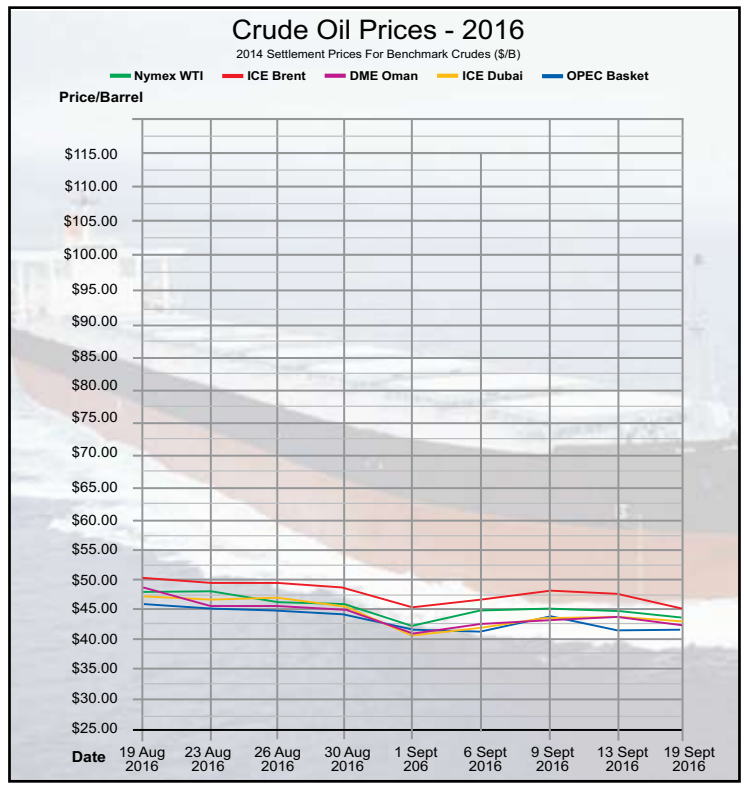
The new annual *World Energy Investment 2016* "shows that the energy system is undergoing a broad reorientation toward low-carbon energy and efficiency," a statement released by the agency said. Low oil prices played a significant role in reduced investments in hydrocarbon projects.

Continuing low oil prices can be expected to impact investment in oil and gas prices in the short term, but even if the fundamentals return to a demand/supply balance, the days of $100/b oil (with the exception of a catastrophe) are gone. The oil glut is estimated at 3 million b/d. Without output reductions that accommodate every producer, that glut could be there for a while.

While Saudi Arabia and non-Opec Russia agreed this summer to consider the condition of the oil market, both are producing oil flat out. Russian officials announced in mid-September that the country is producing more than 11 million b/d. Saudi output is 10.6 million b/d.

One of the options for action that Opec was set to consider in Algiers was a freeze of oil production at current levels. How a freeze at high production levels – Iran is around 3.8 million b/d and Iraq is producing around 4.3 million b/d – would work to remove the glut and balance the market doesn't really jibe.

With the Algiers meeting unlikely to come to a solid consensus on anything, the enigma that Opec must unravel will be carted further down the road to the next official ministerial meeting in Vienna in November.



Not only is Opec and Russian production contributing to oversupply and low prices, but non-Opec countries are seen as boosting production by several hundred thousand barrels per day in the coming year.

In its September *Oil Market Report*, the IEA pointed out that in the current situation with low prices, it would be expected that supplies would contract and demand would grow. But the opposite is happening, it said. Furthermore, oil stocks in OECD countries have grown to 3.1 billion barrels. The agency forecast that the supply/demand dynamic would see no significant change for some time and that the market's "return to balance" would require a longer wait.

In the meantime, oil market watchers can expect to hear more news of an imminent agreement among oil producers. Such comments from Opec figures have bumped up prices in the markets for hours and even days over the year, but observers have reached the point where such comments can no longer be taken seriously since Opec is no longer serious itself.

