THE ENERGY INDUSTRY TIMES

November 2017 • Volume 10 • No 9 • Published monthly • ISSN 1757-7365 www.teitimes.com

Special Project Supplement

When it begins commercial operation, the Tees Renewable Energy Plant will be the largest and most efficient dedicated biomass fired power plant in the world.

China's march

China looks set to become the leading electricity foreign investor globally. The trend has started and the motivation is high. ***Page 13***

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Turnbull accused of following Trump's lead

Turnbull: Australia must have a certain level of dispatchable power

Australia's decision to scrap its clean energy target is seen as a copy of US President Donald Trump's move to dismantle its own Clean Power Plan, and one that threatens its climate change efforts. **Junior Isles**

Australia is to abandon its clean energy target after giving the green light to a policy that threatens its ability to meet its emissions reduction targets under the Paris climate agreement. The government recently rejected a plan to generate 42 per cent of its energy from renewable sources and will instead pursue cheaper and more reliable power.

In a move seen by some as mimicking that of US President Donald Trump's decision to dismantle the US's Clean Power Plan, Australia's Prime Minister Malcolm Turnbull has declared that energy companies in Australia must deliver a certain level of dispatchable power from sources such as coal, gas, hydro or batteries. He also aims to phase-out subsidies for renewable energy from 2020.

Announcing the policy, Turnbull said: "Past energy plans have subsidised some industries, punished others and slugged consumers. Our plan has no subsidies, no certificates and no tax."

He said the policy would deliver lower prices, more reliable power supplies, and claimed it would help Australia meet its international commitments to reduce greenhouse gas emissions.

"Energy companies will have to guarantee the reliability of their energy supplies to ensure the lights stay on. These guarantees will ensure there is a place for all power sources in the nation's future energy mix: solar, wind, coal, gas, batteries and pumped hydro," he claimed.

Many industry experts, however, are not convinced. Bruce Mountain, director at Carbon and Energy Markets, an economics consultancy focusing on energy markets, told the *Financial Times*: "It looks like a carbon copy of the new Trump energy policy in the US as it would likely mandate energy retailers to purchase electricity from coal-fired generators."

Earlier this year President Trump proposed a new payments system available only to coal and nuclear power plants to protect them from competition from lower cost gas and renewables.

Australia's plan, which the government said was new and not lifted from another country, will not provide direct incentives to generators. Retailers would have to buy a set amount of power from reliable sources, which

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EPA may still have to address carbon emissions

The US Environmental Protection Agency (EPA) may still have to demonstrate that it intends to address carbon pollution from power plants despite dismantling former President Obama's Clean Power Plan (CPP).

In October, EPA Administrator Scott Pruitt announced a process to formally undo the CPP, which called for strict limits on power plant emissions and was specifically designed to limit the use of coal.

Some experts argue that because the Supreme Court has classified carbon dioxide as a dangerous greenhouse gas that should be addressed, the EPA cannot ignore a major source of emissions such as existing power plants and must take some action.

James Coleman, a law professor at Southern Methodist University in Dallas, who specialises in energy and regulatory issues, told the *Washington Times*: "They have to say what they're going to do, but what they could say is, 'We're not going to adopt any regulations.'"

Environmentalists went further. "Whether it's straight repeal or repeal-plus-do-nothing-replacement, the Trump/Pruitt Dirty Power Plan will not meet EPA's obligations under the law," said David Doniger, Director of the climate and clean air program at the Natural Resources Defense Council. "The law requires EPA's standards to be effective – a standard doesn't represent the 'best system of emission reduction' if it does not achieve as much carbon pollution reduction as can be accomplished at an acceptable cost."

The Obama-era air pollution rules were intended to cut US carbon emissions by about one-third below 2005 levels by 2030 but was seen as legally flawed. Pruitt says he is on solid legal footing, and that the repeal will save as much as $33 billion over the next 13 years.

"The Obama administration pushed the bounds of their authority so far with the CPP that the Supreme Court issued a historic stay of the rule, preventing its devastating effects to be imposed on the American people while the rule is being challenged in court," Mr. Pruitt said in a statement. "We are committed to righting the wrongs of the Obama administration by cleaning the regulatory slate. Any replacement rule will be done carefully, properly, and with humility, by listening to all those affected by the rule."

Two days after the EPA announcement, former New York Mayor Michael Bloomberg's foundation donated $64 million to a Sierra Club programme seeking to phase out coal fired power plants and reduce carbon emissions.

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include coal, gas, pumped hydro and batteries.

Mountain added that other sectors of the economy would have to carry more of the emissions reduction burden if Australia is to meet its Paris goal of reducing carbon emissions by between 26-28 per cent on 2005 levels by 2030.

Known climate sceptic Turnbull was also accused of following President Trump's lead in pulling Australia out of the Paris Agreement on climate change. Greens leader Richard Di Natale dubbed the Prime Minister "cowardly" when he made the accusations before the government unveiled its new energy plan.

However, it is understood the majority of the backbench supported the plan. The government has endorsed 49 of 50 recommendations put forward by chief scientist Dr Alan Finkel's Clean Energy Target.

"The Finkel report contained 50 recommendations. If we've recommended 49 that's a 98 per cent strike rate," said Craig Kelly, head of the coalition's backbench energy committee.

One of the recommendations endorsed includes a generator reliability obligation, under which each region would be assessed to ensure enough power is available on-call to meet consumer demand for electricity.

Turnbull said the policy, recommended by the independent Energy Security Board, is a National Energy Guarantee policy that is the "lowest cost way of keeping the lights on". Energy companies also have to guarantee their energy sources will enable the country to meet its CO_2 emissions reduction commitments.

Assistant Treasurer Michael Sukkar welcomed the new energy plan as it focused on delivering reliability and affordability.

Energy security was thrust into the spotlight last year when South Australia bore the brunt of the national energy crisis. The state witnessed surging power prices and suffered multiple blackouts last summer, including one that cut power to the entire state.

Foreign Minister Julie Bishop described the federal government's energy plan as a "game changer". She told *ABC Radio*: "The whole mechanism is geared toward reliability but it ties it to environmental policies, so for the first time we have energy policy and environmental policy working together to guarantee reliability of supply.

"It will make it more affordable and it will also enable us to reduce our greenhouse gas emissions in accordance with our international obligations."

Business groups cautiously welcomed the new policy framework, with AGL, Australia's largest energy retailer, saying: "With bipartisan support, it will provide investment certainty."

Under the policy, household energy bills are forecast to fall an estimated $110 to $115 per year between 2020 and 2030 – more than the $90 per year estimated under Dr Finkel's Clean Energy Target.

Residential electricity prices have increased by 63 per cent on top of inflation over the past decade, according to Australia's competition watchdog, mainly due to higher network costs, which comprise 48 per cent of a household bill. Green schemes, which have been the focus of most public attention, made up only 7 per cent, it said.

Digital transformation gathers momentum

Siemens is moving its EnergyIP platform apps on to MindSphere in yet another move that shows how distributed generation is driving digitalisation. **Junior Isles**

Digital transformation of the energy industry is gaining momentum as power equipment suppliers and IT companies continue to join forces and launch solutions.

Last month saw Siemens and a group including IBM make separate announcements of new solutions aimed at increasing the visibility, control and security of devices that make up power systems.

In October Siemens announced that applications that currently run on its EnergyIP smart grid application platform will be increasingly integrated into MindSphere, its cloud-based open operating system for the Internet of Things (IoT).

According to Siemens, 'MindSphere for Energy' reduces the cost of integrating new equipment and enables new and existing applications to be developed and installed using standardised interfaces on MindSphere.

Speaking at a press conference to announce the move, Cedrik Neiker, Member of the Managing Board of Siemens AG, said: "Things have become more complex and will become much more complex in the future. Decarbonisation is driving decentralisation and decentralisation is driving digitalisation… You have to bring assets together and that's why we have built this platform."

With the evolution of energy systems in full swing, data is seen as "the new fuel for energy suppliers". Innovative IoT technologies are essential if utilities are to use the data to derive value for their businesses. Siemens says it is therefore developing the right applications for this, relying on standard protocols.

"This enables us to keep the platform flexible and at the same time open for developers from third parties across our own applications," said Thomas Zimmermann, CEO of the Digital Grid Business Unit in the Energy Management Division of Siemens.

According to the company, any such platform needs to be "deep, broad and open". Zimmermann noted: "It needs to connect as many devices as possible from the grid and from infrastructure – from industries and the edge of the grid."

Siemens says energy management applications that run reliably on EnergyIP will run just as reliably on MindSphere.

"This will create additional added value for our customers by enabling them to more easily combine grid status data with data in other applications fields, such as power generation, in industry and everywhere else that MindSphere is being used in the future," said Zimmerman.

Siemens says existing EnergyIP applications with 75 million devices will be running on MindSphere for Energy from April next year.

Omnetric Group, the Siemens and Accenture joint venture, said that it has partnered with Austrian energy service provider, Kelag, to build its first MindApp for the energy industry. The app will enable the utility to analyse grid data to more accurately decide when to maintain individual grid assets, improve operations and manage workforce requirements and ultimately enable better investment planning decisions.

Siemens notes that the MindSphere platform and the applications are part of its cyber security strategy.

The connection of more distributed devices to the system is creating challenges around network security. According to a recent study by German energy association BDEW and EY, 88 per cent of energy infrastructure suppliers in Germany, Austria and Switzerland believe IT-security is the biggest challenge for a digitalised energy infrastructure.

At the start of October, Infineon Technologies, IBM, GreenCom Networks and icentic joined forces to develop and provide scalable solutions for securely connecting distributed assets to the electrical infrastructure.

The partners demonstrated a first prototype solution based on Infineon's Optiga embedded security chips built in icentic's IceHub connectivity products to authenticate devices that are connected to the Energy IoT platform of GreenCom. GreenCom Networks' Energy IoT platform integrates relevant analytical skills from IBM to forecast and optimise the usage of connected assets.

Utilities "hungry for change", says new report

A new report by law firm Pinsent Masons reveals the extent to which utilities and investors are engaging with the smart energy revolution.

Research conducted by the law firm reveals that energy technology boltons will underpin the future of the global energy industry as companies respond to the seismic shift in electricity distribution and supply, consumer demand and to capitalise on the smart energy revolution.

The report: 'Hungry for change: Investing in a smarter energy future', surveyed 250 senior executives from EMEA and Asia-Pacific across both utilities businesses and investment entities. It found that 90 per cent of energy companies are actively seeking a smart energy technology joint venture or acquisition.

Pinsent Masons says this signals a step-change for the global energy industry as companies strive to keep up with the rapid pace of change in consumer energy consumption behaviour, shifts in government policy and to improve security of supply.

The findings show investors and energy companies prioritising smart meters, new methods of harnessing surplus power and in-house development of data analytics technology within the next two years, while cloud management systems and virtual power plants will see a surge of investment in six years.

Research also found 85 per cent of respondents expect M&A to increase in the next 12 months, with Germany, China and the UK revealed as the top three target countries for smart energy investment for energy companies and investors. Furthermore, 62 per cent of energy companies say they will not opt for in-house development of smart energy solutions due to high start-up costs and a lack of expertise.

Energy partner at Pinsent Masons, Ian McCarlie, said: "Joint ventures and acquisitions are the key to this revolution if utilities are to play a role in the future of the energy industry, maintain security of supply and meet consumer demand in a highly competitive market. The transition to a low carbon economy is gathering momentum presenting significant opportunities for energy service companies as we move towards and into the 2020s. But, action must be taken now to avoid being left behind."

Report claims 90 per cent of energy companies are actively seeking a smart energy technology joint venture or acquisition

France sets aside renewables pot, as solar takes centre stage

The French government plans to invest €7 billion in the next five years to grow its renewable energy sector. The news comes as the International Energy Agency predicted that global renewable power capacity would grow by nearly 1000 GW by 2022.

The French government recently said it was allocating $20 billion to the energy transition as it plans to grow its renewable energy sources by 70 per cent. The investment plan for renewables will support research and innovation related to climate change mitigation, and accelerate the country's green transition, as well as develop new energy sources.

A recent report by the IEA highlighted the pace of the global move to renewable energy sources. In its medium-term renewables market report, the IEA expects global renewable electricity capacity to rise by more than 920 GW, or 43 per cent, by 2022. The projected growth is 12 per cent more bullish than the IEA's forecast last year.

The Paris-based agency raised its forecasts over the next five years following a record 2016, adding that renewables growth is squeezing natural gas and coal.

Solar PV was labelled as "the real star" among renewables, growing 50 per cent last year.

Commenting on the report, Paolo Frankl, Head of the IEA's Renewable Energy Division, said: "Last year, new solar PV capacity around the world grew by 50 per cent, reaching over 74 GW, with China accounting for almost half of this expansion. For the first time, solar PV additions rose faster than any other fuel, surpassing the net growth in coal."

Battery packs boost Caribbean grids

■ Advancion arrays protect Dominican grid ■ Tesla ships Powerwall units

Siân Crampsie

Energy firms in the Americas have highlighted how energy storage assets have helped the region cope with the effects of extreme weather events in recent weeks.

AES said that two energy storage arrays that it installed recently in the Dominican Republic helped the Caribbean country to maintain its power system during Hurricanes Irma and Maria.

The two 10 MW battery storage systems are designed to provide critical grid reliability services for the Dominican Republic's interconnected national electricity system (SENI) but were put to a "critical test" during the September storms, which reached category-4 hurricane conditions.

According to AES, the Dominican grid operator asked for the two Advancion arrays to be kept on line as Irma and Maria approached the region. Both energy storage arrays performed more than double the amount of work during the storms as normal, helping keep the Dominican grid operating during the storms, even as nearly 40 and 55 per cent of the island's power plants were forced offline during Hurricanes Irma and Maria, respectively.

"AES Dominicana's energy storage arrays enhanced the Dominican grid during a most trying time, helping keep vital power resources online," said John Zahurancik, President of AES Energy Storage. "Not only does energy storage improve reliability of the grid on a daily basis, this experience demonstrates how it can add to overall resilience under extreme conditions."

The battery installations are located in the Santo Domingo region and provide fast, accurate frequency control to the Dominican grid, balancing second-to-second variations between electricity consumed and produced.

In the neighbouring island of Puerto Rico, Tesla has been supplying its Powerwall battery packs to help the country restore power.

Puerto Rico's grid was devastated by the two storms; in mid-October, local reports stated that only 15 per cent of the island has electricity.

The country's governor is aiming to get the entire island's network up and running by mid-December.

Tesla says that its battery packs have been useful in bringing individual solar roof installations back on line. Its larger Powerpack units have helped larger renewable energy installations to re-start.

Local media reported in October that Tesla had installed solar panels and battery packs at San Juan's Hospital del Niño in order to restore power.

■ Engie North America and Holyoke Gas & Electric (HG&E) have announced plans for a 3 MW/6 MWh energy storage system at Mt. Tom Solar, Massachusetts. The system will be used to optimise intermittent solar energy and reduce utility capacity costs for HG&E, the system's customer, while reducing stress on the HG&E distribution system.

Ceres network argues business case for solar

A group of influential US businesses has written to the International Trade Commission (ITC) urging it to reconsider its decision in a solar trade case brought by Suniva and SolarWorld.

