THE ENERGY INDUSTRY TIMES

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Special Project Supplement

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Alstom buyout seen as preparation for globalisation

Montebourg will not allow France to become a "shopping centre" for foreign corporations

By becoming a major shareholder in the GE deal to buy Alstom, the French government says it will build alliances in the face of globalisation instead of allowing its industries to be taken over by foreign companies. **Junior Isles**

The French government has managed to satisfy Alstom shareholders while securing the ultimate control of the French engineering giant as part of a deal that will see Alstom's power business sold to US rival GE.

The deal signals the end of a battle to buy the company between GE and Siemens, which had tabled a bid with Mitsubishi Heavy Industries.

GE, however, was forced to alter its original proposal with the main proviso being that the government could buy a 20 per cent controlling stake in Alstom.

Alstom's board had already unanimously approved GE's original proposal but Economy Minister Arnaud Montebourg had used a newly-created state decree to veto foreign investment in energy, water, transport and other sectors deemed strategic to the country.

The government was worried that the GE takeover would cause layoffs and hand foreign owners too much influence over a major industrial player. The controlling stake will enable the government to protect French interests.

Montebourg said: "This is a way of organising ourselves in the face of globalisation. It builds alliances rather than allowing France to become a giant shopping centre for foreign corporations to come and prey on our companies."

A senior presidential aide added that it was "perfectly natural" for the government to have intervened in the deal, noting nuclear power was strategically important. "Such a deal would have been impossible for a French company in the US," he noted.

The government will purchase its 20 per cent stake from French industrial group Bouygues, which currently owns 29 per cent of Alstom. The government and Bouygues have yet to agree on the price of the stake. Based on Alstom's current market capitalisation, a 20 per cent stake would be worth €1.7 billion ($2.32 billion).

Bouygues purchased its stake from the government in 2006, after Alstom was rescued from near-bankruptcy in 2004 through a state-backed bailout. Bouygues bought the stake for around €2 billion with the aim of creating a top player in nuclear power infrastructure.

Around 18 000 of Alstom's 90 000

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UK takes different approach to globalisation

The UK appears less concerned than France when it comes to globalisation and foreign ownership of key infrastructure sectors. Despite concerns about the implications for national security, the UK is to allow Chinese state-owned nuclear firms to design, own and operate new nuclear power stations as long as they meet the requirements of regulators.

An agreement on nuclear cooperation signed during a visit by China's premier Li Keqiang is part of new wider collaboration between China and the UK. China says it wants to pour money into major UK infrastructure projects and signed £14 billion ($23.8 billion) in trade deals.

Rolls-Royce signed an important memorandum of understanding (MoU) with CGN, the Chinese nuclear reactor vendor. The agreement will see Rolls-Royce cooperate more closely with CGN in the field of civil nuclear power, in China, the UK and other overseas markets.

The MoU will explore possible collaboration in areas such as engineering support, provision of components and systems, emergency diesel generators, supply chain management and instrumentation and control technology.

The joint UK-China statement on civil nuclear cooperation builds on a MoU signed with China in October 2013, which sets out a framework of cooperation between the UK and China in the field of civil nuclear energy.

Energy and Climate Change Secretary Ed Davey said: "This joint civil nuclear statement paves the way for Chinese companies to invest in Hinkley Point C, the first nuclear reactor plant to be built in the UK for a generation."

UK Energy and Business Minister Michael Fallon said: "This deal brings a real boost to the UK economy. Closer cooperation between the UK and China could be worth hundreds of millions of pounds to British businesses. We are making the most of Britain's low carbon energy to maximise jobs and business opportunities, get the best deal for customers and reduce our reliance on expensive foreign oil and gas imports."

For the first time, the UK and Chinese governments agreed a groundbreaking joint statement on climate change. This is part of broader work together to reduce emissions and enhance energy security, central to which will be achieving a global, legally binding, and ambitious climate change agreement in Paris in 2015.

Commenting on the joint statement from the UK and China on Climate Change, Lit Ping Low, climate economist, PwC said: "It is yet another signal that China is serious about demonstrating climate action leadership. It is also lifting some of the veil on the negotiation process by suggesting who its allies would be. What's in it for UK? The UK low carbon sector has had eyes on China as an export market for years, so a formal announcement gives the UK industry more confidence in investing in low carbon technology/exports."

Allan Zhang, economist, and China policy specialist, PwC sustainability & climate change said: "It's rare, if not possibly the first time, a Chinese premier has signed off a joint statement with another country purely on the subject of climate change. The statement brings the cooperation between China and the UK to a new level in combatting climate change."

Separate multi-billion pound agreements were also signed by Shell and BP with the China National Oil Corporation, with a strong focus on supplying the liqueified natural gas China will need for its shift to cleaner energy sources.

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global workforce are employed in France. The future of the engineering giant is therefore an important issue for the government, which is battling to reduce a huge trade deficit and record unemployment.

The move fulfils Montebourg's pledge to ensure that the French government would retain a say in jobs and decision-making at the company, which builds power plants and France's high-speed TGV trains.

The new deal, which the government supports, will see GE pay $17 billion for Alstom's operations that manufacture gas turbines for power plants and sell its railroad signal business to the French company for about $825 million.

The agreement also calls for the companies to set up three 50-50 joint ventures: one for the power grid businesses, another for offshore wind and hydropower operations, and a third for nuclear steam turbines. Retaining government control of Alstom's sensitive nuclear activities was a key part of the deal going through.

Completion of the deal, which still requires approval from shareholders and competition watchdogs, is expected in the first half of next year. "The process ahead is still heavy and complex," said Alstom CEO Patrick Kron.

After the deal is completed, Kron will be left running the company's train, tram and railway signalling business, which accounts for around a quarter of the group's total sales and operating profit.

Kron said that the deal with GE "is a combination of Alstom's qualities and GE's economic strength".

Kron says the process ahead is still "heavy and complex"

He also said that buying a stake in Alstom would be a "good investment" for the French government.

GE chairman and chief executive Jeff Immelt said the deal was "good for France, GE and Alstom".

Siemens said it respected and understood France's efforts to preserve its national interests. MHI said it regretted the decision but looked forward to cooperating with other French companies as it has with nuclear group Areva.

It was clear from the outset that the government would dictate Alstom's fate. Russell Solomon, senior vice president and lead GE analyst at Moody's credit ratings agency, said the lengthy negotiations were "indicative of the protectionist type of environment you have to deal with when doing business in France".