Converging futures in the North Sea

New ways of looking at technology are enabling closer collaboration between the renewables and the oil and gas sectors, and also addressing the cost pressures faced by both.
James Young

JDR's new horizontal lay-up machine (HLM) machine. The HLM will enable JDR to provide the next generation of reliable and safe subsea connectivity to the oil, gas and renewables sectors

Obvious differences aside, what has set the business models for oil and gas and renewables apart is the attitude towards cost. When oil price is up, the long-established oil and gas sector has traditionally adopted a high-spend approach to exploration, development and extraction.

As more of a challenger industry, that is a luxury that the renewable sector has not been able to enjoy. Striving to enhance its competitiveness and in anticipation of the end of subsidy regimes in the long term, the focus on driving down costs has been embedded in offshore wind from its very inception.

So it is perhaps not surprising that, with a prolonged slump in the price per barrel, oil and gas operators are looking at the renewables sector as a potential source of cost savings. Equally, in its constant search for cost-effective innovation, the renewables sector has been eyeing up possible solutions from its oil and gas counterparts.

The idea that there could be some technology-driven convergence between oil and gas on one hand, and renewables on the other, is not as outlandish as it may have seemed only a few years ago. So much so that certain oil and gas operators, who had previously exited the renewables sector, are now considering a re-entry – with some already taking the plunge.

Nowhere is this convergence more obvious than in the area of offshore energy generation, where technologies used by the North Sea oil and gas community are being considered by offshore wind operators, and innovations developed for wind and tidal generation are being considered by oil and gas operators.

The first area of interest is that of high-voltage cabling developed for offshore wind generation that can also be used in the oil and gas sector as a cost-competitive solution for driving large amounts of power across the seabed.

For example, new so-called 'wet design' 66 kV cabling significantly steps up the voltage from the 33 kV inter-array standard cable voltage capacity and is being adopted by a number of new wind development projects this year. The advantages of this type of cabling is that it enables power to be transmitted to and from larger turbines that are installed further offshore – essential as the industry starts to look beyond shallower waters to build its wind farms.

Young: To drive down the costs of offshore operations, the distinction between offshore renewables and offshore oil will diminish

The 'wet-design' cable ensures long-term operations without the need for a metallic barrier layer such as an extruded circular lead sheath that, until now, has typically been a large cost component of high-voltage power cables at 66 kV. With the removal of the lead sheath barrier layer the cable is also much lighter, allowing the capital costs associated with installation to be reduced, further enabling operators to deliver more power for the same amount of copper. Although the cable itself requires a small increase in outside diameter over standard 33 kV alternatives, it can deliver double the amount of power through the same conductor size, with much less than double the overall cable capital cost.

The cable was initially developed to support expansion of offshore wind turbine capacity to higher power generation, enabling developers to exploit more offshore wind resources including locations further away from shore. But those high-power, deeper-water characteristics also make it a suitable technology for offshore oil and gas applications. What's more, the 66 kV technology allows a cable to run from the shore to field, where a distribution hub and subsea transformer can be configured to distribute power on the seabed, at typically 11 kV to suit subsea consumers such as pumps, compressors, and other subsea processing equipment.

We are already seeing some examples of a hub-style power distribution system off the coast of Cornwall in the UK, this time for wave energy. An 'export' power cable runs underneath the beach in the village of St Ives and travels 25 km out into the Bristol Channel to a hub, where a number of smaller cables split-off to connect different wave-energy devices, test them and enable them to transmit power back into the grid.

This kind of subsea power distribution, and the technologies that support it, also present great opportunities to oil and gas operators, for subsea power consumption rather than generation. Interestingly, it may be possible to combine energy generation with energy consumption on the seabed, enabling oil and gas infrastructure to be powered by future tidal energy devices.

In return, the possibilities offered by deep-water operations give the offshore wind industry plenty of opportunity to consider the technologies and expertise residing in the oil and gas sector. There is a growing drive towards floating structures for offshore wind as a means of reducing the construction costs associated with building an offshore wind farm in harsh environments and difficult weather conditions, and to create more efficient and effective maintenance operations.

With the Continental Shelf dropping away, floating systems are going to be an interesting development in the North Sea, offering significant growth potential. When Statoil presented its view of offshore wind up to 2030, it claimed that approximately 105 GWh of installed capacity – about 20 to 25 per cent of the total – would be floating offshore wind.