The Ceres BICEP Network, whose members advocate for stronger climate and clean energy policies at the state and federal level in the US, says that tariffs or other trade restrictions on imports of solar cells will increase costs and slow the deployment of solar energy.

In its letter to the ITC, Ceres BICEP, whose members include eBay, Nike, the North Face and Starbucks, said: "Increased solar prices would hinder businesses' and homeowners' ability to purchase solar power. As companies committed to the use of renewable energy, we rely on the availability of solar infrastructure to achieve our sustainability goals."

It adds that a 40 ¢/watt tariff on solar cells and a 78 ¢/watt price floor on modules – as called for in the original Suniva petition – would result in about 88 000 lost jobs in the US solar sector. It also quotes research from Greentech Media that estimates that the tariffs and price floors on solar panels requested by Suniva could lead to a 50 per cent decrease in solar installations in 2019.

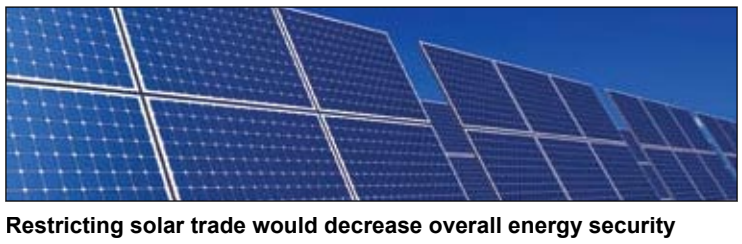
"Because businesses and families rely on solar energy, restricting solar trade would actually decrease our nation's overall energy security," the letter said. "In addition, increasing the average price of solar installation would be costly to taxpayers because the existing investment tax credit subsidises a fixed percentage (30 per cent) of solar installation costs."

Suniva has lowered the tariff recommendation in its original petition filing to a minimum of $0.24 per watt for standard crystalline silicon photovoltaic cells. Other manufacturers have put forward other recommendations, including economic incentive programmes to increase US manufacturing and changes to US energy policy to foster the growth of solar energy.

According to EnergyTrend, the utility-scale segment of the US solar energy market would bear the brunt of any trade restrictions imposed. In 2016 the USA installed roughly 14.8 GW of solar capacity, including 10.6 GW of utility solar.

Demand for solar cells could be as low as 5.5 GW in 2018 if the trade barrier set is high, EnergyTrend also reported.

The ITC is expected to send its recommendations to the President in mid-November. It ruled in September that imports of crystalline silicon photovoltaic (PV) cells have seriously damaged the USA's solar cell and panel manufacturing industry and recommended the imposition of tariffs or other trade restrictions to protect domestic producers.



Restricting solar trade would decrease overall energy security

Brazil sells 2.9 GW of hydro

■ Foreign firms clean-up at auction
■ Enel adds to Brazil portfolio

China's State Power Investment Corp (SPIC), French energy group Engie and Italian energy group Enel SpA have come out on top in a recent energy auction held in Brazil.

The three firms won concessions totalling 2.9 GW in the country's most recent hydropower auction, held at the end of September.

SPIC won the concession for the largest hydropower plant on offer, paying $2.4 billion for the 1710 MW Sao Simao plant. Engie paid $1.1 billion for two projects – the 408 MW Miranda and 424 MW Jaguara plants.

Enel paid $440 million for the rights to the 380 MW Volta Grande hydropower plant.

The bidders paid between 6.5 per cent and 22.5 per cent above the government's minimum price for the assets, which were previously operated by Companhia Energética de Minas Gerais (Cemig). The auction results signal strong investor appetite in the privatisation programme of President Michel Temer, analysts noted.

The concessions are for 30 years and agreements are expected to be signed this month, Enel said. The terms of the sale require the winning bidders to guarantee 70 per cent of each project's output for distribution via regulated market contracts, but say the remainder is eligible for sale on the free market.

"This award further strengthens Enel Green Power's consolidated foothold in Brazil, a country blessed with abundant natural resources, where we are already the leading player in the solar power market," said Antonio Cammisecra, Head of Enel Green Power. "This achievement represents yet another important milestone in our growth strategy for Brazil where we are building a well-balanced and diversified renewable portfolio."

EGP sells Mexican interests

Enel Green Power has sold a majority stake in 1.7 GW of renewable energy assets in Mexico as part of a wider strategy to grow its international clean energy portfolio.

The firm has struck a $1.35 billion deal with Canadian institutional investor Caisse de depot et placement du Quebec (CDPQ) and CKD Infraestructura Mexico SA de CV (CKD IM) to sell an 80 per cent stake in a holding company that owns eight special project vehicles (SPVs).

The SPVs own three plants in operation with a combined capacity of 429 MW, and five under construction totalling 1283 MW.

The agreement is a further step in Enel's 'build, sell, operate' (BSO) strategy, which aims to accelerate the growth of EGP's renewable energy footprint.

"This strategy enables us to further exploit our global pipeline of solar and wind projects whereby [we] gain access to additional resources, accelerating our growth," said Antonio Cammisecra, Head of Enel Green Power. "By attracting solid long-term partners in this transaction, EGP confirms the strategic role that Mexico plays in its global presence. We are enthusiastic about the opportunities offered by the Mexican renewables market and it is our intention to continue to invest in the country."

China counts cost of clean energy funding

- Clean energy subsidy shortfall could hit $30 billion
- Plan to promote large-scale storage

Syed Ali

China may struggle to pay billions of yuan in subsidies to clean energy companies, with the shortfall set to quadruple by 2020, according to a government official.

The total shortfall by 2020 will be Yuan200 billion ($30.2 billion), up from Yuan50 billion last year, said Dongming Ren, Director of the National Development and Reform Commission's Energy Research Institute, speaking at an industry conference. "The shortfall will continue to widen if China keeps its current renewable policy of fixed power prices unchanged," he said.

China is the world's biggest energy consumer and has vowed to increase the use of non-fossil fuel to 15 per cent of its total energy mix by 2020 and cap its carbon emission by 2030 as part of its effort to wean the nation off coal and fulfil its climate change pledge.

The widening gap in subsidies, however, underscores the cost of funding the country's ambitious renewables push and the need for policy change.

Moody's Investors Service warned in September that the dependence of China's renewable sector on government subsidies will be one of the main near-term challenges for clean power.

To ease the government's financial burden and reduce the amount of wasted power, China has cut subsidies for new large-scale solar and onshore wind power projects and set capacity limits in regions with high wastage rates.

It also introduced a green electricity certificate system in February and aims to enforce a compulsory quota system on coal-fired power plants in 2018. The country also plans to launch a nationwide carbon emissions trading system this year, although Ren noted that plan is delayed into 2018.

"China needs to expand the source of renewable subsidies, otherwise it would be very difficult for clean energy to compete with coal, especially before environmental costs are showed on coal-fired power prices," said Ren.

In October, the country said it would boost its large-scale energy storage capacity over the next decade in a major push to solve the problem of stranded power in the west. While China has led the global push to increase the use of wind and solar power in recent years, getting clean energy from western regions to urban users has been a major problem.

A key part of the plan is to issue subsidies to energy storage companies to spur the construction of new power-saving facilities, according to a statement issued by the National Development and Reform Commission (NDRC).

The government will launch several pilot projects to test advances in energy storage technology.

South Korea energy roadmap plans stumble

South Korea's plans to shift its reliance from coal and nuclear power to natural gas and renewable energy received a blow last month following a public opinion survey that showed a majority of almost 60 per cent were in favour of resuming the construction of two stalled reactors.

President Moon Jae-in, elected in May, now says the country would resume construction of the Shin Kori 5 & 6 nuclear plants, with nuclear phase-out delayed to 2060.

With the two reactors set to be completed in October 2021 and October 2022, according to state-run nuclear operator Korea Hydro & Nuclear Power Co. (KHNPC), Moon said safety standards for nuclear plants would be ramped up.

Moon also reiterated his plan to shut down the Wolsong No. 1 nuclear reactor, the nation's second oldest, once the government confirms stability in energy supplies. This announcement came as KHNPC said that roughly 110 kg of coolant has been leaking daily at the plant's Unit 3 and that the amount is increasing. It stressed, however, that there are no radiation leaks.

South Korea operates 24 nuclear reactors that generate about 30 per cent of its electricity, while coal and renewable energy provide 37.5 per cent and 6.7 per cent, respectively, according to the ministry of trade, industry and energy.

The new government had set out an energy policy designed to keep pace with the changing energy environment and growing safety concerns following the 2011 Fukushima nuclear disaster and the nation's largest-recorded earthquake in Gyeongju in September last year.

Commenting on the decision to resume construction of the nuclear plants, Wood Mackenzie said LNG exporters will be disappointed. Wood Mackenzie, a research and consultancy business for the global energy, chemicals, metals and mining industries, estimated that full implementation of Moon's election promises could have resulted in around 10 Mt of extra LNG demand by 2030. This now seems unlikely, it says.

"The decision to continue with nuclear, may make it easier for the government to implement some of the other election promises. Increasing renewable capacity to 20 per cent by 2030 will require subsidies. Displacing coal with LNG will increase fuel purchase costs. Maintaining nuclear makes anti-coal, and pro-gas and renewable policies more achievable, without putting too much upward pressure on electricity prices," it stated.

"With the planned nuclear phase-out delayed, it will be interesting to see whether more aggressive anti-coal policies are enacted."

Last month the government imposed emission standards on eight private coal power plants under construction that are stricter than those in Germany and Japan. Permissible SOx emission levels were set at 15 ppm, which compares with 39 ppm for Japan and 70 ppm for Germany. The level for NOx was set at 10 ppm, while the comparable figures for Japan and Germany were 34 ppm and 97.4 ppm.

- Korea Electric Power Corporation recently held a ceremony marking the completion of the world's largest 1 MW carbon dioxide separator demonstration plant at Dangjin Thermal Power Plant headquarters of Korea East-West Power Company.

Taiwan ramps up clean energy

Copenhagen Infrastructure Partners P/S (CIP), China Steel Corp (CSC) and Diamond Generating Asia Ltd (DGA) will work together to develop and build a 50-turbine offshore wind farm in Taiwan. The project will have a generating capacity of 500 MW.

The companies have signed a memorandum of understanding (MoU) for their collaboration in offshore wind zone 29, west of Changhua County. The project received conditional approval for its environmental impact assessment at the end of September.

According to the daily newspaper *DigiTimes*, Mitsubishi Corp's unit DGA is to supply wind turbines for the project, while CSC will produce key elements for the steel foundations. CIP, meanwhile, will be responsible for financing, project development and management.

In early October, CIP officially unveiled its office in Taiwan and said that it is currently developing three offshore wind projects in the country with a total capacity of up to 1.5 GW. All three are to be located west of Changhua.

Offshore wind farm development is part of Taiwan's move to cleaner energy production.

At the start of October Neo Solar Power Corp. secured a deal to build and operate the nation's biggest super-high-voltage, ground-mount solar power plant. The solar farm in Changhua County will have a capacity of 40 MW.

Bangladesh secures significant international investment

Bangladesh has secured billions of dollars in international funding for projects that will significantly boost its energy sector.

Last month Dhaka and New Delhi signed a $4.5 billion credit agreement with a provision for spending nearly a quarter of the amount on Bangladesh's first nuclear power plant at Rooppur.

The deal sees India become a party to the civil nuclear programme to be implemented by Russia. Russia is building the plant and also providing credit of $12 billion for the project.

Indian Finance Minister Arun Jaitley said the agreement marks the biggest-ever line of credit New Delhi has given to any country. Around $1 billion will be spent on infrastructure development for power evacuation facilities for the Rooppur plant.

The country's electricity grid received a further boost with the news that Sweden's government would invest $1.0 billion to modernise and digitalise the network in order to make the system more reliable and efficient.

State Minister for Power, Energy and Mineral Resources Nasrul Hamid said: "The government is committed to improving the power [system] by setting up new power plants and strengthening transmission systems through new space saving substations and adopting digital power management solutions."

Hamid was speaking at the signing of a Memorandum of Understanding between the country's power sector officials, the Swedish government and ABB Limited to increase technical collaboration, knowledge-sharing and introduce technological solutions.

In September, Hamid said the country is interested in building an interconnection with Myanmar, explaining that the connector would pave the way for electricity exchange between China and Asean countries.

UK sets out clean growth plan

A new round of renewable energy auctions forms part of the UK's new Clean Growth Strategy, underpinning the country's commitment to a low carbon transition.

Siân Crampsie

Renewable energy developers in the UK have welcomed the news that the country's next renewable energy auction will be held in early 2019.

The UK government's announcement confirming the date for the next contracts for difference (CfD) round has been widely welcomed by the industry as it provides investors with greater certainty and will enable project development to move forward.

Energy Minister Richard Harrington confirmed that £557 million will be made available for projects in the CfD auction in spring 2019. The funding is part of the UK's recently announced clean growth strategy, he said.

The auction will once again focus on less established renewable energy technologies – namely offshore wind, energy from waste, marine energy and biomass CHP – confirming the government's wish to continue making offshore wind the mainstay of the UK's renewables strategy.

"[The government] is helping to build a world-leading offshore wind industry which can power a clean industrial revolution, creating new jobs and attracting billions of new investment," said RenewableUK's Chief Executive Hugh McNeal. "Last month we saw a record 50 per cent drop in the cost of offshore wind. This amazing cost reduction is a reminder of what innovative industry can deliver when backed by competitive auctions."

The new CfD auction round follows one held in April 2017, which resulted in funding for three major offshore wind farms as well as eight other smaller-scale biomass and waste to energy plants.

The focus on less established technologies means that cheaper renewable technologies, including solar and onshore wind, continue to be shut out of renewables funding mechanisms.

Paul Barwell, CEO of the Solar Trade Association (STA), said that there are a number of large-scale solar projects in the UK that "could deploy very quickly if long term contracts could be secured".

The STA and seven major solar energy investors have written to the government calling for solar energy to be allowed into auctions for clean power. The letter says that the expected very low price for new solar CfD contracts is unlikely to amount to a net subsidy for consumers, Barwell said.

The STA also said that the Clean Growth Strategy lacked explicit measures to boost solar energy growth. It believes that solar energy can play a key role in modern economies alongside electric vehicles, smart energy systems and energy efficiency policies, but says that it does not have a level playing field.

"Whether it is tax breaks for fossil fuels, a continued emphasis on big centralised power over local power, or access to auctions – solar is not being treated fairly," said STA Policy Manager Chris Hewett.

The Clean Growth Strategy is designed to underpin the UK's plans to transition to a low carbon economy. It includes over £2.5 billion ($3.3 billion) of funding to 2021 for innovation in areas such as energy efficiency, carbon capture and storage, and the use of low carbon fuels in industry. The government has also pledged to provide financial support for electric vehicle uptake, and reiterated its strategy to phase out the use of unabated coal by 2025 and the delivery of a new fleet of nuclear power plants.

"The Clean Growth Strategy marks a sea-change in top-line thinking about the low carbon economy," noted Richard Black, Director of the Energy and Climate Intelligence Unit (ECIU). "There are many areas where more detail needs to be added – particularly on energy efficiency where the goal is clear but the route to achieving it isn't.