However, Peter Ramsauer, chairman of the German parliament's economics committee, criticised France's decision to favour the GE bid and reject the joint bid from Siemens and MHI.

He told German radio station *Deutschlandfunk*: "The French government acts with ice-cold national industrial interest, and the French government has clearly put its own national interests, one-sided French concerns, ahead of European interests."

US power plant emission proposal could boost climate talks

The US's proposal to cut power plant emissions is being hailed as a big step in the global effort to combat climate change, says **Junior Isles**

The move by US President Barack Obama to cut emissions from its power plants is the strongest signal yet that the world's biggest economy and second largest emitter of greenhouse gases is getting serious about combating climate change.

Last month the Obama administration proposed legislation for the first-ever limits on carbon pollution from power plants.

Forty-nine states have each been set varying limits for the maximum weight of carbon dioxide they can emit per megawatt-hour of electricity generated. These limits have to be achieved by 2030. States can choose how they meet their targets – it could be by fuel switching, increasing renewable generation or energy efficiency. States can also use cap-and-trade schemes such as the Regional Greenhouse Gas Initiative covering nine states in the northeast.

The ruling will not hit coal-fired generation as hard as was feared, and the EPA still expects more than 30 per cent of US electricity to come from coal in 2030, compared with about 40 per cent this year.

A big concession to the industry was the EPA's use of the 2005 baseline for the cuts. Carbon emissions have dropped 14 per cent since that year, so the overall reduction sought is smaller than it would have been if the EPA had used a more recent baseline year, as coal and utility executives had feared.

Officials from the Obama administration stressed that they were giving states a great deal of flexibility both in how the states and utilities meet the goals and when they must come up with a plan, which for some could be as long as three years from next summer, when the rule becomes final.

Jan Frommeyer, Director, Market Analysis at ICIS said: "It is important to give states flexibility to react on the regulation, but the deadlines proposed risk that precious time is wasted – the earlier emissions reductions are established, the lower the concentration of toxic gases in the air."

The EPA's proposal will be subjected to a year of consultation and is expected to face legal challenges. Industry groups against the plan warned it would raise the cost of electricity, harming consumers and the economy.

The administration estimates that utilities would spend as much as $8.8 billion a year to comply with the rule. The US Chamber of Commerce says the rule would cost the economy $50 billion a year.

Environmental groups praised the action. Former US Vice President Al Gore called it "the most important step taken to combat the climate crisis" in the country's history.

The proposal is a big step for the US, which has long lagged behind Europe and other developed countries when it comes to national action to reduce greenhouse gas emissions. It may also be a crucial move in pressuring China to accept binding goals to cut greenhouse gases, while allowing the US to start catching up with the EU in the fight against climate change.

Connie Hedegard, the EU's commissioner for climate change, called the rule "the strongest action ever taken by the US government to fight climate change".

China also welcomed the move. Foreign Ministry spokesman Hong Lei said China is glad to see the US take a leading role in global efforts to tackle climate change, and said it would also step up its efforts to cut greenhouse gas emissions.

Investment path falls short of climate goals, says IEA

- Some $53 trillion needed to 2035 to get on 2°C pathway
- High LNG prices could open door to coal

Malika Isles

The current investment trajectory in energy will not be sufficient to meet climate stabilisation goals, according to a special report on investment released by the International Energy Agency (IEA) as part of its *World Energy Outlook* (WEO) series.

The main scenario of the report states that meeting the world's growing need for energy will require more than $48 trillion in investment over the period to 2035; around $40 trillion is in energy supply and the remainder in energy efficiency.

Of the $40 trillion invested in energy supply, almost $10 trillion is in power generation, of which low-carbon technologies – renewables ($6 trillion) and nuclear ($1 trillion) – make up the lion's share and $7 trillion is in transmission and distribution. The remaining $23 trillion is in fossil fuel extraction.

The investment path traced in the main scenario, however, falls well short of reaching climate stabilisation goals. The IEA says that $53 trillion in cumulative investment in energy supply and in energy efficiency is required by 2035 to get the world onto a 2°C path for climate change. Investment of $14 trillion in efficiency helps to lower 2035 energy consumption by almost 15 per cent, compared with the main WEO scenario.

The report notes that a breakthrough at the Paris UN climate conference in 2015 is vital to open up a different investment landscape.

IEA Executive Director Maria van der Hoeven expressed her concern. "The reliability and sustainability of our future energy system depends on investment. But this won't materialise unless there are credible policy frameworks in place as well as stable access to long-term sources of finance."

Newly compiled data show how annual investment in new fuel and electricity supply has more than doubled in real terms since 2000. The WEO report also notes, however, that a large portion of today's investment spending is related to fossil fuels, whether extracting them, transporting them to consumers, refining crude oil into oil products, or building coal and gas-fired power plants.

Last month the IEA also unveiled its *Medium-Term Gas Market Report*, which gives detailed analysis and five-year projections of natural gas demand, supply and trade developments.

The report says the "Golden Age" of natural gas now well established in North America will expand to China over the next five years. It projects a near-doubling of Chinese gas demand through 2019, which will compensate for a slight slowdown in growth in many other areas of the world.

Despite the projected growth in gas demand, especially in Asia, the IEA Executive Director said warning lights were flashing.

"High LNG prices are threatening to crimp demand as many countries are increasingly unwilling, or unable, to afford these supplies – and that could open the door to coal. Looking ahead… only a very strong climate policy commitment could redirect Asia's coal investment wave to gas.

Ukraine-Russia dispute prompts vow for EU energy union

The European Union has vowed to move toward "an energy union with forward-looking climate policy" after a pricing dispute led to the cut-off of Russian gas supplies to Ukraine – the transit country for around 15 per cent of the EU demand for the fuel.

The EU heads of state and government backed efforts to speed the creation of a common energy market, develop infrastructure and diversify supply, according to a strategic agenda signed at a recent summit in Brussels

"We must avoid Europe relying to such a high extent on fuel and gas imports," leaders said in the document. "To ensure our energy future is under full control, we want to build an energy union aiming at affordable, secure and sustainable energy."

At the summit the 28-nation bloc's leaders agreed to make security of energy supply, reduction of costs and the fight against climate change a priority for the next five years. They pledged to mobilise all efforts to meet the October deadline for a deal on the climate and energy framework that they set at their March meeting.