Naturally, managing floating structures is something that the oil and gas sector has been doing for decades. And with savings in capital and operational expenditure on offer, the offshore wind industry is looking for ways of replicating its success – in particular, by deploying more dynamic power cables that can be hooked onto floating structures, floating production storage, and offloading vessels. These cables have to be capable of installation and dynamic operation underneath a floating structure, and withstand all the fatigue loads and various environmental conditions throughout the cable life.

Interestingly, one area where this type of cable is being considered is in the deployment of renewable technology to help power the subsea needs of oil and gas operators. Projects such as the DNV-GL led WIN WIN joint-industry project are already looking at the feasibility of using a floating offshore wind turbine with battery storage and other equipment to pump water into an oil and gas well.

Again, it is the use of dynamic cables that are very different from standard renewable energy cables used for fixed structures that will enable this kind of system to operate and function. With static applications the cable design often has a single layer of armouring, with a roved protective outer layer comprising a series of polypropylene strings to protect the cable. For the design of dynamic systems, cable design is more complex, ensuring the cable remains torque-neutral under high tensile loads, and the outer protective layers can withstand the arduous external environment. The cable design has to minimise twist and ensure the dynamic cable stays in place and responds appropriately to the motion of the vessel and the platform to safeguard its longevity and long-term performance.

Once again, many of the underlying differences come down to cost. Static cables for current offshore wind farms tend to be a highly cost-efficient design, optimised for a range of subsea locations and often either buried or protected by additional cable protection conduits. In contrast, cables for dynamic systems are a highly engineered product that is more bespoke and can sometimes be fine-tuned to suit the specific dynamic conditions prevalent at the offshore location and precise water-depth. We are at an interesting point in the industry where technology, across the offshore energy sector, is enabling the collaboration that market forces increasingly demand.

We have already seen plenty of opportunities for renewables and oil and gas to learn from each other. But the gap between the two industries seems likely to become narrower as those lessons are embedded in technology development. And the collaborative future goes beyond the essential support technologies like cabling. Engineers are looking at the possibility of reusing oil and gas infrastructure itself for some offshore wind projects, as well as combining new infrastructure.

The future will increasingly be about knowledge sharing and integration. To drive down the costs of offshore operations, the distinction between offshore renewables and offshore oil will diminish. In the near future, the conversation and the innovation will simply be about offshore energy – and reducing the offshore costs for the benefit of developers and operators alike.

James Young is Chief Technology Officer at JDR Cables.

Offshore wind goes down to the wire

The financial severity of cable claims due to subsea cable faults is increasing year-on-year, to the point that they now account for over three quarters (77 per cent) of overall losses in the global sector. **Johnny Allen** looks at how the issue may affect the drive towards reducing the cost of offshore wind to €100/MWh by 2020.

Up to now, it has very much been a case of 'out of sight, out of mind' when it comes to tackling the subsea cable challenges facing the offshore wind industry. This is perhaps unsurprising given the already considerable capital expenditure on turbines, foundations and substations. Yet despite their inconspicuous nature, incidents of subsea cabling faults are prevalent in what is a relatively small, Eurocentric industry.

In turn, and despite the considerable time and energy spent minimising initial financial outlay on equipment and installation, this blind spot will continue to threaten long-term project reliability. As we look to reduce the cost of offshore wind to €100/MWh by 2020, the widespread and underlying faults in subsea cables risk undermining the foundations on which the future growth of offshore wind will be built.

In total, the past seven years have witnessed approximately 90 subsea cable losses, totalling over €350 million in incurred claims. How do these claims come about, and what can be done to mitigate this source of loss, particularly as offshore wind looks to expand beyond Europe, and into North America and Asia?

It has been estimated that there are 4600 subsea cables currently serving offshore wind turbines across the world. Of these, there are two principal types: export cables that carry the power generated by wind farms to shore; and inter-array cables that connect individual wind turbines to each other at sea. While the number of declared incidents of cable failure each year is relatively low (approximately 10), the average cable downtime resulting from these failures is 100 days.

Clearly, these incidents and the accompanying financial implications for developers and project owners pose a considerable threat to the continued growth of the industry. As offshore wind faces up to the additional challenge of meeting increasingly stringent cost reduction targets, the importance of nipping these issues in the bud as soon as possible will be critical to maintaining the confidence of the international investment community.