"Nevertheless, there is no doubt that ministers have produced a strategy that if delivered, can ensure Britain meets its national and international commitments on reducing carbon emissions while bringing society other benefits along the way."

Coalition confirms coal phase-out plans

The Netherlands is driving forward with its ambitious climate change strategy with plans to phase out coal-fired power generation and the setting of more challenging CO_2 reduction targets.

The new government has published a coalition agreement containing plans to close all coal-fired power plants by 2030 and the setting of a target to reduce CO_2 emissions by 49 per cent by 2030 compared to 1990 levels.

The new four-party coalition also wants to push for more ambitious climate targets across the European Union.

The Institute for Energy Economics and Financial Analysis (IEEFA) said that the new policies would send a "sharp signal" to European energy markets and that "no investment in coal-fired power in Europe is safe".

"[The] announcement highlights the risk of investing in either new or existing coal-fired power, and the lesson is clear: national coal phase-out plans such as this, combined with the rise of renewables and the impact on demand of improved efficiency, put old electricity production models at risk," IEEFA said in a statement.

There will also be new targets for carbon capture and storage, with the industry being asked to sequester 18 Mt of CO_2 by 2030.

Last month the Dutch Ministry of Economic Affairs published details of the country's next offshore wind tender, in which it expects to be able to attract bids without subsidies.

The application period for the Hollandse Kust (zuid) sites I and II will open in mid-December. One permit will be granted for each wind farm site and applicants are expected to put forward bids for at least 342 MW for each site.

If no qualifying applications are received in the first window, a second window will be opened up for applications based on subsidies.

A tender for two more sites in the Hollandse Kust (zuid) zone is expected to take place in 2018. An additional 700 MW is planned to be tendered in 2019 in the Hollandse Kust (noord) zone.

UK, France show the way in floating wind

France and the UK have made significant strides in developing floating offshore wind concepts.

Last month Ideol officially inaugurated its Floatgen project off the French Atlantic coast, while Statoil and Masdar announced that their 30 MW Hywind project off the east coast of Scotland was operational.

The developments show that floating offshore wind is no longer an R&D concept, WindEurope said in a statement. "This technology has developed significantly in recent years, and with a pipeline of projects approaching the commercialisation of over 350 MW by 2021, and a full potential of close to 4000 GW in European waters, this technology is now ready to be integrated into the energy market," it said.

The £210 million Hywind wind farm was officially opened by Scotland's First Minister, Nicola Sturgeon, and features five 6 MW Siemens wind turbines installed on floating foundations anchored to the sea bed by cables.

The project will help to reduce floating offshore wind farm costs, and prove the technology's viability, Statoil said.

"Hywind can be used for water depths up to 800 m, thus opening up areas that so far have been inaccessible for offshore wind," said Irene Rummelhoff, Executive Vice President of the New Energy Solutions business area in Statoil. "The learnings from Hywind Scotland will pave the way for new global market opportunities for floating offshore wind energy."

The Floatgen project will demonstrate a 2 MW floating wind turbine installed on Ideol's patented floating foundation at the SEM-REV test site located 12 nautical miles from the city of Le Croisic. It will be the first floating offshore wind turbine to be installed in France, where a number of floating offshore projects are planned by EDF Energies Nouvelles, Engie, Eolfi, EDPR and Quadran.

Delay likely at Moorside as NuGen seeks investors

The construction of the Moorside nuclear power plant in northern England is likely to be delayed because of financial problems at Toshiba, the parent company of developer NuGen.

According to news agency *Reuters*, NuGen CEO Tom Samson said that the company was aiming to secure a new investor in 2018, but that the scheme would then most likely be pushed back to a commissioning date beyond 2025.

NuGen is planning to build three reactors with a combined capacity of 3.8 GW near Sellafield, with commissioning planned for the end of 2025.

However, the future of the project was thrown into doubt after developer Toshiba's nuclear arm Westinghouse went bankrupt this year.

Toshiba's NuGen joint venture partner Engie subsequently pulled out of the project, leaving the Japanese firm searching for new investors.

The completion date of the plant now depends on how quickly a new investor can be found.

South Korea's Kepco and China's CGN are both thought to be interested in investing in Moorside. Kepco's reactor design has yet to start the UK's regulatory approval process, while CGN began the process earlier this year as part of its plans to build a new nuclear plant in Bradwell, Essex.

Eskom receives nuclear approval

Eskom has received approval for a new nuclear plant at Koeberg but the future for new nuclear energy capacity in South Africa is far from certain.

Siân Crampsie

Duynefontein is likely to be the location of a new nuclear power plant in South Africa after the country's government authorised a final environmental impact report for the site.

National utility Eskom is known to have favoured a greenfield site at Thyspunt in Eastern Cape province for a new nuclear plant but a record of decision (ROD) by the Department of Environmental Affairs (DEA) means that Duynefontein, next to the existing nuclear plant at Koeberg, will be developed.

Eskom said in a statement that it welcomed the DEA decision, describing it as "an important milestone in the development process of South Africa's nuclear programme".

"While we had worked on Thyspunt being the preferred site… we have always considered both sites equally capable of hosting a nuclear power plant," Eskom said in a statement. "To this end, we had progressed the Nuclear Installation Site Licence (NISL) to the National Nuclear Regulator (NNR) for both sites."

Under South Africa's National Integrated Resource Plan, around 9600 MW of new nuclear energy capacity is scheduled to be added to the grid by 2030, with the first unit scheduled to be on-line by 2023. However, that plan is currently being revised and South Africa's policy on new nuclear generation will not become clearer until next year.

Plans for new nuclear capacity in South Africa were also thrown into uncertainty earlier this year when the Western Cape High Court ruled that two governmental determinations covering the procurement process for new nuclear were unconstitutional and should be set aside.

The ruling was made in response to a case brought by Earthlife Africa and other environmental organisations that have campaigned to stop South Africa's nuclear programme.

The DEA said in its ROD that the overall environmental impacts associated with the Duynefontein site are acceptable and materially lower than those at the Thyspunt site. It also said that Duynefontein's proximity to the existing Koeberg nuclear site allows for a suite of logistical and operational synergies.

Five sites had initially been investigated at the scoping phase: Brazil and Schulpfontein in the Northern Cape, Bantamsklip and Duynefontein in the Western Cape, and Thyspunt in the Eastern Cape.

Following the scoping phase, Brazil and Schulpfontein were excluded from further detailed specialist environmental studies for the project.

The two-unit Koeberg plant has a generating capacity of about 1830 MWe and generates five per cent of South Africa's electricity.

Iran signs Saga deal

Investors are eyeing Iran as a potential new market for energy and renewables since sanctions on the country were eased last year.

Last month Norwegian solar panel maker Saga Energy signed a €2.5 billion deal with Iranian state-owned company Amin Energy Developers to build solar power plants in the country. The deal follows one signed in September by London-based investment firm Quercus for a 600 MW solar farm.

According to *Mehr News Agency*, the deal between Saga and Amin entails the construction of 2 GW of capacity over four to five years.

The company will rely on banks, pension funds and Norwegian state export guarantees to fund the plan, and aims to recoup its investment through a 25-year deal on electricity prices.

Iran plans to install 5 GW of renewable capacity by 2020 and irradiation levels make solar an obvious choice. Earlier this year Germany's Athos Solar connected a 14 MW PV facility to the grid in Kerman province, while Iranian PV developer Mokran installed a 20 MW plant in the same area.

International sanctions on Iran were lifted in early 2016 after the International Atomic Energy Authority (IAEA) said that the country had complied with a deal designed to prevent it from developing nuclear weapons.

However US President Donald Trump recently announced he would decertify that deal saying it is not in the interest of US national security. He wants the US Congress to make the deal tougher or else he will pull the US out of the international agreement.

Egypt's green energy strategy gains momentum

Egypt's New and Renewable Energy Authority (NREA) is planning to launch a digital map for solar and wind power projects as part of a strategy to attract investment to the sector.

The country has been successful in attracting international investment to its renewable energy sector and wants to maintain this momentum, the head of NREA, Mohamed Al-Khayat, said at an industry event in Cairo last month.

According to Al-Khayat, three new solar power plants will start operation this month under the first round of Egypt's feed-in tariff system (FiT), while 20 solar power developers have signed power purchase agreements (PPA) with the Ministry of Electricity to take part in the second round of the FiT system.

A total of 34 companies have expressed interest in developing projects under the second phase of the FiT system.

The FiT system and a clear regulatory framework have helped to attract finance, according to the European Bank for Reconstruction and Development (EBRD), which is backing 16 solar photovoltaic projects. The IFC has backed a further 13 projects.

Together the two multilateral lending institutions are supporting 1.4 GW of capacity with over $500 million of loans. They have also helped to attract a further $1.3 billion of private investment to the projects.

Last month Saudi-based alfanar said one of its subsidiaries, Alfa Solar Company, has signed a strategic $57 million loan deal with EBRD and Islamic Corporation for the Development of the Private Sector (ICD) to fund a 50 MW solar PV project in Egypt.

In September the African Development Bank (AfDB) agreed to fund three solar power plants in Egypt's Aswan region, while the Asian Infrastructure Investment Bank (AIIB) approved a loan to finance new solar capacity in the country.

AfDB said it would lend $55 million to each of three 50 MW solar PV plants located in the Benban solar complex. The AAIB deal will support 11 greenfield solar projects with an aggregate capacity of 490 MW. It is lending $210 million to the projects.

Turkey prepares for Akkuyu construction

- Construction permit expected in 2018
- Poland, Saudi Arabia make nuclear progress

Construction of Turkey's first nuclear power plant is expected to start after a limited construction permit for the project was issued.

The permit was issued to Akkuyu Nuclear JSC by the Turkish Atomic Energy Authority (TAEK) last month and allows the start of construction and installation works at all facilities on the nuclear power plant, except for the buildings and structures important for nuclear safety.

A full construction permit is expected to be issued in 2018 after further evaluation of the project and site by TAEK's Nuclear Safety Department.

"Obtaining of the Limited Construction Permit is a significant step forward for the Akkuyu project implementation," said Yuriy Galanchuk, Chief Executive Officer of Akkuyu Nuclear JSC. "We are actually moving from the preparatory stage to the construction activities at the site.

"Our next task is to get the Construction License. We would like to commence construction of the entire set of the NPP buildings and structures at the earliest time possible. Full compliance with all national and international safety standards remains our top priority."

The World Nuclear Association (WNA) said the permit for Akkuyu was a positive sign that reactor construction would start in 2018 and that Turkey would become the latest country to introduce nuclear energy to its mix after the UAE and Belarus.

"It is great to see Turkey's nuclear energy ambitions finally mature," said Agneta Rising, Director General of WNA. "Nuclear energy will help drive economic growth in the country and reduce reliance on imported gas."

WNA noted that other countries were also making progress towards new nuclear capacity, including Poland, which says it will begin a reactor selection process in 2018 and Saudi Arabia, which is expected to launch a reactor tendering process within the next months.

"The world is quickly adding to the number of countries building nuclear plants for the first time," said Rising. "More than 9 GWe of new nuclear capacity came online in 2016, the largest annual increase for over 25 years and global nuclear generation rose for the fourth successive year.

"The level of new build remains high, but the pace of new construction starts must accelerate if we are to successfully balance environmental goals with human development."

Special Project Supplement

Teesside goes big on biomass

When it begins commercial operation, the 299 MW Tees Renewable Energy Plant in the UK will be the largest and most efficient dedicated biomass fired power plant in the world. **Junior Isles** examines the plant, which marks a new milestone for circulating fluidised bed technology.

Like many parts of Europe, the United Kingdom has been making a concerted effort to reduce its carbon emissions. This has seen significant growth in renewables such as wind and solar. Although to a lesser extent, there has also been an increase in the use of biomass for power generation.

While projects like the conversion of Drax (formerly Europe's largest coal fired plant) from coal to biomass have been dominating the headlines in recent years, other notable biomass fired power plants have also been making progress. Perhaps the most significant of these is a £650 million project being built on Teesside in the northeast of England.

At 299 MW, the plant will be the world's largest dedicated biomass power station and heralds a leap into 300 MW-class biomass fired units. Teesside not only marks an important milestone in the UK's efforts to tackle climate change but also demonstrates the versatility of circulating fluidised bed (CFB) technology and its ability to be scaled up.

The project, owned by MGT Teesside Limited, is being constructed by Technicas Reunidas in a consortium with Samsung C&T and will use an Advanced Bio CFB (ABC) boiler supplied by Sumitomo SHI FW.

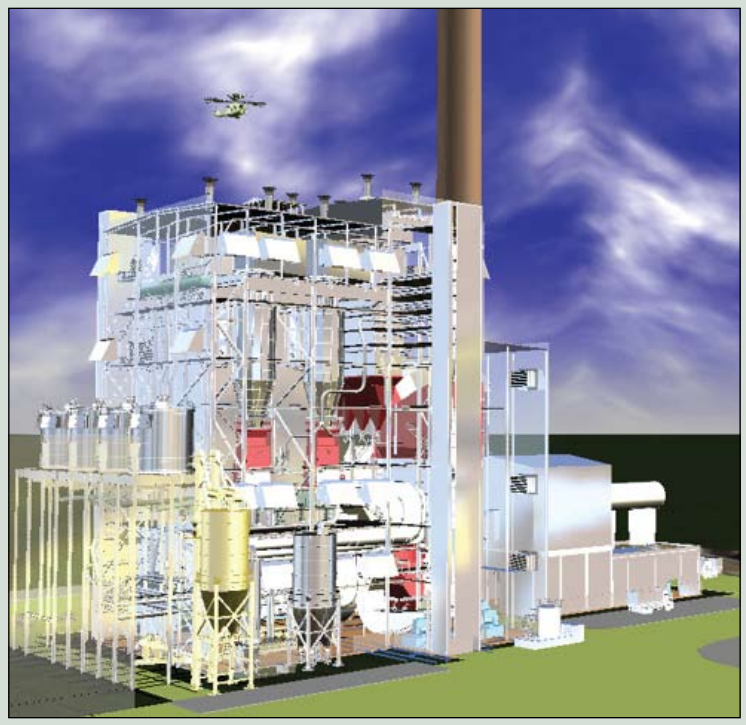
Following the contract award for the boiler in August 2016 boiler steelwork erection is about to start, with commercial operation planned for January 2020. At this time, the plant will not only be the biggest biomass-only power plant ever built but also the most efficient.

Commenting on the project drivers, Robert Giglio, Senior Vice President, Strategic Business Development of Sumitomo SHI FW said: "The UK has been doing everything it can to reduce its carbon profile; it has done a great job of moving away from coal. But the problem is, it still needs power. With nuclear being slow to build, the emphasis has been on gas and renewables. But while gas is good for base load and can support intermittent renewables, it is a fossil fuel. Biomass, however, is considered carbon neutral and unlike wind and solar, it's dispatchable."

The power output of the boiler at the plant is the latest step in demonstrating what is possible in terms of building large biomass units.

Of the more than 480 CFB boilers sold to date, approximately 120 are designed to burn some portion of biomass, with 54 units firing biomass as the primary fuel. Further, since 2008 Sumitomo SHI FW has commissioned over 20 CFB plants firing 100 per cent biomass (Table 1). The largest of these, and still currently the biggest biomass-only, utility-scale power plant in the world, is the 205 MWe (447 MWth) Polaniec 8 boiler in Poland owned by Engie.