The framework would see the bloc adopt a binding goal to cut greenhouse gases by 40 per cent by 2030 and sets an EU-wide target to boost the share of renewables in energy consumption to 27 per cent. The commission is also believed to be considering proposing an energy efficiency goal of 27-30 per cent within the coming weeks.

Just ahead of the summit, a report released by Greenpeace described the Commission's plans to cut reliance on energy imports as woefully inadequate. The report claimed that strong EU commitments on renewables and energy efficiency could reduce the need for imports by 45 per cent more in 2030 than under the EU's existing plan.

Greenpeace energy expert and lead author of the report Sven Teske said: "Every Euro spent on renewables is an investment in security of supply."

NGOs claim victory as HidroAysén cancelled

Chile says it will continue to support hydropower projects in spite of cancelling the 2750 MW HidroAysén project.

Siân Crampsie

Chile's Ministry of Energy says that the decision to cancel a $9 billion hydropower project in Patagonia would not compromise the country's energy agenda.

The country's new centre-left government cancelled the environmental permit for the HidroAysén project, which would have seen the construction of five large-scale hydropower plants on two rivers in Chile's Aysén region.

The dams would have added 2750 MW to Chile's grid, which is under strain due to a booming economy and strong growth in the mining sector.

HidroAysén, which is 51 per cent owned by Endesa Chile and 49 per cent by Colbún, said that it would wait for the ministers' formal resolutions before deciding on its course of action.

Environmentalists have strongly opposed the project, which was first proposed eight years ago, because of the impact it would have had on the wilderness of Patagonia. Chile's previous government gave the project the green light in 2011.

Chile's Minister of Energy, Maximo Pacheco, said that the decision by the Committee of Ministers – the country's highest administrative authority – did not mean the government no longer supported hydropower. "This was not a discussion of energy policy, was not a discussion whether to use water resources; this was a discussion of whether a project qualified," he said.

He added: "We will support the development of power projects based on water resources. However, it cannot be in our country today [that we] run projects like this without thinking of the people on whom the project impacts."

The project was reviewed by technical teams from Chile's energy, mining, economy, health, agriculture and environment ministries over a two-month period prior to a three-hour meeting in June. "The Committee of Ministers has decided to... nullify the Environmental Qualification Resolution of HidroAysén project," said Environment Minister Paul Badenier.

Pacheco added that HidroAysén "suffers from serious shortcomings in its implementation by dealing with due care and with due regard to aspects related to people who live there".

Environmental groups, led by the Patagonia Defense Council (CDP), called the ruling an important landmark that would put Chile "on track toward a sustainable, clean energy future". Juan Pablo Orrego, International Coordinator of the PDC said: "This decision is in line with what we've always said: HidroAysén's impacts could not be mitigated, and in fact could not be evaluated."

HidroAysén would have helped Chile improve its energy security. It already depends on hydropower for 40 per cent of its primary energy needs, while the rest is mainly imported because the country produces virtually no oil or gas of its own.

President Michelle Bachelet in May unveiled an energy policy that favours natural gas, energy efficiency and renewable sources, including solar, tidal and geothermal power.

In June SunEdison brought online a 100 MW solar photovoltaic (PV) plant in the Atacama desert – the largest PV plant in Latin America. "This plant demonstrates that photovoltaic solar energy is an ideal way of diversifying the energy matrix in Chile, reducing costs and contributing towards meeting the demand for clean and sustainable energy," said José Pérez, SunEdison president for Europe, Africa and Latin America.

Elsewhere in Chile Rame Energy is planning the construction of four wind energy plants totalling 118 MW after agreeing a finance deal with Banco Santander. Santander helped Rame to finance its first two wind farms in Chile, which added 15 MW to the country's grid.

Rame's latest phase of projects will be completed by the end of 2015, with Santander contributing up to $69 million of equity financing.

The HidroAysén project would have involved constructing three dams on the Pascua River and two on the Baker River. A 1900 km-long transmission line was to have been built to link the project with Chile's grid.

The projects would take 12 years to construct at a cost of $3.2 billion, according to HidroAysén.

Gamesa taps Chinese funding for Uruguay project

- Gamesa gains competitive edge
- Latin America targeted for wind, solar

Gamesa's success in leveraging Chinese finance for a wind power project in Uruguay shows that the firm's commitment to the Chinese market is paying off.

The Spanish wind turbine manufacturer has reached an agreement with Chinese bank China Minsheng Banking Corp (CMBC), through the Chinese Export Credit Agency, Sinosure, for the funding of the Talas de Maciel II wind farm.

Gamesa has had a presence in China since 2000 and says that the agreement with CMBC makes it more competitive through cheaper finance. The loan agreement includes local content clauses that will mean Gamesa manufactures the wind turbines for the 50 MW project at its factory in Tianjin.

"Sinosure's willingness to close this transaction, highlighting the agency's commitment to helping multinationals such as Gamesa, which are displaying a commitment to the Chinese market and its use as an export base, was crucial to clinching the financing deal," said José Antonio Miranda, Gamesa's CEO in China.

The wind project is being built by Abengoa, one of several international developers keen to build business in Latin America's rapidly growing renewable energy market.

Abengoa recently announced that it would double the investment and size of its first thermal solar power plant in Latin America, a 110 MW project in Chile's Atacama desert.

Abengoa initially planned to invest $1 billion in the project, but it now expects to pump nearly $2 billion into the power plant on Dominador hill in Chile's Antofagasta region. The power plant will have a capacity of 220 MW and an operating life of 30 years.

Wind turbine firm Vestas is also targeting Latin America, and in particular Brazil, where its market share is less than five per cent. It announced in June that it would invest €32 million in its Brazilian facilities in order to meet the country's rules for local production.

The investment will enable the company to produce up to 800 MW per year in Brazil and will "place Vestas as a central figure in the Brazilian market", according to Jean-Marc Lechene, Vestas' executive vice president for production and global sourcing.

DOE funding keeps NuScale SMR on track

NuScale says it is on track to submit a design certification application to the Nuclear Regulatory Commission (NRC) for its small modular reactor in the second half of 2016.

The nuclear energy company is set to receive up to $217 million in funding over the next five years after signing a cooperative agreement with the US Department of Energy (DOE).

It says it will use the funds to perform engineering and testing needed to proceed through the NRC's design certification process. NuScale, which is majority-owned by US energy company Fluor, will be expected to at least match the DOE funds.