Poor quality mechanical protection of the joints, coupled with changing seabed conditions, can, for instance, lead to stressing and scouring of the cables themselves.

The use of substandard design, manufacturing or materials is certainly troubling, but is in large part a product of the industry's blinkered focus on reducing the associated costs of offshore wind. It is perhaps no coincidence that these faults have become all the more prominent as offshore wind attempts to expand its operations across the globe. Unfortunately, while this focus may well drive down energy costs in the short term, it often hurts the long-term reliability of offshore wind projects.

Cable faults of all types can often be insidious, going unnoticed during the installation phases, only to appear and cause severe disruption once the wind farms are operational.

> ... the past seven years have witnessed approximately 90 subsea cable losses, totalling over €350 million in incurred claims

While the continued evolution of cable installation techniques and monitoring technology is of course welcomed, it has become apparent that these can only go so far in addressing the issue. Instead, a sea change in industry thinking and behaviour will be essential if the issue of undersea cable faults is to be definitively tackled.

Most frustrating of all, for instance, is the fact that these mistakes are often made by repeat offenders: contractors under considerable pressure to complete a project on time and on budget, but who are inadvertently introducing the same faults into multiple projects. The problem is then exacerbated by the high levels of staff migration between the relevant companies.

Factors such as these have ultimately combined to make communication and collaboration within the offshore wind industry extremely difficult, hindering attempts to share lessons learnt or establish best practice guidelines. Indeed, the scale and diversity of errors being made highlights a growing requirement to ensure greater quality control during cable laying, build more effective communication channels and improve upon current data collection procedures.

In an industry so aggressively focused on driving down costs, however, there has up to now been very little collective will to do so. However, in the absence of concerted action it is clear that the impact and severity of cabling incidents will only rise further, all the more so as the scale of construction ramps up and projects are increasingly built further from shore and in more testing environments.

A number of lessons must therefore be learnt sooner rather than later if the industry is to achieve its stated aim of getting the cost of offshore wind down to €100/MWh by 2020. However, such change can only come about if the sector is willing to embrace a broad behavioural shift in the way developers balance risk and reward in supply and installation contracts.

Positive early indications of change can be seen in the greater involvement of engineering teams in projects at an earlier stage. In addition, more time and care is beginning to be devoted to considering cable routing from a constructability perspective, rather than the traditional focus on purely acquiring consent.

Further challenges lie ahead, especially in the current contractor model for undertaking work. Cable claims trends witnessed over the past number of years indicate that this model – and its assumption of a lot of risk for a fixed price – is simply not a viable long-term strategy.

In addition, developers will need to begin to think outside the box as to how they communicate the benefits of successfully installing a cable without any incident – and, more importantly, those of avoiding longer-term operational defects that only manifest after a number of years.

There are a number of ways this could be approached, including looking at financial incentives as a means of encouraging a longer-term perspective. To take one example, installation contractors could be given access to a small proportion of a project's long-term generation profits.

However the benefits of successful undersea cable installations are communicated, doing so will surely lead to a more open, transparent and collaborative environment within the offshore wind industry. While we recognise that subsea cable failures will always occur, drawing on past experiences within the industry and following the best practices on offer will ensure that, as the industry looks to new horizons, we will be better equipped to manage and share the inherent risks involved in subsea cable installation.

Jonny Allen is Head of Offshore Wind, GCube Insurance and author of the report, 'Down to the Wire: An Insurance Buyer's Guide to Subsea Cabling Incidents'.

Allen: mistakes are often made by repeat offenders

Living with smart grids

PowerMatching City was the first European field trial of smart grids. Phase 2 kicked off in 2011, expanding the connected community from 25 to 40 households

The PowerMatching City demonstration project at Hoogkerk ended in late 2015, but the smart grid infrastructure remains in place to support any future projects. PowerMatching City was envisioned as a demonstration of the possibilities of smart grid technologies – something it clearly achieved.

Albert van der Noort

For most people in the power industry, the question isn't "should we build smart grids?" it is "how and how fast?" The need to maintain an affordable, reliable and sustainable electricity supply makes smart grids inevitable. But we have no previous hands-on experience, so how can the industry and society in general make sure it is making the right choices in implementing smart grids?