Known as the 'Green Unit', it fires a mixture of 80 per cent wood chips and 20 per cent agricultural wastes sourced within a 100 km radius of the plant. The boiler island, which was supplied by Sumitomo SHI FW on a turnkey basis, has been in commercial operation since November 2012.



CAD cutaway of the 299 MW Tees Renewable Energy Plant biomass project. The project is being built on a brownfield site at the Teesport port facilities near Middlesborough

Polaniec 8 is currently the world's most efficient biomass-only power plant

In 2016, the Green Unit operated with a net efficiency of 36.5 per cent and produced 1.52 TWh, representing about 25 per cent of Poland's renewable energy market. Notably, Polaniec Unit 8 builds on the technology and experience base of earlier plants that burn 100 per cent biomass fuel, such as Kaukas Kaukaan Voima Oy's power plant, located UPM-Kymmene Oyj Paper Mill site in Lappeenranta, Finland (385 MWth), Kraftringen Energi AB, Örtofta, Lund, Sweden (110 MWth), and ZE PAK, S.A., Konin, Poland (154 MWth).

As the industry moves to the next size-class with Teesside, Sumitomo SHI FW says that scaling up is not really a technology challenge. Today, utility-scale 300 MWe-class units are available for 100 per cent biomass applications with subcritical steam conditions, 600 MWe-class units for fossil fuel applications with 50 per cent biomass co-firing, and up to 800 MWe for 20 per cent biomass with ultra-supercritical steam conditions.

Timo Jäntti, Senior Vice President of Technology at Sumitomo SHI FW, said: "From a technical point of view, we do not see any scale-up limitation. We have 100 CFBs burning different types of biomass and projects burning this type of fuel. So we know the design criteria for the process and how to dimension the boiler for this type of fuel. Also, at 299 MW the boiler dimensions are big but we have built boilers at a similar scale, such as Lagisza in Poland. So we know the issues with regard to scale. It's very much a proven design that we are utilising."

According to Sumitomo SHI FW, it is already possible to achieve biomass-only CFB boilers capable of producing 500-600 MW. The more difficult challenge, it says, is fuel sourcing. "We can do the sizes," said Giglio, "but the fuel supply is what becomes the limiting factor."

To gather the amount of biomass needed at Teesside, MGT Teesside will have to source fuel from both domestic and international sources. "They will also have to procure biomass pellets from the US and Canada," said Giglio.

The fuel for the plant will be 70-100 per cent wood pellets sourced from sustainable forest by-products in North America delivered to the port at Teesport. The remainder of the biomass fuel will be in the form of sustainable wood chips delivered overland, primarily from the UK. Fuel will meet a sustainability threshold in terms of sustainable timber harvesting and CO_2 footprint based on fuel supplier guarantees.

Biomass properties vary considerably depending on their biological origin, location, seasonality, farming and harvesting practices, and ultimately their preparation and processing. This leads to broad variations in chemical composition and physical properties across different biomass types and even within the same type. Design fuel data for both 100 per cent wood pellets and a mixture of pellets and chips is shown in Table 2.

In addition to providing nearly CO_2-neutral energy by using renewable

Table 1. Sumitomo SHI FW has commissioned over 20 CFB plants firing biomass alone

Start-up year	Sumitomo SHI FW	Country	MWe
2020	Teesside Ltd.	UK	299
2016	Spectrum Coal & Power Ltd.	India	50
2016	United Renewable Energy	Japan	20
2016	Emami Cement Ltd.	India	30
2016	Monbetsu Biomass	Japan	45
2016	Summit Energy	Japan	75
2015	Kirisima mokushitsu Hatsuden	Japan	5
2015	Miyazaki shinrin Hatsudensyo	Japan	5
2015	Oji Engineering Green Energy Hokuriku	Japan	5
2015	Oji Green Energy Ebetsu	Japan	25
2015	Green Biomass Factory	Japan	6
2015	GS E&C	South Korea	105
2015	Oji Green Energy Nchinan	Japan	25
2014	Kraftringen Energi AB	Sweden	35
2013	Green Energy	Japan	6
2015	Nihon Kaisui	Japan	19
2012	GDF Suez Energia Polska	Poland	205
2012	Asahi Kasei Chemicals	Japan	186
2012	PAK, S.A.	Poland	55
2010	Prokon Nord	Belgium	26
2010	Kawasaki Biomass Power	Japan	33
2010	Kaukaan Voima Oy	Finland	125
2009	Söderenergi	Sweden	85
2008	NV Huisvuilcentrale Noord-Holland (HVC-NH)	Netherlands	28
2008	Nippon Paper Industries	Japan	41

fuels, Teesside will fulfil the most stringent emission limits set for traditional (35 mg/m³n SO_2, 140 mg/m³n NOx, 50 mg/m³n CO, and 5 mg/m³n dust) air emissions.

The use of wood pellets is not only important in terms of emissions but also with regard to the physical dimension of the boiler. Although Teesside will be the largest of its kind in terms of power output, it will be smaller than the latest CFB units firing fossil fuels.

Giglio explained: "The sizing of the unit depends on the fuel. Biomass typically contains a lot of moisture, which turns into gas. So the furnace has to be big enough to accommodate that gas. You therefore end up with a big furnace, without making a lot of steam.

"In the case of Teesside, however, we have dry pellets. Pellets are a very compact way of transferring the most energy in biomass. Because you take the air and moisture out of the cargo, you're shipping more BTUs. Pellets give you that concentrated form of energy from the biomass. That's why when you go to this size, you need to use pellets for a large, secure supply of fuel."

The dry, high-quality fuel essentially gives Teesside a 50 per cent increase in plant rating. Its use also makes fuel transport and handling easier. On arrival at the plant, the fuel will be unloaded using a ship unloader rated at 1600 tonnes/hr. Conveyors then move the fuel to 16 circular silos. Each silo measures 27 m in diameter and is 30 m high, providing a total storage capacity of 260 000 m³. The silos will include a sloped bottom to accommodate the vibrating floor, necessary for the correct reclaiming of the fuel from the silos.

The plant can be fed from any silo, which allows separation of different cargoes along with fuel blending. The fuel delivery system is designed to supply wood pellets and chips to the boiler at a rate of 660 tonnes/h and the plant will burn more than one million tonnes of biomass fuel each year. When completed, the fuel unloading and handling system will be one of the largest in the world for a biomass power plant.

3-D aerial view: Teesside is built around a Sumitomo SHI FW CFB boiler and a single steam turbine, along with a fuel storage area and conveyor system, a wood chip drier, and air-cooled condenser

The low-sulphur wood pellets contain little moisture (5 per cent), ash (1 per cent), and sulphur (0.02 per cent) and therefore produce low emissions. The emission limits set for this project are in line with the new IED and LCD BREF emission limits covering multiple pollutants. The controlled pollutants include sulphur dioxide/trioxide (SOx), nitrogen oxides (NOx), dust, carbon monoxide (CO), ammonia (NH_3) slip, mercury (Hg), hydrogen chloride (HCl) and hydrogen fluoride (HF).

The pellets also have an excellent fuel heating value of 17.8 MJ/kg. When the wood pellets are mixed with 30 per cent domestic wood chips with 18.5 per cent moisture content, the fuel heating value is reduced to 14.95 MJ/kg. The mixing ratio is highly variable and the boiler is capable of burning up to 100 per cent pellets at full load.

Steam conditions in the Teesside boiler reflect recent technology advances that will also produce increased efficiency. For example, Polaniec Unit 8 produces steam at 127.2/20 bar[a] at 535°C/535°C (superheat/reheat). Although higher steam parameters have been applied to some extent in smaller industrial boilers, it has become more important in large utility size boilers firing biomass aiming for maximum steam cycle efficiency.

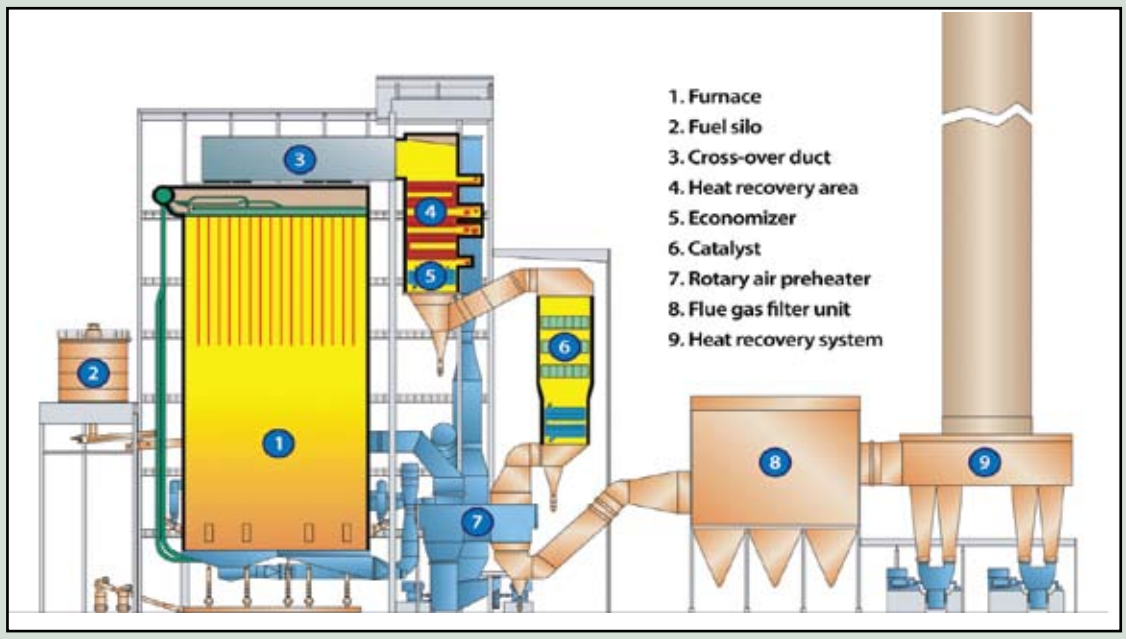
The Teesside boiler SH/RH (superheat/reheat) steam conditions will therefore be 229/205 kg/s, at a pressure of 176/43.8 bar[a] and temperature of 568/568°C. The clean fuel selected allows these high steam pressures, which is about the maximum applicable in natural circulation boilers. These higher steam conditions will ensure plant efficiency exceeds the 36.5 per cent achieved at Polaniec 8.

The steam cycle design also includes provisions to deliver low-pressure steam to a wood chip dryer, on the order of 6 MWth, to reduce the moisture content of the incoming wood chips.

According to Sumitomo SHI FW, the Teesside boiler will be its most advanced biomass CFB to date. "It is the first time that steam parameters will be at such a level for a biomass-only plant," noted Jäntti. "The boiler utilises the highest steam parameters, which contributes to the highest efficiency. It will also utilise advanced flue gas heat recovery systems to reduce the flue gas temperature before it goes to the stack. It will be the most efficient biomass fired plant when it begins commercial operation."

Sumitomo SHI FW says that with

A 3-D view of the boiler island



A cross-sectional view of Teesside

sufficiently clean biomass and a state-of-the-art design, high availability and acceptable lifetimes of boiler pressure parts can be maintained at the advanced steam pressures and temperatures.

CFB boilers operating on 100 per cent biomass have typically used steam conditions of approximately 540°C and up to about 140 bar[a]. Steam conditions have been limited by commonly identified corrosion issues in the combustion of biomass and waste derived fuels, attributed to ash forming elements such as halogens (notably chlorine), alkali metals (mainly sodium and potassium), phosphorous and heavy metals (e.g. lead, zinc).

Sumitomo SHI FW's ABC technology has specific features which control ash agglomeration, fouling, and corrosion.

From the top of the furnace, flue gas flows into steam-cooled high efficiency solids separators. Separated solids are conveyed to the return leg and discharged into INTREX heat exchangers, which contain high conduction heat transfer coils submerged in the bubbling hot solids. The INTREX units serve as the final main steam superheaters and extraction steam reheaters and, as the coils are submerged, they are protected from corrosive elements in the flue gas.

The ABC technology not only addresses the fuel issues related to biomass firing, but also considers plant requirements such as operational load range and steam data, as well as investment factors such as plant availability.

The Teesside steam plant is designed to operate in a sliding pressure mode in order to maximize efficiency over its load range and to allow the unit to respond to rapid load changes when operating at base load conditions. The plant is designed to fulfil the frequency response required by the United Kingdom's national grid.

Primary frequency control is 5 per cent load change within 30 seconds. Secondary frequency control requires 3-5 per cent of maximum continuous rating near minimum and near maximum load between 30 seconds and 15 minutes. Also, the plant must respond to a 10 per cent load change in 10 seconds and maintain that load for 30-60 seconds.

For short-term transients, sufficient steam pressure is maintained upstream of the steam turbine control valves in order to effectively respond to grid frequency dips. For long-term transients, the CFB firing rate changes in order to respond to a grid transient. Also, the Teesside CFB can use overfiring to achieve a 10 per cent step change in load in 10 seconds.

Teesside's operational and fuel flexibility, as well as its size, create more opportunities for plant developers and utilities looking to produce green, more sustainable energy. But while it is possible to build boilers of higher output than Teesside, Sumitomo SHI FW believes the real opportunities still lie in the smaller units. The economics of large biomass projects mean that, currently, they still require subsidies. And as governments seek to balance budgets against high-cost environmental solutions, financial support for larger projects will reduce.

Giglio said: "There are other environmental solutions that you could select, like wind and solar with gas as a backup. So we don't see a lot of strong support for the large units. There is also the logistical issue of getting the fuel, so most of the market will continue to be in the smaller to medium 50-100 MW range. A lot of countries can source the biomass locally in this range."

He also noted that avoiding imports means governments are less dependent on other countries for their energy needs. In addition, using locally supplied fuels in CFBs presents the opportunity for the development of community-type schemes.

"A community can get together with a developer and source fuel from waste and biomass, or even locally available coal which can be blended in. What's good about this model is that they can source the fuel locally as long as they have a flexible technology that can adjust its fuel appetite; and a CFB does that. That same plant can then provide the community with heat and power and even steam for industrial plants. We see this model becoming more viable on a small scale," said Giglio.

In the medium-scale 100 MW range, Sumitomo SHI FW sees projects that still work like the Teesside project, i.e. they have to import some fuel but most of the fuel is sourced locally. In this case, to increase the scale of the plant for better economics, a developer would typically over-size the plant so it can use the domestic fuel first and then import the remainder.

South Korea is a good example of this, where Sumitomo SHI FW executed an interesting project called the Dangjin 1 Biomass Power Plant. When it began operation just over two years ago the 105 MW plant, owned by private utility GS EPS, became the largest renewables power plant in the country.

Giglio said: "It was originally designed for coal with some wood pellets and palm kernel shells but the government has now said that no coal can be burned in the plant. The coal has therefore been replaced with locally produced recycled wood chips. Although we had to modify the boiler at Dangjin 1, due to an increase in debris in the waste fuel, generally speaking the technology allows you to do that."

In situations where fuel flexibility is key and greening the power sector is crucial, CFB technology has an important role to play and the start-up of Teesside will go a long way to demonstrating what is possible.