The DOE selected NuScale in December 2013 under a second SMR funding opportunity that will see the DOE meet up to half of the cost of developing, licensing and commercialising the reactor. NuScale believes that its first planned project in Idaho, in partnership with Energy Northwest and Utah Associated Municipal Power Systems, could begin commercial operation by 2023.

NuScale's SMR is a 45 MWe self-contained pressurised water reactor and generator set, which would be factory made and shipped for deployment in sets of up to 12 to make scalable nuclear power plants with capacities of 45-540 MWe. Using conventional fuel assemblies, the core would be cooled by natural circulation, requiring fewer components and safety systems than conventional reactors.

A first round of DOE SMR funding was awarded in November 2012 to Babcock & Wilcox (B&W) for its mPower design. But the firm failed to find customers or investors and in April announced it was slashing its spending on mPower from $150 million per year to $15 million per year.

Caribbean courts green growth

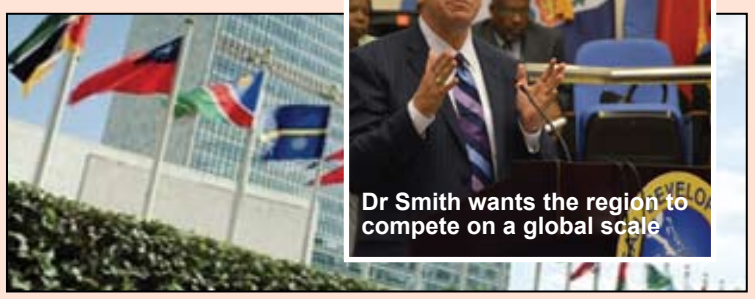
Caribbean nations require $30 billion of investment over the next decade to modernise their power, water, telecoms and transports sectors, according to the Caribbean Development Bank (CDB).

The CDB is concerned about the impact of economic shocks and climate change on the region's island nations and is actively promoting a strategy of green investment and sustainable growth.

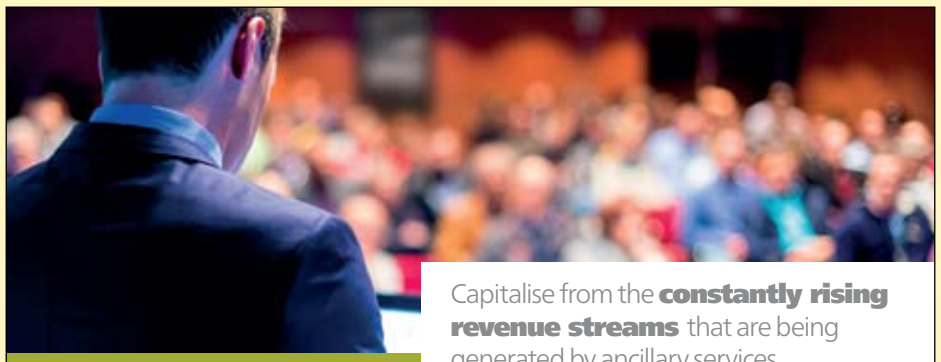
Investments in energy efficiency, renewable energy and sustainable technologies would not only bring economic growth but also reduce poverty and enable the region to compete on a global scale, said Dr Warren Smith, CDB President.

"In the energy sector alone, massive investment will be needed to replace obsolete and inefficient generating plant over the next five years and to transform the electricity infrastructure so that the region's vast renewable energy potential can be exploited," said Smith.

"Most of our countries are highly dependent on imported fossil fuels for power generation. This vulnerability to volatile oil prices has contributed hugely to the competitiveness challenges of Caribbean industries. It has also been a principal cause of unsustainable balances of payments and sovereign indebtedness problems."



Dr Smith wants the region to compete on a global scale



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Cooperation with US deepens as China cleans up

- Energy efficiency deals signal greater cooperation
- China's emissions reduction efforts under scrutiny as US proposes to cut its own power plant emissions

Syed Ali

China and the United States have signed a package of agreements on energy efficiency projects in a move expected to deepen energy cooperation between the world's two largest economies.

The deals include a programme to jointly train personnel specialising in energy efficiency management and one on a low-carbon eco-city in China. Another deal was also signed between General Electric (China) Co., Ltd. and a Shanghai-based new energy company for a distributed energy a programme to be piloted in a 20 km^2 international tourism resort zone in Shanghai.

David Danielson, assistant secretary of the US Department of Energy, said the two sides will evaluate the newly signed projects, discuss energy efficiency standards, and seek new opportunities in trade cooperation.

Improving energy efficiency will be an important tool in reducing China's carbon footprint. The country aims to reduce energy consumption per unit of GDP by 16 per cent from the 2010 level by 2015.

China needs to conserve energy, reduce emissions and steer away from reliance on coal in order to reduce its carbon emissions.

A senior government climate change adviser was recently reported as saying that China should impose an absolute cap on its emissions from 2016. Until now, China has only agreed to a target for carbon intensity i.e. greenhouse gas emissions relative to GDP.

At a conference in Beijing in June, Professor He Jiankun, vice-chairman of China's National Experts Panel on Climate Change, said that he and other advisers had recommended including such a limit in the next five-year plan, which comes into force from 2016.

In a report in the *Financial Times*, Professor He said: "This is our experts' advice and suggestion. The government has not decided on this policy yet. We hope to implement this in the 13th five-year plan, but the plan has not been fixed yet, so it isn't government policy yet."

However, China's Chief Climate Negotiator Su Wei later reaffirmed his nation's commitment to lower carbon intensity while dismissing reports that it will adopt an absolute cap.

China and the US are the world's top two energy consumers and carbon dioxide emitters, and China's moves to cut carbon emissions are being closely scrutinised after the US announced its plans for a 30 per cent cut in emissions from its power plants by 2030.

"Envoys are waiting for China to take leadership because it's the biggest emitter," said Fuqiang Yang, senior adviser on energy, environment and climate change for the Washington-based Natural Resources Defense Council's China programme.

Earlier, China and the EU launched a three-year cooperation on a carbon emissions trading scheme during the China-EU bilateral dialogue on climate change held on May 20th.

Also in May, the National Development and Reform Commission (NDRC) announced a list of 80 projects in a new test for inviting private capital to play its role in advancing investment and financing structure reform. Among the 80 projects, 36 are clean energy projects, with distributed solar PV projects accounting for 30 of these.