This was the question that demonstration project PowerMatching City was set up to explore. While Phase 1 of the project focused on the technical feasibility of smart grids, the recently completed Phase 2 looked at how smart grids and the flexibility they bring add value for consumers, the energy industry and communities.

PowerMatching City is a living lab for exploring the future of energy (electricity, gas and heat) infrastructures. Located at Hoogkerk near Groningen in the Netherlands, it was the first European field trial of smart grids and was designed to test centralised and renewable energy systems on a community-wide level.

The trial was launched in 2009 by a consortium of leading players in the Dutch energy industry and academia, coordinated by DNV GL. Phase 2 kicked off in 2011, expanding the connected community from 25 to 40 households and with a brief to explore the market mechanisms that should be deployed with smart grids.

This is critical to the success or failure of smart grids and green energy in general. If we want to make the transition to a sustainable energy future as efficient as possible, we need to get consumers involved in that transition. We need to find out what services and incentives work for them.

In the trial community, electricity is generated by solar panels. Some of the homes have a micro combined heat and power (CHP) system that can generate electricity and heat according to demand. The heat produced can be stored in a buffer tank if necessary. Other homes have a heat pump connected to a buffer tank in order to flexibly use the power and provide heat depending on the fluctuating demand.

In addition, homes are equipped with programmable appliances, such as washing machines. The specially created PowerMatcher operating system matches the energy supply and demand of various providers and users in real-time, allowing the smart management of appliances and systems. This management could take one of three forms:

- Automatic control of the heat pump or micro CHP
  - PowerMatcher autonomously decides when to switch on and off in response to energy costs / demand
- Semi-automatic control of the washing machine
  - PowerMatcher switches on the appliance in response to demand but within boundary conditions (e.g. latest end time) set by user
- Manual control of dishwasher, hair dryer, etc.
  - User decides when to switch on and off, possibly guided by information from PowerMatcher.

Smart meters and a power monitor give people feedback on their own energy consumption and generation, which they could compare with the averages from the entire street.

To explore the most suitable market mechanisms for smart grids, researchers and residents at PowerMatching City developed two contrasting energy services. The first, *Smart Cost Savings*, allowed residents to minimise the cost of energy consumption and generation. The second service, known as *More Sustainable Together,* focused on maximising the share of renewables within the community's energy mix by channelling any excess energy back into the community.

Residents were allocated to the two services randomly, and researchers measured the actual energy consumption and generation of all the devices in the home over a period of seven months. Those on the *Smart Cost Savings* were shown the effects of their energy as a Euro value, while the *More Sustainable Together* service presented the user's impact via leaf symbols.

Being environmentally minded, the majority of residents originally expressed a preference for the *More Sustainable Together* service. But by the end of the trial, most found that the *Smart Cost Savings* service actually fitted their needs better.

This is not to say that the residents chose lower cost over higher sustainability. Rather, it highlights the difficulty and importance of expressing the value of sustainability. Services need to be simple and simple to understand. But sustainability is a difficult topic for consumers to understand, as it is hard to see how your individual actions impact the entire system.

Residents said they found the information on costs tangible and motivating. By contrast, the leaf symbols and the sustainability gains they represented were seen as less tangible. Interestingly, residents on the *Smart Cost Savings* service were far more likely to manually start their appliances at times suggested by the PowerMatcher and checked their energy monitor on average twice as often as people using the *More Sustainable Together* service.

This suggests that, to ensure the success of services, service providers need to find a way to express sustainability in a way that engages consumers. And that often means presenting it as some kind of monetary value.

One of the key advantages of a smart grid is the flexibility it offers. Analysis of the results from PowerMatching City suggests that this flexibility in the Dutch consumer market could be worth €1-3.5 billion for the period to 2050. This divides into benefits for system operators and benefits for the energy market as a whole.

For system operators, the key benefits are the need to invest less in developing new networks and maintaining existing ones plus fewer losses due to long distance transport. Meanwhile energy providers in the wholesale market can profit in the wholesale price to purchase cheaper energy for their customers.

This flexibility relies on energy providers having some control over when consumers use and generate electricity. Hence it is vital that consumers understand and buy into their role in delivering flexibility, and balancing supply and demand.