Table 2. Design fuel data for both 100 per cent wood pellets and a mixture of pellets and chips

Fuel component	100 per cent wood pellets	Mixture __ per cent pellets, __ per cent chips
Sulphur	0.02 per cent	0.03 per cent
Nitrogen	0.05 – 0.6 per cent	0.16 per cent
Moisture	5.0 per cent	18.5 per cent
Ash	1.0 per cent	1.0 per cent
Heating value (LHV)	17.8 MJ/kg	14.95 MJ/kg

Dangjin 1 Biomass Power Plant: South Korea's largest renewable energy project

A New Global Leader in Sustainable Energy Solutions

Our advanced biomass CFB will cleanly and efficiently produce 299 MWe of power from carbon neutral biomass at MGT's Renewable Energy Plant in Teesside, UK.

We are excited about our new company, **Sumitomo SHI FW**, as it allows us to dedicate our talent and quality of service on our fluidized bed technologies, which we see as the future for converting biomass and waste into clean and sustainable energy.

Key attributes of the new company are:

- Largest and most experienced team of fluidized bed experts
- Largest global delivery network for fluidized bed technology
- OEM of nearly 50% of the operating CFBs in our served markets
- Largest global network of fluidized bed R&D resources and capability

Please visit our new website at shi-fw.com and come see us at trade shows to learn more about our exciting new company.

Sumitomo SHI FW

- Waste-to-energy

Oil majors keep faith in CCS

Several oil and gas majors are joining forces to build a carbon capture and storage project in Norway. The move demonstrates an increasing desire to invest in technologies aimed at cutting carbon emissions. **Siân Crampsie**

Shell and Total are joining Norwegian firm Statoil to develop a carbon storage site on the Norwegian continental shelf in a move that reflects the companies' desire to put carbon capture and storage at the forefront of their strategies.

The three companies have signed an agreement to become equal partners in the first phase of a Norwegian government-backed project to build a full-scale carbon capture and storage project.

Gassnova awarded Statoil the contract for the first phase in June 2017. The first phase of the project could reach a capacity of around 1.5 million tons of CO_2 per year.

"Statoil believes that without carbon capture and storage, it is not realistic to meet the global climate target as defined in the Paris Agreement," said Irene Rummelhoff, Statoil's Executive Vice President for New Energy Solutions. "A massive scale up of the number of CCS projects are needed and collaboration and sharing of knowledge are essential to accelerating the development."

Total's President of Gas, Renewables & Power, Philippe Sauquet, said that the aim of the project was "to develop viable, reproducible commercial CCUS model in view of carrying out other major projects around the world".

The storage project will store CO_2 captured from onshore industrial facilities in eastern Norway. The CO_2 will be transported by ship from the capture facilities to an onshore receiving terminal on the west coast of Norway. At the receiving terminal CO_2 will be transferred from the ship to intermediate storage tanks, prior to being sent through a pipeline on the seabed to injection wells east of the Troll field on the continental shelf.

There are three possible locations for the receiving terminal, Statoil said, with the final selection likely to be made later this year. The project will help to stimulate investment in the wider carbon capture and storage industry, it added.

Oil majors have been increasingly investing in technologies aimed at cutting carbon emissions – a trend that has seen many of them entering the renewable energy arena. In October Statoil announced plans to invest in a 162 MW solar farm in Brazil – its first investment in the solar energy sector. The company signed an agreement to buy a 40 per cent stake in the Apodi solar farm from Scatec Solar for $25 million. It will also own a 50 per cent stake in the project execution company and has agreed an exclusive cooperation deal on the joint development of future solar projects in Brazil.

Dong name change reflects clean energy transformation

Dong Energy's imminent name change to Ørsted marks a new chapter in the company's transformation from an oil and gas business to one focused on clean energy.

The Danish energy company, which has its roots in the oil and gas business, has called for an extraordinary general meeting to approve the move and aims to start trading as Ørsted at the beginning of November.

"Dong was originally short for Danish Oil and Natural Gas. With our profound strategic transformation and the divestment of our upstream oil and gas business, this is no longer who we are," said Thomas Thune Andersen, Chairman of the Board of Directors. "Therefore, it is now the right time to change our name."

The new name references the innovative Danish scientist Hans Christian Ørsted (1777-1851), who pioneered several scientific discoveries, Dong said. The company has become a leading developer of offshore wind energy in Europe as well as emerging markets in North America and Asia, and has a vision of "a world that runs entirely on green energy".

"Our new name recognises H.C. Ørsted's curiosity, dedication and interest in nature and our brand identity speaks to the innovation and profound understanding of nature, which is vital to create a world that runs entirely on green energy," said Henrik Poulsen, CEO of Dong Energy.

Dong said it would continue to trade in natural gas as it is a fuel that will help the transition to renewables.

■ Dong Energy has announced that Goldman Sachs Group Inc is selling all of its remaining 2.7 per cent stake in the company. Luxembourg company New Energy Investment Sarl (NEI), which is controlled indirectly by Goldman's merchant banking division, has offered its 11.44 million existing shares in Dong Energy to institutional investors. NEI was Dong Energy's second largest shareholder after the Danish company's initial public offering last year. At the time, NEI held an interest of 14.7 per cent in Dong Energy.

ABB moves to strengthen electrification business

■ ABB puts share buyback on hold
■ GE deal boosts ABB electrification business

Siân Crampsie

ABB says that its planned acquisition of GE Industrial Solutions will strengthen its global position in the electrification market and improve its access to the North American market.

The Swiss engineering firm has made an offer of $2.6 billion for the underperforming GE unit, which it plans to bring back "to peer performance" over time.

GE Industrial Solutions will be integrated into ABB's Electrification Products business. ABB will retain the Industrial Solutions management team and will also be able to continue to use the GE brand.

ABB is expecting to spend $400 million investing in the new business and on restructuring costs, and will generate $200 million in annual cost synergies after five years, it said. ABB has put a previously announced share buyback programme on hold.

"With GE Industrial Solutions, we strengthen our number 2 position in electrification globally and expand our access to the attractive North American market," said ABB CEO Ulrich Spiesshofer. "Combined with the long-term strategic supply relationship with GE, this transaction creates significant value for our shareholders."

In 2016, GE Industrial Solutions had revenues of approximately $2.7 billion, with an operational EBITDA margin of approximately 8 per cent and an operational EBITA margin of approximately 6 per cent. This is less than half the 15 per cent operating margin at ABB's comparable Electrification Products division.

GE has been under pressure to improve the performance of its business and the sale of Industrial Solutions is part of a strategy announced in 2016 by former CEO Jeff Immelt to adjust its portfolio.

"This combination brings together two global businesses with a broad complement of electrical protection and distribution assets," said John Flannery, CEO of GE. "ABB values our people, domain expertise, and our ability to operate in the segments where we have depth and experience. GE will also benefit through an expanded strategic supply relationship with ABB as the two companies work together."

Americas

Greensmith and AEP launch hybrid storage

Greensmith Energy and American Electric Power (AEP) have agreed to install a 4 MW energy storage system integrated with the Buck and Byllesby hydroelectric power plants in southwest Virginia, USA.

The system will start operating in early 2018 and will harness Greensmith's GEMS software platform that offers multiple storage applications. The project will serve both of PJM's frequency regulation markets, including traditional regulation known as RegA and dynamic regulation known as RegD.

The integration of advanced energy storage and software with hydroelectric generation is seen to be a world's first hybridized system of its kind to provide ancillary services.

"Although we've delivered six grid-scale energy storage systems to the PJM market, this innovative hybrid project will see AEP raise the standard for hydroelectric use-cases globally," said Greensmith CEO John Jung. "And the potential for hybridization is massive as hydroelectricity represents over 1000 GW of generation globally, roughly a sixth of the world's total."

Dominion orders SVC Statcom unit

Siemens is providing Dominion Energy, a subsidiary of one of the largest producers and transporters of energy in the US, with the company's first mobile SVC Statcom unit.

The Statcom solution will keep the grid stable during disturbances and faults by providing fast and controlled reactive power. A mobile solution will also give Dominion an unprecedented level of flexibility to move the device anywhere grid support is needed, especially in cases of unexpected outages from extreme weather or unplanned events.

Siemens will deliver the first mobile Statcom device in mid-2018.

Wärtsilä signs Caimancito O&M deal

Wärtsilä has signed a ten-year operation advisory and maintenance (OA&M) agreement with Sullair Argentina S.A. for the company's Caimancito power plant.

The tailored OA&M solution is built around risk management, predictive maintenance tools and planning, and will help to enhance the plant's reliability and availability, Wärtsilä said.

Under the agreement, Wärtsilä experts will provide advice and recommendations on site based on real-time operational data, optimising the installation's efficiency on a continuous basis. The ten-year agreement also includes scheduled and unscheduled maintenance, spare parts and comprehensive logistics support.

The 92 MW Caimancito plant, located in the Jujuy province in northwest Argentina, is powered by five Wärtsilä 50SG-A gas engines. It started operating in June 2017.

EDF RE to supply 120 MW of wind energy

EDF Renewable Energy has signed an agreement to supply Kimberly-Clark Corporation with 120 MW of wind energy from the 154 MW Rock Falls Wind Project in Oklahoma, USA.

The Virtual Power Purchase Agreement (VPPA) is Kimberly-Clark's first use of utility-scale renewable energy and will help the firm to surpass its 2022 commitment to reduce greenhouse gas emissions by 20 per cent four years ahead of schedule.

Commercial operation of Rock Falls is scheduled to start in December 2017.

Allied Power seals nuclear maintenance contract

Allied Power has received a five-year contract to provide maintenance and modification services for 14 Exelon Corporation nuclear plant sites in five US states and fleet wide staff augmentation services.

The agreement is for a five-year initial term with the potential for a five-year extension. Allied says that its services are designed to support Exelon's aim for safe, event-free outage and operational performance at its sites located in Illinois, Maryland, New York, New Jersey and Pennsylvania.

Celpa planning Brazilian microgrids

Brazilian utility Centrais Elétricas do Pará (CELPA) has placed an order with Siemens for the design and supply of 12 microgrids in the state of Pará.

Siemens will deliver and install the automation, protection and control technology in power generation plants. A central control centre in Belém will be able to monitor and control these self-contained island networks, which will improve the analysis of plant data and thus increase the availability and reliability of the plants.

The 12 plants are powered with diesel generators and are geographically distributed across Pará state. They have a combined power output of 80 MW.

Asia-Pacific

UGL to build stage 1 of Bannerton solar park

UGL, a subsidiary of CIMIC Group, has bagged an A$133 million ($104.4 million) contract to design and build stage one of the Bannerton 110 MW solar park near Robinvale in Victoria, Australia.

Under the terms of the contract, awarded by Foresight Solar Australia, UGL will be responsible for the engineering, procurement and construction of stage one of the solar park, including associated substation and Powercor Australia grid connection.

The contract, which is due to start in late 2017, is scheduled to be generating power to the grid from July 2018. Once operational, UGL will provide operation and maintenance services for a period of two years.

ABB to optimise QPPL coal fired plant

Swiss firm ABB has secured the contract to optimise the operations of Quezon Power (Philippines) Ltd. Co.'s (QPPL) 460 MW coal-fired plant in Mauban, Quezon.

The contract involves the supply of a high-fidelity operator training simulator to upgrade the skills of the Quezon power plant operators.

The simulator will offer a virtual re-creation of the actual Quezon plant, including non-standard scenarios and faults, allowing both newly recruited staff and current operators to become more familiar with their working environment and learn how to react in challenging situations.

The scope of work for this project runs from design and engineering to installation, commissioning and training.

Europe

Nordex scoops County Tyrone contract

NTR plc, a Dublin, Ireland based investor and asset owner in sustainable infrastructure, has placed an order with Nordex for the supply of wind turbines for the Castlecraig project in Northern Ireland.

The project will comprise ten N100 turbines with tip heights of 125 m. They are specially designed for the strong wind conditions prevailing at the site in County Tyrone, Nordex said.

The turbines will start operating in the summer of 2018.

ABB to supply Hinkley transmission equipment

ABB has won an order of around $130 million (£99 million) to build the power transmission infrastructure for EDF Energy's new Hinkley Point C power plant in the UK.

ABB's Power Grids team in the UK will be responsible for the design, supply and installation of the power transmission infrastructure, including substations for two separate units that will feed 3200 MW of power produced by Hinkley Point C to the national grid.

As part of the contract, ABB will supply six 700 MVA generator transformers, six auxiliary transformers, 400 kV gas insulated switchgear, control and MicroScada systems as well as the transmission feeds to transfer power from the plant.

Hinkley Point C is due to start operating in 2025.

Dong to support wind with flexible gas plants

Dong Energy has entered into an innovative agreement with Gas Power Developments (GPD) and GAM Capital (GAMCap), to develop and operate three 6 MW flexible gas peaking plants.

The power plants – Prestige House, Newhouse and Clay Flatts, located in Lancashire and Cumbria in the northwest of the UK – will be operated alongside one of the world's largest wind portfolios owned and managed by Dong Energy.

Dong Energy will optimise the operation of the flexible gas fired plants based on changes in electricity demand and production. The control and market optimisation of the three plants will be handled from Dong Energy's 24/7 trading desk in Denmark.

Chris Isard, Operations Director at GAMCap and GPD, said: "We're delighted to be entering into a long-term agreement with DONG Energy on the first phase of building and operating a portfolio of flexible peaking plants.

Earthquake-proof backup for Greece

Alcad has won a competitive tender to provide anti-seismic backup batteries for the Megalopolis B power station in Greece, owned by the Public Power Corporation of Greece (PPC).

The new nickel battery system provides more than eight hours backup time for mission critical equipment at the 300 MW plant, including switchgear, oil pumps and lighting. The battery ensures the safe shutdown of the different installations and controlled switching to backup power generation.

Alcad's new system comprises a total of 680 cells in two identical arrays of MB765P batteries and has replaced an existing battery installed 27 years ago.

International

Siemens is preferred supplier for Triton Knoll

Siemens Transmission and Distribution Ltd has been selected as the preferred supplier to deliver the onshore and offshore substations for the 860 MW Triton Knoll offshore wind farm in the UK. Under the prospective contract, Siemens will build two offshore substation platforms and the onshore substation. It will also design and deliver a 400 kV connection into a National Grid substation.

Triton Knoll will be built off the east coast of England by a joint venture between Statkraft and Innogy. A financial investment decision is expected in 2018, with full onshore construction to begin soon after that.

Ansaldo in flaring deal

Ansaldo Energia has signed a memorandum of understanding (MoU) with subsidiaries of Iranian state oil firm NIOC on the use of flared natural gas for power generation.

The Italian firm wants to collect natural gas that is currently being flared off from the South Pars gas field Phase 12 for conversion to electricity. The MoU was signed in Tehran by Giuseppe Zampini, President of Ansaldo Energia, Bijan Alipour, Managing Director of the National Iranian South Oil Co., and Ali Vakili, Iran Fuel Conservation Co.

The MoU calls for the installation of a 600 MW power plant in a first phase. A second phase would convert the turbines to combined cycle operation, adding 100 MW to the plant.

Angola orders three new power projects

Wärtsilä has signed a framework supply contract to supply the generating equipment for three new power plant projects in Angola.