Vietnam weighs energy security

Vietnam needs to reduce its dependence on China to secure energy security, says **Syed Ali**

Economists have urged the government to take action to ensure Vietnam's energy security in case tension escalates in the East Sea.

Dr. Pham Sy Thanh, director of the Chinese Studies Program under the Vietnam Economics Policy Research Center (VEPR), said that energy security is a matter Vietnam should think about first when preparing economic scenarios in case the Vietnam-China territorial dispute worsens.

"If Chinese contractors stop executing the construction works in Vietnam and return to China, tens of power projects capitalised at billions of dollars would be left idle," Thanh said in an interview given with *Thoi Bao Kinh Te Saigon*.

Thanh said Vietnam could face an electricity shortage if power plants cannot be implemented as scheduled.

According to the national power zoning plan, Vietnam will need more than VND17 trillion ($805 million) each year from now to until 2020 to invest in electricity projects.

During a speech marking the 20th anniversary of the 500 kV north-south power line in Hanoi, Deputy Prime Minister Hoang Trung Hai said that annual electricity production had risen by 13.2 per cent on average, from 12.3 TWh in 1994 to nearly 130 TWh last year.

In May, the 500 kV, 437.5 km Pleiku-My Phuoc-Cau Bong line and the 500 kV Cau Bong transformer station were commissioned after more than two years of construction. The lines will ensure electricity supply in the dry season in the southern region.

The new line, the third in the north-south power transmission system, will help boost transmission capacity from Pleiku to southern provinces to 2300 MW and support socio-economic development in the south.

To ensure national power security, Vietnam is also planning to build several nuclear power plants.

Two years ago the government selected Russia's Rosatom State Nuclear Energy Corporation to build the 2000 MW Ninh Thuan 1 nuclear power plant. It planned to start construction of the project in 2014, but decided to delay it to ensure safety. A new timeline has not yet been set.

At the start of June representatives from Mitsubishi Heavy Industries (MHI) visited Vietnam to present information on the ATMEA 1 reactor technology that MHI has proposed for the second nuclear power plant in central coastal Ninh Thuan province.

"We know Vietnam is in the final stages of selecting technology for its second nuclear power plant. The Japanese government has advised ATMEA1 as suitable to this project," said a senior officer at MHI.

Australia must "pull its weight" on climate change

Australia is being urged to "pull its weight" on climate change following the US's proposal to curb emissions from its power plants.

Climate Council, an independent community-funded non-profit organisation in Australia said the action in the US highlights that coal-fired power stations are a key target in stopping climate change.

Amanda McKenzie, CEO of the Climate Council said that based on this situation, Australia stands alone as the highest per capita emitter of greenhouse gas on the planet.

"Australia has one of the oldest, and least efficient fleets of power stations in the developed world and electricity generation is responsible for almost half of Australia's energy emissions," she said.

"Global giants like the US and China are moving to limit emissions from electricity generation and Australia will be expected to pull its weight too," McKenzie added.

According to a new report, Australia risks increasing repair bills from extreme weather events and being unable to access capital for major projects if it does not get its response to climate change right.

The Committee for Economic Development of Australia's (CEDA) report said climate change was both an environmental and an economic issue, despite recent comments from senior politicians that seemed to question the latter.

The report stated Australian businesses and governments need to ensure they keep in step with international developments and have the options available to move to less carbon intensive industries and energy sources if the country is to remain globally competitive.

CEDA Chief Executive Professor Stephen Martin said: "We must invest in research and development to drive technological breakthroughs and have in place regulatory regimes for all energy sources, including nuclear, so that options can be taken up swiftly as technological breakthroughs occur."

Indonesia encourages industrial generation

The energy and mineral resources ministry is drawing up a new regulation that would encourage companies to build their own power plants.

To anticipate the increasing electricity consumption and also address the issues of sufficient financing for state utility Perusahaan Listrik Negara (PLN), the ministry will roll-out measures to encourage industries to build their own power plants.

Jarman, the ministry's director general for electricity, said the new regulation would be centred on three issues: bureaucratic hurdles, pricing policy and ease of access to infrastructure.

"We'll expedite the process for industries to obtain permits to build their own power plants," Jarman said. The ministry says it will also remove electricity subsidies for certain industrial consumers making it cheaper for them to build their own power plants.

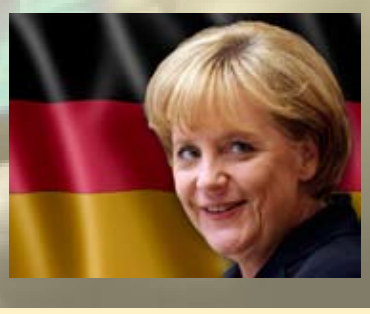
Under the scheme called power-wheeling, independent power producers will be able to distribute their excess power to industries through the existing transmission network.

PLN president director Nur Pamudji said the policy would encourage power plant construction. With looming power shortages, PLN is targeting to complete 12 new plants this year that will raise national capacity by 2610 MW.

Despite this new capacity, however, the islands of Java and Bali are under threat of electricity crises beginning in 2017. PLN's director of construction and renewable energy Nasri Sebayang explained that several large plants that are scheduled to start operating by 2016 will miss the targeted time.

A number of major projects that may be postponed are the Batang steam power plant in Central Java and steam power plants 8, 9, and 10 in South Sumatra. The 2 x 1000 MW Batang power plant was initially targeted to start operating in 2016, but the schedule was pushed back to 2018.

Energy security fears taint RWE deal



Europe faces energy security threats on two fronts, writes **Siân Crampsie**

Fears over energy security in Europe have led Germany's government to launch an investigation into plans by RWE to sell oil and gas assets to LetterOne Group, a company controlled by a Russian oligarch.

The proposed €5.1 billion sale of RWE Dea was announced in March but tensions between Russia and Ukraine and the threat that poses to European gas supplies have led the Merkel government to examine the deal.

In June Russian energy giant Gazprom said that it would only continue to supply natural gas to Ukraine if the country paid for deliveries in advance. Because around half of Russia's gas headed for Western Europe flows through Ukraine's pipelines, European leaders put energy security at the top of the agenda at the European Council meeting scheduled for late June.

Berlin's probe into the RWE Dea deal could take two months and could result in the proposed transaction being blocked under Germany's foreign business law, which aims to protect national security and infrastructure of strategic importance.