The automatically controlled appliances (micro CHP, heat pump and – where present – electric vehicles) offer suppliers most flexibility. Residents also reported that these appliances contributed most to the goals of the energy services. They were more than happy for the PowerMatcher to control these appliances automatically so long as they worked as required.

For example, people didn't mind when their electric car was charged so long as it was ready to go when they were. Occasionally, the residents noticed that certain devices switched on or off at seemingly illogical times. And once the user has lost confidence in the device, it is very hard to win it back.

On the other hand, manual control – guided by the energy monitor – gave people the greatest sense of satisfaction with and control over the system. In fact, once they had learned a little about demand and cost cycles, many residents preferred to control the semi-automatic washing machines themselves – turning them on and off at the best times.

In a smart grid, much of the flexibility lies with the individual consumers. So how do we let grid operators and energy suppliers utilise these small packets of flexibility effectively while giving the consumers ready access to the market? One of the key findings of PowerMatching City Phase 2 was that a single party should be responsible for bundling and distributing this flexibility for the market.

Exactly how this aggregator role should be implemented remains an open question and is currently being explored by the Universal Smart Energy Framework (USEF) Foundation, drawing on the lessons learnt at PowerMatching City.

PowerMatching City was envisioned as a demonstration of the possibilities of smart grid technologies – something it clearly achieved. Phase 1 showed that smart grids are technically feasible. Phase 2 went further by demonstrating how the flexibility of smart grids has economic value. It also proved that desirable energy services can be built on smart grid infrastructure, and that market barriers to the monetisation of flexibility can be eliminated relatively cheaply.

The PowerMatching City demonstration project at Hoogkerk ended in late 2015, but the smart grid infrastructure remains in place to support any future projects. Meanwhile the challenge of demonstration has passed on to larger-scale projects such as EnergieKoplopers, a 200-home field trial at Heerhugowaard in the Netherlands, being carried out by the Smart Energy Collective based on the principles of USEF.

Projects such as PowerMatching City and EnergieKoplopers will give governments and the industry the information and experience they need to make the right strategic choices for implementing smart grids. These choices will need to be made at the European level to deliver the desired legislative framework in European Union member states. Critical to this process is a clear timeline so that the investment risk for the energy sector and the providers can be managed and the likelihood of dis-investments is reduced to a minimum.

Albert van der Noort is 'Head of section – Smart Energy' at DNV GL. He is project manager of PowerMatching City.

Smart meters and a power monitor give people feedback on their own energy consumption and generation, which they could compare with the averages from the entire street

Digitalisation and data dollars

Junior Isles

Data is the currency of the future. That at least is the view of some experts in the energy business. For the big players in the sector – whether oil and gas or electricity – these are tough times, and finding ways to squeeze every ounce of profit from their operations is critical.

At the recent *FT Digital Energy Summit* in London, UK, Lisa Choong, Executive Vice President of Technology & Competitive IT at Shell, said: "The oil and gas industry is in a challenging environment. Over the last two decades the construction cost of large capital projects has become much, much more expensive.

"The industry has also become less productive as a whole. The capital cost per barrel has more than doubled and operating costs have increased by at least 25 per cent since the year 2000. This happened even before the low oil prices, and we are now in a state where we need to respond and we need to respond in a sustainable manner."

In an era where the need for affordable, low carbon energy is top of many government agendas, cost is key. The role of digitalisation as a means of increasing productivity, performance and therefore profits, is a hot topic in Shell and other companies. Choong noted that while the use of digital technology is not new, what is different today is the pace of change.

"There is more sophisticated analytics, algorithms and artificial intelligence. There has also been a rapid increase in processing power, and there is free, reliable, wireless access to the internet worldwide," she said. "Now we are moving into the areas of big data and advanced analytics… the data itself is going to be key. "

Gathering and monitoring data from refineries and offshore platforms is being used to improve operations and predict maintenance. "Projects like this have never failed to repay their investment within one year," noted Choong. "It's a new way of working that allows us to do more with less. The data-centric way of working is the way of the future."