The power plants are being developed by Dongfang Electric International Corporation on a fast track basis to meet Angola's pressing need for more electrical capacity.

The three new baseload plants will be located in Luena, Benguela and Saurimo, and will each have an electrical output of about 23 MW.

The plants are expected to be operational in the third quarter of 2018, and Wärtsilä is scheduled to begin the delivery of the generating sets in the first quarter of 2018.

GE bags $141 million Riyadh service contract

GE Power has signed a multi-year service agreement with Saudi Electricity Company (SEC) to provide maintenance, parts and repairs services for eight GE 7F.05 gas turbines at Riyadh Power Plant 12 (PP12).

GE supplied the highly efficient 7F.05 gas turbines under a previous contract with SEC, with four units entering commercial operations in 2014, followed by the rest a year later.

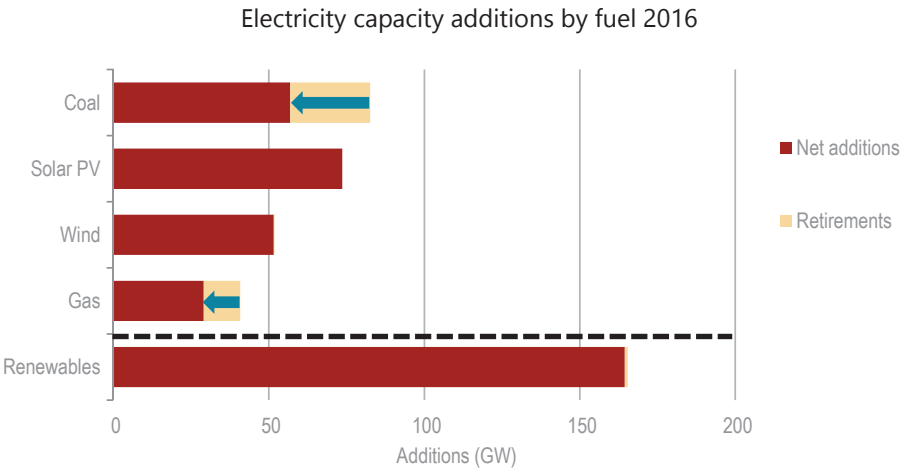
Under the new service agreement, GE's team will provide support onsite and equipment at PP12 will also be monitored by the Saudi PowerGen Efficiency Center (SPEC), located in the GE Manufacturing & Technology Center (GEMTEC) in Dammam.

Saudi Arabia invites solar bids

Saudi Arabia has opened the bidding for a 300 MW solar power plant.

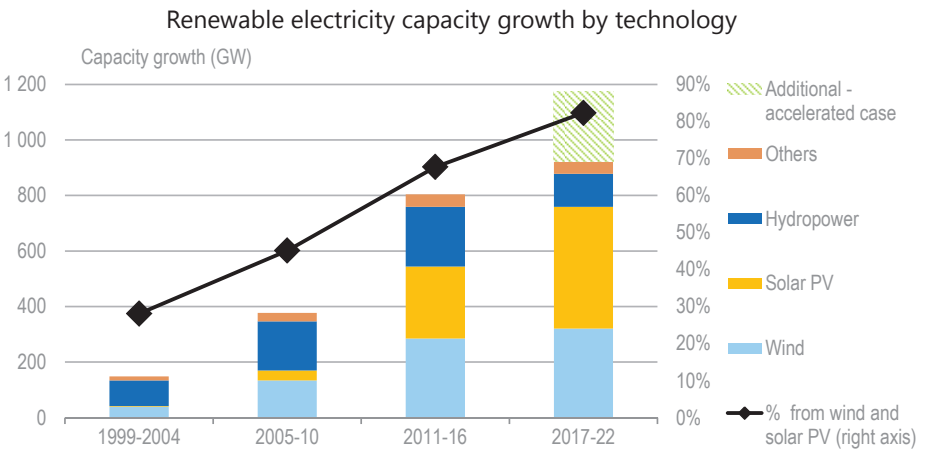
The Sakaka solar energy project will be located in Saudi Arabia's northern Al-Jouf region and is an important step for the country's National Renewable Energy Programme. Bidders for the project will be shortlisted at the end of November.

2016 – Renewables hitting new records driven by solar PV



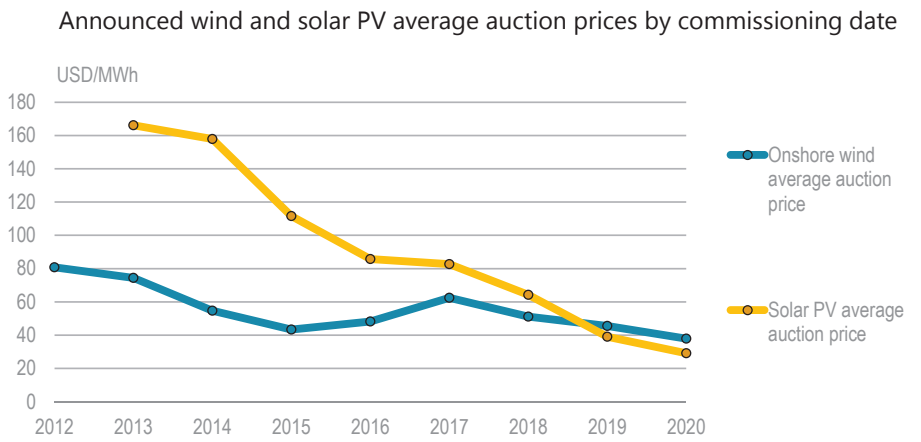
For the first time a single renewable fuel became the largest source of net capacity growth, while all renewables provided an all-time record two thirds of global net capacity additions

Renewables growth more and more dependent on wind and solar



Solar PV enters a new era, becoming the undisputed leader in renewable power capacity growth
PV also accounts for 60% of the upside potential in the accelerated case

Competition driving costs down



Price discovery through competitive auctions effectively reduces costs along the entire value chain
Forthcoming expansion of auctions to more countries will accelerate cost reduction trends

For more information, please contact:

International Energy Agency
9, rue de la Fédération
75739 Paris Cedex 15
France.

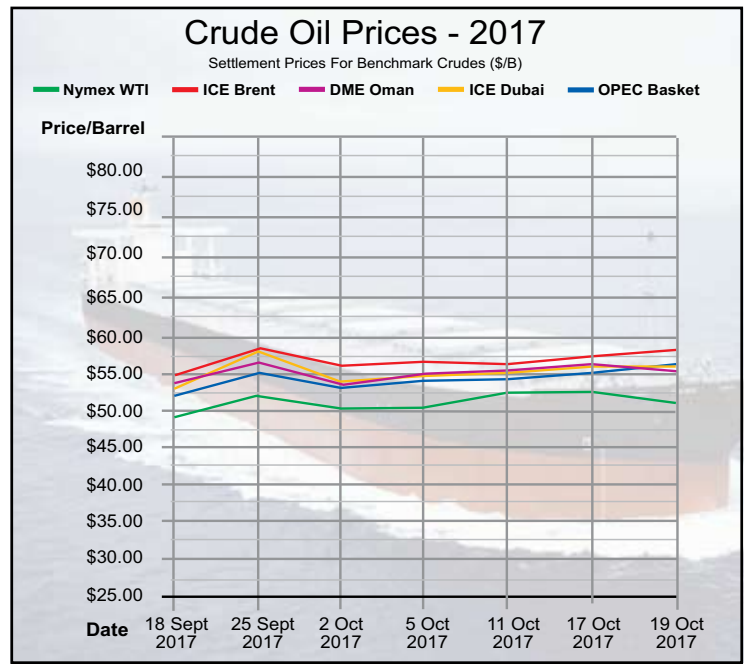
Email: bookshop@iea.org
website: www.iea.org

Source: Media launch slides from Renewables 2017 Market Report © 2017 OECD/IEA

Oil

Oil price improves but Opec plans another year of cuts

- Estimated 171 million barrels of surplus crude in storage
- Russia and Saudi Arabia aim for $60/b oil price



David Gregory

The oil market is firming up but there remains some distance to go before the balance that oil producers have long been looking for arrives. Since mid-September the price of Brent crude has held steady at $55/b or better, and West Texas Intermediate was near $50/b or above, prompting numerous promising comments about the future of the oil market.

At its next meeting in November, Opec and its non-Opec partners, particularly Russia, are expected to extend their current cuts in production to the end of 2018. Initiated in November 2016 with the intention of removing 1.8 million b/d of Opec and non-Opec oil from the market, the cutback was extended to the end of March 2018. Opec now expects it to take until the end of the third quarter next year to see the removal of the surplus crude oil that has swamped the market and weakened prices. It is estimated that there yet exists 171 million barrels of surplus crude in storage.

A number of circumstances have contributed to the upward trend in prices in recent weeks. Oil production in Libya continues to fluctuate as the country continues to struggle with militias and rival governments, while in mid-October the administration of US President Donald Trump declined to certify that Iran is in compliance with its nuclear programme deal.

Further, a referendum in Iraqi Kurdistan on independence from Iraq resulted in a reduction of exports from the Kurdistan Region Government (KRG) autonomous area through the Turkish port of Ceyhan. In the wake of the referendum, which went overwhelmingly in support of independence, the Iraqi army seized back from the Kurdish Peshmerga fighters the oil fields around Kirkuk.

Turkey's opposition to the referendum led to a threat by Ankara to halt Kurdish oil exports across Turkish territory, while the Iraqi government is taking steps to resume responsibility from the Kurds for its own oil exports through the northern route.

These developments have introduced an element of risk, lending support to the market, and there will be more. The political future of Opec-member Venezuela might be one factor to keep an eye on in the coming year, and oil demand in China will be another.

It's clear now that Saudi Arabia's move in 2014 to boost production to force expensive producers such as US shale out of the market was a mistake. US shale suffered some losses, but it also found its resilience and it's now projected to account for more than 6 million b/d of the 10 million b/d that the US will produce next year. Furthermore, US oil exports are making a growing impact in the international market and is increasingly competitive in Asia, which Saudi Arabia and Russia both see as the prime market.

Saudi Arabia's King Salman visited Moscow in early October to meet with Russian President Vladimir Putin to discuss future steps towards balancing the market. The two oil countries, leaders of Opec and non-Opec respectively, are reported to have set their sights on hitting and maintaining a target oil price of $60/b. Their cooperation is seen as a significant change from earlier times when the two had very different opinions of how the world should be.

Speaking to reporters in Sochi, Putin said there are no ideological contradictions between Moscow and Riyadh, adding that "there is nothing that would fundamentally divide us from Saudi Arabia or other countries in the Middle East region," the *Saudi Gazette* reported.

Russia's support for the regime of Bashir al-Assad in Syria has led to it pushing for closer relations with all the governments in the region, not only Saudi Arabia, but also Saudi Arabia's rival Iran, Turkey and Iraqi Kurdistan and Iraq. Shia Militias from Iran and Lebanon have also been fighting to support Assad, thus strengthening their ties to Russia. Rosneft, Russia's giant oil company also has assets in Iraqi Kurdistan and is promising to help the Kurds and Iraqi government to resolve the independence issue.

Putin said Russia agreed a position with Opec, particularly Saudi Arabia, on the energy market, after which oil price was stable at over $50/b, which he called fair and which was achieved through joint efforts. King Salman and Putin also agreed to create a $1 billion energy investment fund that would focus on gas processing and petrochemicals.

More cooperation between the two giant oil producers is expected. Both Moscow and Saudi know to keep the message positive if they want to keep prices rising and a bull market. The over supply has been dwindling, market conditions are improving – this has been the mantra and it will probably remain so for some time.

Gas

Japan investment will boost Asian LNG market

Japan's latest move to encourage growth in Asia's LNG market will see the nation provide $10 billion for government and private joint projects in the region.

Mark Goetz

Japan took steps last month to boost the Asian LNG industry with an initiative making $10 billion available for government and private joint projects throughout the region. Japan is the largest importer of LNG and in recent months has taken steps to liberalise the LNG market and eliminate destination clauses that most suppliers place in delivery contracts.

Asia already accounts for 70 per cent of sales of LNG and Japan is encouraging growth in the sector with the offer to provide funding. There are many areas throughout Asia where access to electricity is limited or communities must rely on carbon-heavy liquid fuels to provide power. Through projects created with the initiative and the decision to eliminate the destination clause, Japan will be able to redirect LNG cargoes that it does not need to other customers in the region and in the process, promote the cleaner-burning fuel.

Last month during the annual LNG Producer-Consumer Conference in Tokyo, Japan's Minister of Economy, Trade and Industry (METI), Hiroshige Seko, said the $10 billion in financing would go towards upstream, midstream and downstream projects and for the training of at least 500 people for careers in the LNG industry.

"Japan will continue to work towards developing LNG markets in Asia, seek specific actions creating LNG demand by new LNG utilisation measures such as LNG bunkering, and contribute to building international consensus on the benefits of LNG," Seko said.

And he encouraged Asian leaders to seriously consider expanding the use of a "smart energy" like natural gas. He also urged LNG producers to boost the attraction of LNG as a fuel by using more rational and flexible trading conditions.

Earlier this year Japan's Fair Trade Commission ruled to ban clauses in LNG supply contracts that prevent buyers from reselling the LNG delivered to them on the grounds that such clauses are anti-competitive. Surplus LNG delivered to Japanese companies could be resold to new markets developed through the METI initiative, which would finance the construction of new regasification terminals and power generation schemes.

Japan has traditionally signed long-term contracts with Qatar, Australia, Malaysia, Indonesia, Russia, Brunei and the UAE.

Its actions signal the changes that await the LNG industry. The market is oversupplied and customers are reluctant to sign up to long-term contracts. Traders expect to see more short-term contracts and more action in the LNG spot market.

Smaller regasification terminals are expected to be built and more floating storage and regasification units (FSRUs) will be commissioned and installed. In the meantime, more LNG will come into the market, especially from Australia, the US, Africa and Russia.

The Fair Trade Commission's ruling followed an investigation into the history of the destination clause and when announcing its ruling, the FTC called for companies to adjust their business practices. Due to the fact that Japanese LNG importers anticipate a significant increase in global LNG supply, they had expressed their concern to the commission that they would not be able to resell any excess LNG that could arrive at their ports.

Japan's second-largest importer of LNG, Tokyo Gas, last month announced that it would no longer accept long-term supply contracts that include a destination clause. The company purchases 14 million tons of LNG annually and company president Michiaki Hirose said during a briefing on the firm's mid-term business plans that Tokyo Gas has "no intention of signing new contracts unless the destinations are free."

The company is in the midst of renewing its long-term contracts, but it will increase the number of short-term contracts and spot market purchases by 30 per cent as a response to market volatility, Hirose said.

India has joined Japan in its insistence that LNG suppliers make their deals more amenable to the customer. During the Tokyo conference, Japan and India signed a joint cooperation accord expressing their desire to see a more liquid and flexible market. India is the fourth-largest market for LNG and in the coming years its imports are expected to rise significantly.

A statement issued by the Indian government said the Japan-India agreement "provides a framework to cooperate in facilitating flexibility in LNG contracts, the abolition of destination restriction clauses and also explores possibilities of cooperation in establishing reliable LNG spot price indices reflecting true LNG demand and supply."