RWE Dea operates in 14 countries, including Germany, the North Sea and offshore Norway. Its domestic German oil and gas output amount to only one per cent of the country's primary energy needs.

Blocking the deal would show Berlin's willingness to exert pressure on Moscow and would add to sanctions already imposed on Russian businesses by the West because of Russia's stance over the Ukraine crisis.

The spat over gas between Moscow and Kiev is the third in eight years. While in theory it should not impact gas supplies to Europe, EU energy commissioner Günther Oettinger has been keen to broker a deal between the two sides during talks in Kiev last month.

Oettinger said after the talks that he hoped discussions would continue. Although the Ukrainians support a compromise plan put forward by Oettinger, Russia is rejecting it "for the moment", according to a statement from Brussels.

Speaking on the sidelines of the Annual Eurelectric conference last month, Oettinger said: "We want to come to fair market-based prices between Russia and Ukraine as we have, more or less, in our European Union. We also want to leverage Ukraine by financial assistance to pay their own bills and buy gas during the next three months." He said this gas would be stored in Ukraine's storage facilities so there is gas within the EU "for a long and cold winter". Oettinger noted that Europe has enough gas stored to last 30 days.

Within Europe, security of supply concerns have also been raised by Cedigaz, the French natural gas information centre, which says that almost 30 per cent of the EU's gas-fired generating capacity could be closed by the end of 2016.

According to Cedigaz, natural gas has lost its attractiveness in the EU's power sector because of low carbon prices and a supply glut of coal on the international market. Gas demand has fallen by 51 billion cubic metres (bcm) in the last three years – the equivalent of France's annual gas demand.

Coal demand increased by ten per cent between 2010 and 2012, says Cedigaz, but renewable energy growth and environmental legislation means this trend is reversing. The rapid rise of renewable energy output in Europe has also pushed natural gas fired plants out of the merit order.

In a statement, Cedigaz said: "In Germany, the average load factor of gas-fired power plants declined to 21 per cent in 2013. In Spain, it went down to just 11 per cent this same year. Due to unfavourable economic conditions, 25 GW of the EU's gas-fired capacity were idled, closed or at risk of closure at the end of 2013. A further 25 GW are currently at risk of suffering the same fate."

It adds: "Altogether a capacity of 115-120 GW, representing a third of gas and coal capacity in the EU, is closing or at risk of closure, posing a serious challenge for security of supply.

"The building of flexible power capacity is threatened by the lack of market signals and adverse investment environment. This situation has the potential to unfold into a major structural crisis and must be addressed urgently."

New initiatives boost offshore wind sector

The UK government is attempting to remove important areas of uncertainty for offshore wind developers in order to boost investment and underpin growth.

Energy Minister Michael Fallon last month announced a review of the UK's offshore wind supply chain and also released details of an agreement on how wind farm developers would be compensated if oil or gas reserves are discovered in their license zones.

Just days later the UK's Green Investment Bank (GIB) said it would invest directly in offshore wind energy projects in a move designed to attract more long term investors to the sector.

The UK now has 3.6 GW of offshore wind capacity, with a further 1.4 GW under construction and more projects in the pipeline.

Speaking on the sidelines of *The Economist*'s Energy UK conference in London last month, Benj Sykes, Country Manager for Dong Energy UK Wind Power noted: "The UK is well set up to remain the market leader. We have a very clear forward pathway with the regulatory regime... there is more offshore wind resource here than the rest of Europe combined; it's up to us to deliver..."

The government is anxious that the country maintains its global lead in the offshore wind sector and avoid the type of setbacks that have beset the industry in recent months.

In a keynote speech at the RenewableUK Global Offshore conference in Glasgow, Fallon said: "Offshore wind isn't just an energy sector, it's a growth sector – and it's vital that as the offshore wind sector grows, it strengthens its contribution to economic growth and creating jobs in the UK."

He added: "Overall UK content in our offshore wind farms can be, and should be, much higher – especially in capital expenditure."

The GIB is planning to attract new capital to the offshore sector through a new £1 million fund that will buy equity stakes in operational wind farms. GIB has made two equity investments totalling £461 million in the offshore wind sector, and wants co-investors to join this new initiative.

"Equity investments in operational wind farms can offer a compelling opportunity for investors seeking long-term, inflation-linked returns," said GIB in a statement, noting that such investments are particularly well-suited to long-term infrastructure investors such as sovereign wealth funds and pension funds.

A supply chain review will identify the opportunities that exist within the UK supply chain. The review, to be conducted by the Offshore Wind Industry Council (OWIC) chaired by Matthew Chinn, managing director of Siemens Energy UK and Ireland, will then examine how industry and government can work to ensure that these are realised.

Meanwhile the agreement on oil and gas discoveries gives a detailed framework guaranteeing full compensation to offshore wind developers. Amongst its clauses, the document includes an independent arbitration process safeguarding a fair outcome.

RenewableUK's Chief Executive, Maria McCaffery, said: "The Minister's announcement of the details of this vital safeguard will reassure offshore wind developers that they are no longer being asked to take an unreasonable financial risk.

"The Oil and Gas Clause was a major barrier to obtaining finance in our sector. Now, after working on the issue for nearly 10 years, RenewableUK is pleased to see comprehensive guidance in place which will guarantee full compensation if the need to terminate a lease should arise."

Germany mulls fracking re-start

Germany is preparing to embrace the shale gas revolution with plans to reverse a current moratorium on hydraulic fracturing – or fracking – next year.

In spite of continued opposition to fracking – the method used to extract shale gas from beneath the surface – the German government is keen to get the industry started in order to improve energy security and boost industrial competitiveness.

It has promised that it will set tough environmental standards on shale gas operators. If the country goes ahead with shale gas exploration, it will join other EU states including Poland, Denmark and the UK that are moving ahead with developing their industries.

In the UK, the government recently announced that it would update existing trespass laws to enable shale gas firms to drill horizontally underneath multiple land holdings without seeking landowners' permission.

France sets limit on nuclear capacity

- EDF to draw up nuclear reduction plan
- Energy efficiency, renewables and EVs in the mix

France will cut the share of nuclear energy in its power generation sector to 50 per cent by 2025.

The target was outlined in a new energy transition law, unveiled by the Socialist government in mid-June, which aims to rebalance the country's generation mix and increase the share of renewable energy.