Commenting on the electricity sector, Dr James Yu, Future Networks Manager, ScottishPower Energy Networks said his company is looking at how to minimise the operational expenditure for monitoring its 40 000 km of overhead lines. Currently it inspects its lines visually – a process that takes two years – but is looking at how to improve the monitoring and maintenance process by making better use of the vast amounts of data it gathers.

Yet the digitalisation of operations is more than just about optimising the operation of assets in the field or improving maintenance, as Rolf Riemenschneider explained. Riemenschneider, Head of Sector IoT, DG CONNECT/E1, European Commission said: "The Internet of Things (IoT) is not new. We started looking at what we expect, what we need from the IoT about 15 years ago. We've heard about sensors, sensor integration, robots, connectivity, data storage etc. We had all of that 10-15 years ago. So why do we need IoT now?

"It's a combination – it's about how to keep up with the pace of innovation and even more important, from a Commission point of view, it's about how to avoid siloed collaboration. The IOT is a key issue in the [European] single market. We want companies to cooperate across borders, exchange information, have the same legal environment for sharing data and data storage, and to enable and have a connected society."

James Neophytou's Practice Leader, Chemicals & Petroleum, UK & Ireland, IBM also noted that digitalisation and the IOT was about more than just operational efficiency. However, he went further, stressing that it is about survival.

"If you look at the downturn in the upstream segment of the oil gas sector, one in six jobs have gone in Aberdeen [Scotland], there has been about 60 bankruptcies in Houston."

He explained that although the industrial internet has been around for years, companies have been slow to seize the opportunities presented by digitalisation.

"The industrial internet has been around for 30 years, so when we talk to clients about IoT and sensors in the field, smart oilfields have been around for a very long time. [Yet] People are just getting their heads around 3D printing, [although] Formula 1 manufacturing was doing that 10 years ago for spare parts.

"Frankly, the entities that will survive over the next 10-15 years are those that act on the messages heard here today. One thing we have heard about is convergence. It's about collaboration and re-use. GE uses imaging [techniques] from its healthcare business in its oil and gas business. Those that survive are the ones that enable and embed these capabilities across their organisation."

For utilities, big data and IoT technology may once have been considered as something that is "nice to have". With the changing energy landscape, however it is increasingly being seen as a "must have". The traditional way of supplying electricity from large generator to consumer is changing and will completely change in the future. Demand will follow supply, electricity will flow from large generator to consumer, and from consumers to the grid and other consumers, in a fully automated system. This will only be possible through the use of big data and the IoT.

E.On is already preparing for this brave new world. Susana Quintana-Plaza, SVP Innovation, E.On SE said: "We are working on the optimisation of assets and using advanced condition monitoring systems etc. But the issue for utilities is not about how to use big data or how to use IoT to optimise our assets.

"Utilities in the future will not own any assets, the assets will be owned by the consumer. That means the utility industry will become a consumer goods and service industry. Our role will not be to optimise these assets for ourselves but to use the best retail tools and big data to identify which consumers to target with which products and services.

"We are the first to be going through this transition and believe the others will follow. We have a lot to do. The main challenge will be to change the mind-set – to change this industry from [one of] engineers and financiers with an infrastructure mind-set to people who know how to do marketing, sales… digitalisation will be a huge change for E.On."

One of the biggest challenges facing utilities and other companies, however, is the use of data in Europe. Quintana-Plaza cited Google as an example, where customers have to share their data if they want to use a service such as Google Maps. "In Europe consent is required from the consumer to access data from a smart meter. But without access to the smart meter, a utility cannot regulate a grid or offer energy products and services," she said. "Today Europe has very restrictive regulations on data and its usage. I'm not advocating having the wild, wild West here but I'm advocating a system that allows you to have the use of data, to analyse data and behaviours.

"While we are stopping European companies from doing so, American companies have not been regulated. Data is the currency of the 21st century and they have the currency for the 21st century that we don't. So they already have an advantage and are already offering a product. Energy companies don't have a product today because we don't have the data."

Her frustration is understandable. Yet the topic of data use is a murky one. Riemenschneider called data "the new oil" but with new ways of exchanging and storing data, he said, "we need rules between businesses".

Indeed there is plenty to be done as we embrace the digital age. Companies see data as the currency of the future but with the widespread selling of data both legally and illegally, it's arguable that it is already the currency of the present.

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