While addressing the conference, Indian Petroleum Minister Dharmendra Pradhan remarked that the global LNG market is experiencing a major change brought about by new supplies and subsequent oversupply. He urged producers and consumers to work towards designing new flexible terms that adjust prices, give new consideration to flexible take or pay clauses, and end the destination clause. Such steps will be needed, he said, for the creation of a transparent, efficient and balance LNG market.

China continues global expansion

China looks set to become the leading electricity foreign investor globally. The trend has already started and the motivation for their power companies is high.
Joseph Jacobelli

Jacobelli: It is unlikely that companies will focus on a certain region or energy source; the approach will remain opportunistic

China's influence on the global power generation landscape continues to grow. Motivated by government policy and support, earnings diversification and financing capability, the country's electric companies' hunt for mergers and acquisitions looks set to accelerate over the next few quarters.

While there will be some M&A at home, most activity will be abroad. At home, authorities are seeking to combine some of the power related groups to make them strong, large companies. There have already been two significant government-mandated mergers. One is State Power Investment Corp. formed in 2015 by the merger of China Power Investment Corp. and State Nuclear Power Technology Corp. The other is China Energy Investment Corp., which was created in 2017 through the merger of Shenhua Group Corp., China's largest coal miner, and China Guodian Corp., one of the nation's largest power producers. More of such mergers are likely to be executed in the next few quarters.

In terms of international investments and acquisitions, a primary resolve has been to encourage Chinese electric power companies investing abroad to purchase assets, knowledge and technologies – with some enterprises actually seeking new markets to deploy their own technologies. Notable companies include the network giant State Grid Corp. of China and waste-to-energy focused China Everbright International.

Investing abroad also allows China's power companies to diversify earnings in the face of a harsh sector backdrop at home, which is creating challenges to earnings that are unlikely to dissipate for at least the next four years.

New electricity supply in China rose 60 per cent faster than the rate of consumption in 2016, continuing the 2015 trend. Although demand rebounded in 2017, supply is still rising faster. The imbalance has created a massive glut that will take several years to absorb.

The oversupply situation has had a deep financial impact on the largest power generation groups, which have asset portfolios chiefly made up of coal fired power plants that have been facing historically low utilisation rates. At the same time high domestic thermal coal costs are also cutting their margins. Apart from low utilisation rates and high social costs, the average realised electricity unit-sale prices from coal plants are also weaker. This is partly due to additional lower-priced power sold directly as a percentage of the total as the nation progressively liberalises its power market.

Year to 31/12/16	Datang	Guodian	Huadian	Huaneng	SPIC
Sales (Billion, Yuan)	n.a.	183.6	189.3	243.9	195.9
Year-on-year (%)	n.a.	n.a.	-4.0	9.1	1.8
Profit (Billion, Yuan)	10.75	13.10	13.12	13.57	13.21
Net margin (%)	n.a.	7.1	6.9	5.6	6.7
Output (TWh)	470.0	505.2	491.9	621.6	369.9
Capacity (GW)	130.2	142.6	142.8	165.5	116.6
Low carbon (%)	31.9	30.3	37.0	29.0	42.9
Coal/kWh (grams)	306.9	304.6	303.1	302.3	304.9
Year-on-year (%)	-0.8	-0.6	-1.1	-1.1	-0.8

Source: China Electric Power News Network, February 20, 2017

China's leading electric power groups

The tough domestic market has resulted in poorer financial results for all of the key nationwide power generation groups. Looking at the listed companies that offer some financial transparency, broadly speaking, the return on equity (ROE) has been declining in the past few quarters. This decline is an incentive for these companies to seek returns abroad through acquisitions and greenfield projects.

The companies' median ROE had previously outpaced that of other Asian peers, partly thanks to tariff hikes. They have fallen since 2015 due to lower unit-sales prices and higher unit-fuel costs and should falter more in the next few quarters.

The third factor facilitating an acceleration of M&A by Chinese companies is their strong financing capabilities. On the debt front, despite poor bottom line earnings in the past few quarters, the median net-debt-to-equity level of listed Chinese electric power companies has dropped from its 256 per cent high, recorded in 2H11, and still provides them with significant financial muscle for M&A.

The higher cash flows were caused by low coal prices while cuts in power tariffs, which reflected the low fuel price, were delayed. The ratio edged higher in 1H after a sharp rise in coal costs and a lag to tariff changes but it should start declining again from 2018 following a mild income recovery.

The financing of projects is crucial and China's financial institutions, including the largest state banks and policy lenders, have been keen to support Huaneng Power, Longyuan and other developers. Policy support includes, but is not limited to, the Belt and Road initiative. State-funded or state-owned policy banks include the Export-Import Bank of China and the China Development Bank.

While there are numerous examples of power groups investing overseas, there is no clear trend in terms of the sources of energy or regions the Chinese are probably interested in. They have chiefly been opportunistic.

If we were to take the nation's nuclear developers as an example, the primary aim is to export home-grown technology and experience. They are likely to be attracted by any geography that is open to having Chinese investment in their nuclear industry – something not many nations are open to.

Bloomberg Intelligence channel checks indicate that all of the major groups are looking at opportunities abroad and many are conducting in-depth feasibility studies. They have so far invested anywhere from Brazil (Three Gorges) to Greece (State Grid) to South Africa (Longyuan), encompassing all forms of energy sources. Also they have not been shy to invest jointly with other groups. For example JinkoSolar joined Japan's Marubeni to build a solar power plant in the United Arab Emirates.

Australia has been a key focus for Chinese energy groups and this will continue in the coming years as M&A activity by Chinese power companies increases. Australian energy markets remain open, the country has low sovereign risk and Chinese companies have accumulated relevant knowledge. Australia has been the source of 21 deals based on data scrutinised by Bloomberg Intelligence.

Of these, 17 are pending or completed while four were cancelled or terminated. Only the deal value of 13 of the 17 is public information. They amounted to $4.1 billion. State Grid Corp. of China is still interested in Australian transmission and distribution assets, even after its bid for a network last year was blocked. CGN and other nuclear companies focus on uranium assets. Others, including wind-operator Longyuan, have been looking for investments.

Although the interest is high, there are of course hurdles the companies have to face but most are surmountable. These include understanding country risk, the volatility of some geo-political relations and currency fluctuations. Chinese companies have gained much experience in the past decade and now have a better understanding on how to address these. Recent examples include investments by nuclear developer CGN in Malaysia, Shanghai Electric in Pakistan and coal-giant Shenhua Energy in Indonesia.

On the currency risk front recent investments show that currency worries may be overdone as short-term fluctuations are less of a concern given the long-term nature of projects. Consensus also forecasts a stable Chinese yuan vs. the dollar.

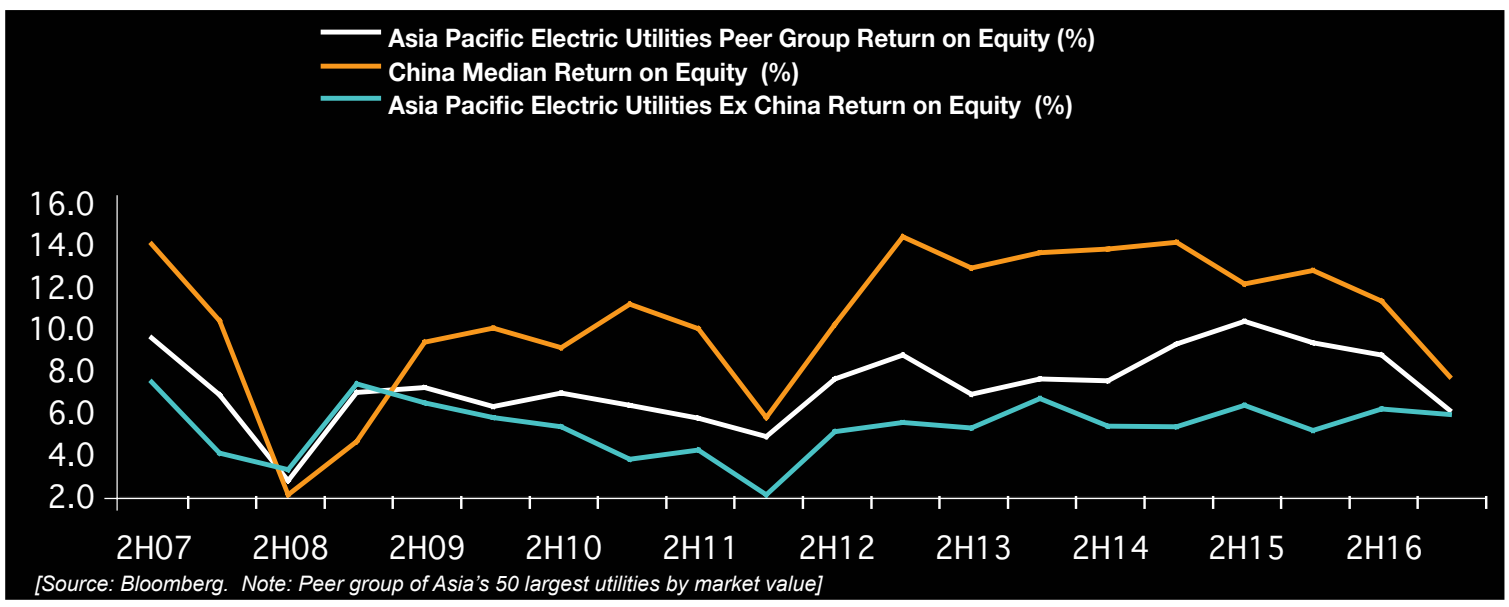
The companies have located investments that meet their hurdle rates, and have succeeded in competitive bids against experienced rivals. The rates sought for overseas investments for companies such as Huaneng and Longyuan are generally a return on equity of at least 10 per cent.

In the coming years acquisitions and investments by Chinese power groups abroad should steadily increase, although they will of course continue to compete with other foreign investors. In Asia for example Chinese companies compete with Japanese and Korean ones as these companies too are trying to diversify earnings.

Nevertheless, it is most likely that China will become the leading electricity foreign investor globally. The trend has already started and the motivation for the companies is high.

Joseph Jacobelli is Senior Analyst, Asia Utilities & Asia Content, Bloomberg Intelligence.

China power companies return on equity. The decline in return on equity in recent quarters is an incentive to seek returns abroad.



[Source: Bloomberg. Note: Peer group of Asia's 50 largest utilities by market value]

Power to the people

Demand-side management is crucial in delivering increased flexibility, grid stability and added value for end-users in a decentralised system. **John Langley-Davis**

Our relationship with energy is changing. Distributed, renewable energy sources, microgrids, flexible loads and electrical vehicles are turning today's supply and demand models on their head at the lowest level of the grid. At the same time, new technologies are giving consumers unprecedented insight into their electricity usage and the means to control it.

This approach has changed the relationship between utilities and those who pay the bills, giving consumers the power to generate, distribute and even sell their own electricity. To ensure society's need for safe, reliable and affordable energy, the power industry must adapt to this new paradigm.

Driven by the growth of distributed, low-carbon generation, the traditional top-down energy hierarchy has been disrupted like never before. Where once energy was delivered in a linear, one-way flow from power station to home, power now comes from many scattered generation resources.

For distribution network operators (DNOs), this change heralds a transition to a more complex model with multiple points and more variable supply. Faced with this challenge, they are gradually becoming distribution system operators (DSOs) with more responsibilities to balance their grids within the broader power system.

To ensure operational efficiency and system reliability, grid loads and distributed generation must be managed using more data-driven, real-time insights. This is enabling the concept of demand-side management (DSM) so that consumer's demand can be activated to compensate grid balancing.

Langley-Davis: DSM encourages consumers to better understand and manage their consumption

Effective DSM bolsters grid reliability, by shifting and flattening demand curves and redistributing consumption from peak to off-peak times through dynamic price incentives. It also addresses operational and emergency reserves, capacity, and real-time balancing to avoid blackouts or emergency load shedding. Yet, in addition to securing supply, DSM greatly enhances utility-consumer relationships by strengthening customer service, building trust and reducing churn.

DSM encourages consumers to better understand and manage their consumption and become more energy efficient. Today's advanced metering infrastructure (AMI), or smart meters, gives grid operators unprecedented insight into real-time consumption. This knowledge serves both customers and operators in managing the grid infrastructure and generating power more efficiently, maximising physical assets and reducing energy losses and costs.

In light of the impending changes to European energy regulation and the shape of the future market linked to the EU Winter Package, DSM can make a big difference, encouraging more people to become 'prosumers'. In tomorrow's more decentralised energy markets, the more active players, including aggregators and prosumers will see their roles evolve. A more competitive and cleaner energy system will emerge enabling the clean energy transition to a low carbon economy by 2050.

In fact, it's the increased intermittency in supply that has created a greater need for flexibility and responsiveness both on the supply and demand side. The market needs to price the costs involved and reflect them in the price of its energy services. City districts, campuses, hospitals, commercial buildings, factories, and residential homes all have the potential to become proactive energy consumers.

There are already three million of these prosumers in Europe, with room for many more. In this way, DSM is helping people reduce energy costs while also improving the efficiency of the entire energy framework.

In the coming years, variable and renewable generation sources like solar will require DSM systems to help maximise supply and protect grid stability. DSM will not simply ease the transition to a more distributed generation model, it will be essential to its success.

The most fundamental drawback of renewable energy is its unpredictability. Traditionally, utilities have based their energy forecasts on weather patterns and historical trends. However, the growing number of renewable energy sources means that something as small as a sudden change in weather can rapidly change energy need.

Furthermore, as renewable energy plants best operate in isolated areas, modern energy production has scattered, forcing grid extension at a time when demand has become centralised towards our growing urban centres. This, coupled with the unpredictable nature of the energy, can lead to imbalances in the grid, and even power failure. As renewable energy sources grow in popularity, the limitations of grid capacity will only increase.

To achieve greater flexibility and strengthen the foundations of renewable generation, utilities, operators and commercial aggregators are pioneering innovative flexibility programmes and technologies. As our energy mix becomes more distributed, renewable and sustainable, and as our network design and operation models change, it is clear that the global utility industry faces DSM on a massive scale. UK DNOs, for example, are taking a more active role in local balancing and are rolling out distribution automation technologies to meet growing voltage control and network monitoring requirements.

In Manchester, UK, intermittent renewable sources and growth in electricity demand is fuelling an increase in the network fault level. When a fault occurs and the fault current exceeds the maximum level of energy infrastructure on the network, it threatens to jeopardise the power supply of over five million users in the North West of England.

To prevent this, local DNO Electricity North West (ENW) is working with Schneider Electric to deliver an enhanced network management system (NMS) supported by a Fault Level Assessment Tool. The tool will utilise a real-time topological model, able to process network conditions and predictively adapt it for anticipated faults. It will then supply this information to ENW's NMS to dynamically react to changing conditions in real-time. This intelligence and connectivity-driven approach will help ENW future-proof its grid and secure its customers' power supply while also boosting the viability of renewable sources.

Often a familiar component of the growing microgrid trend in the US, battery storage is also playing a vital role in DSM. As battery technology grows cheaper, its use is becoming a viable method for reducing peak consumption levels. Battery storage also provides a valuable reservoir of backup power, which can ensure a consistent power supply when parts of the grid must be shut off or powered down during demand response.