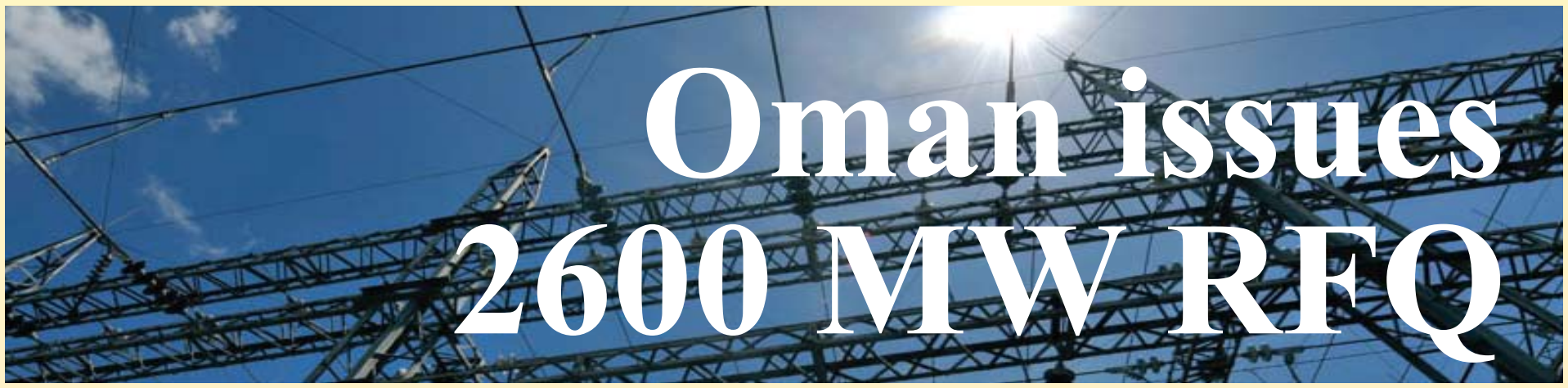
The government wants EDF to draw up a plan on how the nuclear target is to be achieved. With the 1630 MW European pressurised reactor at Flamanville due to come on-line in 2016, the proposed legislation will require existing nuclear capacity to be shut down.

The law would also set a target of increasing renewables to 40 per cent of electricity output by 2025 and to 32 per cent of all energy consumption by 2030. Energy efficiency and electric cars are also important aspects of the legislation.

Critics say the government is putting one of the country's most vital strategic assets at risk and also point to the fact that the country's nuclear sector employs 200 000 people.

Under the legislation, a new limit on nuclear capacity would be set at the existing level of 63.2 GW. There is also a target for electric vehicle charging points, tax breaks for energy efficiency improvements and targets for reducing fossil fuel consumption.

Nuclear energy in France today accounts for 75 per cent of electricity generation.



Oman issues 2600 MW RFQ

■ 2 x 1300 MW IPPs up for grabs ■ Renewables sector growing

Oman is rapidly ramping up power sector investment to keep pace with rapidly growing demand.

In addition to major new independent power projects (IPPs), plans are afoot for the development of renewable energy capacity.

Last month the Oman Power and Water Company (OPWP) announced plans to procure 2600 MW of new capacity that would amount to the single largest ramp-up of the country's power generation infrastructure.

The Rural Areas Electricity Company (Raeco) also says it will invest more than $1 billion over the next five years to increase power generation capacity by 336 MW.

OPWP has issued a request for qualifications (RFQ) inviting interested international developers to submit their credentials ahead of the launch of a competitive tender for IPPs. The projects would be developed at two separate locations in Oman's northern grid and would most likely consist of two 1300 MW plants.

OPWP says that the 2000 MW Phoenix Power Company IPP at Sur – Oman's largest greenfield IPP scheme – is due to come into operation soon.

According to OPWP, the sole procurer of all new power generation related water desalination capacity in the Sultanate, the new IPPs will help meet escalating domestic power demand, which has been growing at an annual rate of around nine per cent.

Raeco's investment plans will boost its power generation capacity by 80 per cent. One-quarter of the planned additions will be solar and wind farms, adding to Oman's nascent renewable energy industry.

One of the most innovative renewable energy schemes in the pipeline in Oman is the construction of a large-scale thermal solar project for enhanced oil recovery (EOR).

Discussions are under way between Petroleum Development Oman (PDO) and US-based GlassPoint to develop the 700-1000 MW solar plant, which would enable natural gas normally used for EOR to other uses, such as power generation.

Discussions on the project are at an early stage.

Raeco says that its customer base of 30 000 is expected to rise by 50 per cent by 2019.

OPWP has identified the need for new capacity additions of 800-1000 MW by 2017 and a further 1500-2000 MW by 2018. This combined capacity is proposed to be procured roughly in conjunction with the procurement of 225 000 m^3/day (50 million imperial gallons per day) of new water desalination capacity, with the commercial operation date slated for 2018.

Oman is also hoping to attract investment through the privatisation of power utilities.

Shares in Al Batinah Power Co and Al Suwadi Power Co are being offered through IPOs.

Interest in the IPOs from investors has been strong, according to local reports.

Shale oil plans for Jordan

Jordan says it will boost its energy security by using oil shale to fuel a new power plant.

The government has granted a license to an international consortium of local, Estonian and Malaysian companies to build a $2.1 billion power plant, according to state news agency *Petra*.

The new plant will have a capacity of 470 MW and will be constructed by Eesti Energia of Estonia, Malaysia's YTL Power International and Near East Investments of Jordan. It will be operational in 2017.

Jordan imports around 96 per cent of its energy needs. It has also embarked on a civil nuclear power programme to improve energy security.

Nations urged to ratify Kyoto extension

The UN's Christiana Figueres has urged nations to ratify the extension to the Kyoto Protocol in order to lay the foundation for a new global climate change treaty.

Figueres, the Executive Secretary of the UN Framework Convention on Climate Change (UNFCCC) made the comments as she congratulated Norway on becoming the eleventh nation to ratify the document.

The amendment will only enter into force once three-quarters of the Protocol's 192 parties ratify it.

"I would urge others, many of whom worked diligently to secure the Doha amendment, to follow suit," said Figueres, adding that it would be an important milestone on the way towards a new global climate change agreement at the 2015 climate convention in Paris.

Norway is the first country with binding emission cut targets to ratify the second commitment period of the Kyoto Protocol. In the ongoing climate change talks in Bonn, developing nations are continuing to urge other countries with binding targets to follow Norway's lead.