Battery storage is also delivering exciting advances for electrical vehicles (EVs). EVs undoubtedly create complexity, with charging stations putting pressure on very localised parts of the grid. However, their increased adoption will accelerate the need to define how the management of flexible distributed resources will be shared between TSOs and DSOs. The UK is seen as a leader in the field of testing new business concepts around flexibility management, and the country's RIIO (Revenue = Incentives + Innovation + Outputs) regulatory framework is creating opportunities for innovative balancing services on distribution networks.

Digital transformation is a key enabler. As IT and operational technology (OT) systems converge through the internet of things (IoT), the energy industry is well-placed to gain from the reliability and performance these tools provide. For this reason, digital transformation will be instrumental in the fortunes of many utility companies. The reinvention of an organisation and its processes using digital technology improves performance vastly. It is a way of programming and automating processes, which is key to orchestrating energy resources at the back end. However, a successful digital transformation must be underpinned by a strong, holistic approach to cyber security.

In any connected system with increased endpoints, there are risks to be considered. To secure our energy networks, providers should look to build security into the design of both their IT and OT systems. To limit costs, this should be done through retrofit, upgrades or bolt-on approaches. Integrated cyber security strategies must also define policies around patch management, data ownership, data privacy and identity management compliance. As more and more data is created within the utilities sector, end-to-end security from the sensor to application level, is more critical than ever.

Data is the future of the distribution utility business. It's the core component of digitised mechanisms for asset management and grid operations, as well as future grid orchestration. Fine granularity and data integration between key applications, as well as full interoperability with external players in an open power ecosystem, improves efficiency, service levels and decision-making processes. Furthermore, relying on international standards in terms of data models, data integration, and data management is not only essential to enabling a sustainable evolution of IT/OT systems. It also permits distribution level technologies enabling demand-side awareness, control, and optimisation of DER (like DERMS, DG, microgrid, and VPP).

Distributed energy trends disrupt distribution utilities more than other players in today's power industry value chain. The cost and complexity of additional network reinforcement versus the automation required to manage distributed resources is a complex equation. DSM has proven its worth in delivering increased flexibility, grid stability and added value for end-users by giving power to the people.

John Langley-Davis is Product Marketing Manager at Schneider Electric.

Hydrogen rising

Excess renewable energy generated is used to produce hydrogen using two containerised electrolysers

Hydrogen is proving itself to be an important part of the future energy mix, thanks to its ability to bring together renewable generation and the need for energy storage, clean transport and smart energy systems.

Siân Crampsie

A pioneering community energy scheme in Scotland is demonstrating the ability of hydrogen to overcome the energy sector's emerging challenges.

The Levenmouth Community Energy Project combines renewable energy generation with a microgrid, hydrogen production and storage, and green transport, and is showing how the fuel can enable communities to maximise the use of renewable energy as well as clean up the transport sector.

The start-up of the project in April this year was well-timed, coming just ahead of announcements from the UK and Scottish governments about the phase-out of petrol and diesel vehicles over the next 20-25 years.

The announcements are expected to encourage the development of zero-emission vehicles by manufacturers as well as of installation of the infrastructure needed for electric vehicles (EVs) around the country and the uptake of EVs by consumers.

However, the electrification of transport systems will have wide-ranging and complex impacts on the electricity sector, including increased electricity demand, rising numbers of 'prosumers', and increasing levels of renewable energy generation.

Managing these complex resources will be a major challenge, according to National Grid, which predicts that the number of plug-in cars and vans on the roads of the UK could reach 9 million by 2030, up from around 90 000 today.

However projects such as that at Levenmouth are aiming to prove that the challenges at the intersection of clean energy and transport can be met.

Levenmouth has been a pioneer in the demonstration of hydrogen production using renewable energy since 2009, when it installed a 750 kW wind turbine and linked it to a small hydrogen electrolyser, storage facility and fuel cell. Installed by the Hydrogen Office, now known as Bright Green Hydrogen, the project ran for several years until the project partners decided that an expansion of the system was appropriate and would help further demonstrate the benefits of using renewable energy on an islanded network.

Bright Green Hydrogen therefore formed a consortium with Fife Council and Toshiba in 2014 to design a new, islanded renewable energy system, and applied for funding from the Scottish Government's Local Energy Challenge Fund.

The application resulted in a grant of £4.4 million, and the project partners appointed Logan Energy as a contractor to deliver and install key components of the scheme.

Edinburgh-based Logan is a hydrogen and fuel cell specialist business that is responsible for the installation of over 1.1 MWe of fuel cell based clean energy technology in the UK. Its CEO, Bill Ireland, said: "At the Levenmouth Community Energy Project we have delivered what many visionaries have been talking about for some time and shown that it can be integrated into the existing energy systems for stationary power and transport needs.

"The drive for increasing our reliance upon renewable technologies is not new but the economic need to do so, and means to time-shift energy, has never been more pertinent. The work we have completed at Levenmouth is a true first and highlights the power of hydrogen as a standalone multi-sector energy resource that also supports existing energy networks.

"This is a milestone in the energy sector and marks the practical delivery of a new hydrogen based energy era."

The Levenmouth project comprises the existing wind turbine, as well as 160 kW of roof-mounted solar photovoltaics. These are connected to a microgrid supplying electricity to around eight buildings at a site in Methill, Scotland, including the offices of Bright Green Hydrogen itself.

Excess renewable energy generated is used to produce hydrogen using two electrolysers supplied by Canada-based Hydrogenics.

Hydrogenics supplied a PEM electrolyser as well as an alkaline electrolyser. Both electrolysers are containerised, according to Logan, which also supplied hydrogen storage and vehicle refuelling units for the project.

Hydrogen generated at the facility is compressed and stored; it can also be transported to other facilities for vehicle refuelling, including a Fife Council depot using two hybrid hydrogen-diesel refuse collection vehicles.

The Levenmouth facility also includes a 250 kW PEM electrolyser that generates hydrogen at 30 bar for a 20 m^3 storage facility, and a 100 kW PEM fuel cell – also supplied by Hydrogenics – that can generate electricity for the private wire network when renewable generation is low. There is also an interconnector on site allowing hydrogen to be diverted depending on where demand is greatest.

Bringing the entire system together is an energy management system supplied by Toshiba, which determines how to prioritise electricity demand and usage, and hydrogen production and storage.

This system is one of the most complex of its kind that Toshiba has been involved with outside Japan, Toshiba said. Its energy management system uses defined business rules as well as factors such as weather patterns, predicted renewable generation, hydrogen demand for vehicles and electrical load to determine how the system runs.

The Levenmouth project currently supplies hydrogen for 17 vehicles: ten Renault Kangoo electric vans fitted with hydrogen fuel cell range extenders; five Ford Transit vans owned by Fife Council, which use dual fuel diesel-hydrogen combustion engines; and two refuse collection vehicles, also running on a mixture of hydrogen and diesel.

The use of dual fuel vehicles means that they can continue to operate in the absence of a hydrogen supply. Similarly, the buildings on the microgrid are able to switch back onto the main grid network in the event of a fault, or a lack of renewable generation and hydrogen supplies. "But the idea is that this is a test site that we can learn from and use to establish a village running off hydrogen solely from renewables, including transport," noted Ireland.

According to Logan, the Levenmouth project will operate for five years and will enable the project partners to gain a better understanding of the challenges, benefits and opportunities of implementing such facilities.

One of the biggest challenges in the project is finding people with the right skills, and helping businesses understand the risks and regulations of working with hydrogen as a fuel, said Ireland. "We have had to develop skills both in-house and among our suppliers," said Ireland. "There's also a lack of understanding surrounding hydrogen – most people tend to run a mile – but it's just another combustible gas and is in fact potentially safer than, for example, natural gas, because hydrogen rises and disperses if it leaks."

There are also numerous safety devices and regulations governing hydrogen use that don't apply to other combustible fuels, Ireland noted.

However a better understanding of hydrogen in the wider industrial sector will hopefully enable projects like Levenmouth to fully show the benefits that the fuel can bring to towns can communities determined to improve air quality and reduce carbon emissions across a range of sectors.

Logan has previously undertaken a study in conjunction with the UK government that looks at turning a town with a population of around 15 000 people into an area running on 100 per cent renewable hydrogen. The firm is also moving onto another energy storage-transport project, this time in Tenerife.

"The project in Tenerife is a similar system [to that in Levenmouth], but this time generating fuel for vehicles from seawater using electricity from wind and solar," said Ireland. "The seawater is first purified before being put in the electrolyser. The hydrogen will be used in the island's taxis."

And now other companies are taking up similar initiatives.

Last month Arcola Energy announced it had completed the delivery of a unique hydrogen fuel cell system, as part of an innovative energy storage project in the Orkney Islands, Scotland.

The firm partnered with Germany's Proton Motor to design, build and install a 75 kW hydrogen fuel cell system for the 'Surf and Turf' project in Orkney. The project sees excess renewable electricity converted into hydrogen on the island of Eday, which is then stored and transported to Kirkwall, on the Orkney mainland. Here the fuel cell converts the hydrogen back into electricity to provide renewable power to ferries while they are in port and heat to buildings on the harbour. A fleet of hydrogen-powered vans, supplied by Arcola Energy, are also planned for later in 2017.

Ben Todd, Managing Director of Arcola, said that the project would "demonstrate the central role that hydrogen can play in our future low carbon energy mix".

The Levenmouth project currently supplies hydrogen for 17 vehicles

Don't get stranded

Junior Isles

There is much talk of utilities needing to transform their businesses if they are to survive in the energy world of the future. But as is often the case, things are a lot easier said than done, with the road full of twists, turns and potholes along the way.

One of the biggest challenges facing utilities is how to make investments in technology in a rapidly changing landscape – in a way that avoids stranding assets. Extracting value by optimising the use of assets in this fast changing environment is no small task, and what energy companies need are solutions that help them from the investment level down to the operational level.

In terms of asset investment, it is about the ability to prioritise on long-term investments across a portfolio of assets that is usually broad and expensive, and being able to make the best informed decisions when it comes to modernising or repairing those assets. This can only be achieved by obtaining and understanding actual real-time data on the health and status of assets, which in turn enables maintenance operations to be optimised through asset management platforms using the right level of data.

Consequently, in the electricity generation part of the energy chain there has been a growing deployment of smart sensors installed in the field that gather vast amounts of information on equipment – data that can be fed back and analysed using complex machine learning algorithms to not only optimise fleet operation but also to provide the visibility of fleet that operators need to make informed investment decisions.

Jean-Yves Bodin, Director of Energy Digital Solutions in Schneider Electric's Energy Business division commented: "Right now, power generation is the most intensive area of asset management solutions. There are a number of references leveraging advanced predictive algorithms that use machine learning. Data is collected from the rotating machine, with machine learning used to identify patterns and check against a normal condition baseline in order to identify abnormal behaviour."

But asset management goes beyond optimising operation and maintenance of a thermal power plant or fleet of wind turbines. While there is less maturity in transmission and distribution, the need is there – especially when considering the opportunities it presents.

It is therefore no surprise there has been a spate of tie-ups between companies and launches of new solutions aimed at gathering and analysing data further down the energy value chain to enable companies to optimise their T&D operations and seize new opportunities.

During the European Utility Week (EUW) conference and exhibition in early October, Schneider Electric showed how, through its tie-up with IPS Company Group, its existing EcoStruxure Grid solutions will fully meet the asset performance management (APM) needs of transmission and distribution utilities by giving them greater control of escalating operational costs. Under the cooperation, IPS-Systems adds a huge technical library relating to new and legacy assets, to EcoStruxure Grid.

Jérome de Parscau, SVP energy digital solutions & strategy at Schneider Electric said: "By combining our know-how in deploying IoT equipment on electrical utilities' assets, and our new partnership with IPS Company Group, we can retrofit old equipment to become smart, as well as providing a whole range of new connected equipment. Schneider Electric's strategy is to continue finding synergies outside the company that can help its customers control costs while supporting their digital transformation in a rapidly changing energy landscape."

In the T&D arena, the volume of assets is enormous – equipment at the transmission level includes transformers, switchgear, switchboards, circuit breakers as well as towers, lines and cables. According to Bodin, platforms are needed that support the maintenance on one side and the analytics on the other, in order to determine the best investment strategy. "It's about the ability to identify an inventory of assets in an efficient way. IPS has some references where the lead time for the deployment of the project is only eight months," he noted.

The solutions at the distribution level are similar to those at the transmission level. Again, smart sensors and advanced software have to be deployed to capture and analyse real-time data from transformers and switchgear, etc. The only real difference is that the volume of information is much greater due to the number of substations. Utilities can therefore use the same type of architecture and asset management platforms across both transmission and distribution.

At the meter, which is also a source of information, Bodin says he does not see many projects in terms of asset management. But this will change as smart meters become increasingly prevalent.

While the advent of smart meters and indeed the entire digital transformation, will bring challenges, it also presents opportunities.

On the sidelines of EUW, Martin Dunlea, Utilities Industry Strategy Lead in EMEA for the Utilities Global Business Unit at Oracle, also said: "It is about using the data that's generated to better understand your business and then to drive the kind of transformational changes that move you from being a good company to one that is driving excellence – one that transforms how you interact with your customers and drives efficiency into the way that you operate."

Dunlea sees three or four opportunities that are definitely on the utilities' radars. The first is the opportunity to set out and improve the way they engage with customers. In terms of driving excellence, he also notes that smart sensors and smart meters enable utilities to give updated real-time visibility to their networks and how their operations are performing.

"It's an opportunity to transform your business around: how you procure, manage and oversee the complete lifecycle of your assets; how you engage your own crews and provide them with the information to make informed decisions – how you improve first time fix-rates around appointments. Technology and data is supporting huge opportunities to improve in these areas," said Dunlea.

On the operations side, the growth of renewables and distributed generating sources is a challenge but also offers an opportunity. Dunlea explained: "Distributed energy sources is a bit of a double-whammy… but those who understand what is happening at the low voltage end of their grid and manage the complexity at the edge, can drive significant enhancements in their products and start to engage with these new prosumers around services and new products."

The other key area that he sees on the utility radar – which is linked to both customer engagement and network solutions and associated technologies – is taking stock of data. He echoed Bodin in saying: "One of the areas that utilities have now started to focus on significantly, is driving excellence in obtaining a better insight and understanding of what the data is telling you."

The goal has to be to move from what Dunlea calls a "rear view mirror" perspective – i.e. reports and data analytics of what has happened in the past – to predictive analytics. "This allows them to make decisions in near real-time, whether that's around engaging with customers, energy consumption, driving energy efficiency through demand-side programmes, supporting time-based utility pricing such as time of use pricing, etc."

Making near real-time decisions calls for investment in technologies that allow the gathering and understanding of the mass of incoming data and leveraging tools such as artificial intelligence and machine learning to perform the necessary near real-time analytics.

Ditching the rear view mirror approach and navigating the road ahead will not be easy. But if utilities hope to avoid the pitfall of stranding assets by ensuring they invest in the right technologies, they would be well advised to understand the end game and follow a path that covers asset investment planning, asset performance management, maintenance operations, and the integration of these operational technology systems with IT systems. From this they can then execute step-wise deployment of technology according to their business priorities. *Bon voyage!*