"Developed countries need to take the lead. This is why Norway took on new commitments under the Kyoto Protocol. We encourage all other Parties to the Kyoto Protocol to advance their ratification process rapidly," said Tine Sundtoft, Norwegian Minister of Climate and Environment.

Figueres is urging others to follow Norway's lead

Europe losing global PV market share

Solar PV installation growth slows in Europe but Asian markets are picking up the slack.

Siân Crampsie

The global photovoltaics (PV) market reached record levels of growth in 2013 and is expected to see strong performance throughout 2014, according to new analysis.

At least 38.4 GW of new PV capacity was installed globally in 2013, up from 30 GW in 2012, according to the European Photovoltaic Industry Association (EPIA). However, Europe's share of the market is falling as Asian markets such as Japan gain pace.

EPIA expects the three key non-European PV markets – China, Japan and the USA – to at least maintain the same levels of growth in 2014, with "China probably above 10 GW for several years", says EPIA in its *Global Market Outlook for Photovoltaics* report.

The latest analysis from IHS echoes EPIA's forecast for 2014.

IHS believes that in spite of a slow start to 2014 for the global PV sector, the pace of installations will increase and finish with a record last quarter of 15 GW. "The second half of 2014 will see a surge in global PV demand driven by incentive policy changes in several key markets as well as the ramping of installations triggered by record low system prices," said Ash Sharma, Senior Director of Solar Research at IHS.

Overall, IHS expects global PV installations to reach 46 GW in 2014. Large-scale projects will be the main driver of growth this year, with a predicted 9 GW of megawatt-scale installations in the last quarter alone.

EPIA figures show that China in 2013 was again the country with the largest market share, installing 11.8 GW, followed by Japan (6.9 GW) and the USA (4.8 GW). Overall, 11 GW of PV capacity was installed in Europe in 2013, a fall from 17.7 GW in 2012.

IHS, however, indicates some uncertainty in the Chinese market because of a recent push away from large utility-scale systems to distributed PV solutions. "Industry players have rightly become concerned about China's ability to install 8 GW of distributed PV in a single year, given the lack of channel infrastructure, financing conditions and issues over roof ownership rights," said IHS in a research note. However, the market analysis firm expects new policy to be released as early as July to help speed development of this market segment and most importantly ease bottlenecks in financing.

Assuming new policy is announced in Q3, IHS predicts China's PV installations to amount to 13.1 GW in 2014, with more than 70 per cent of this happening in the last six months of the year.

Germany is the top market in Europe, with 3.3 GW installed, followed by the UK (1.5 GW) and Italy (1.4 GW). PV now covers three per cent of the electricity demand and six per cent of the peak electricity demand in Europe, says EPIA.

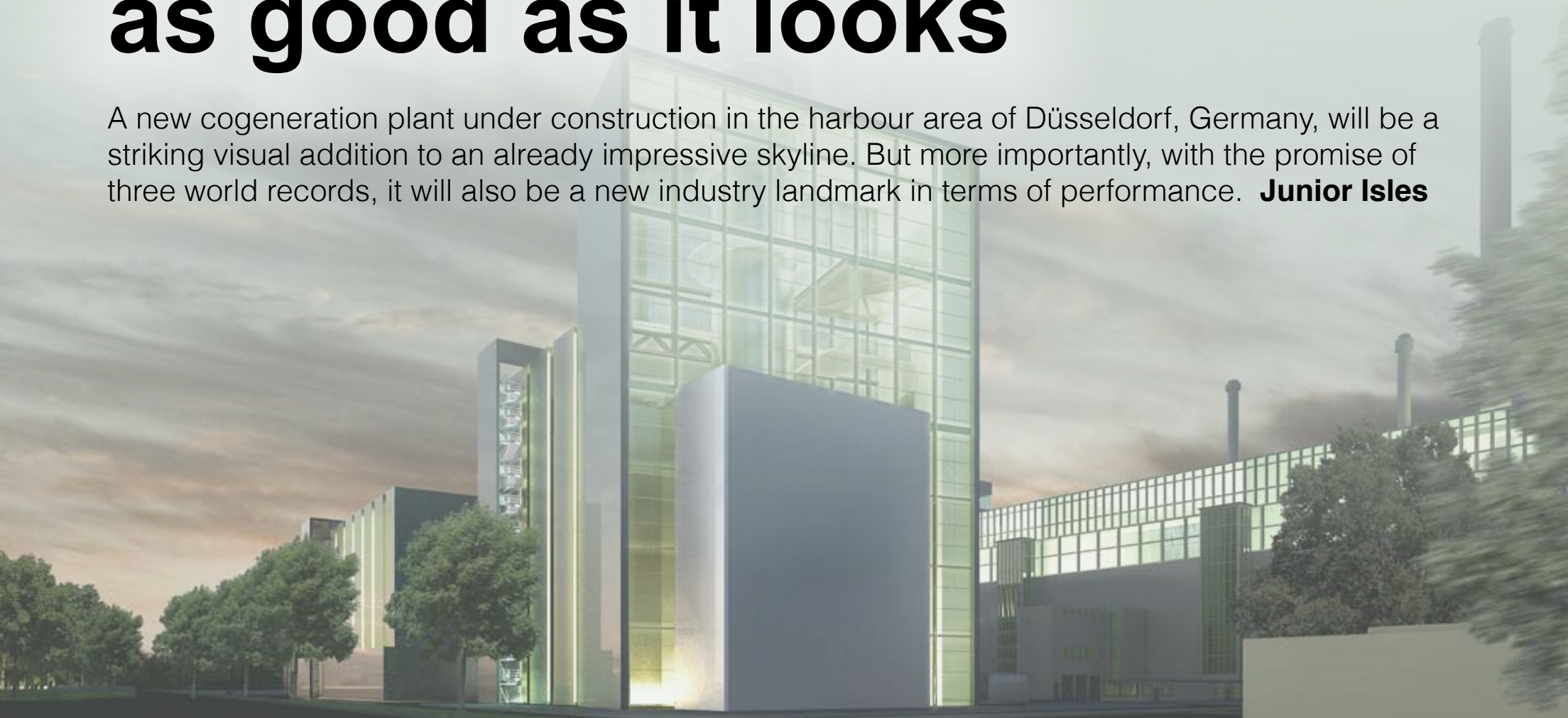
Other key emerging markets include India, Korea, Thailand and Canada.

■ Joule Africa has signed a memorandum of understanding with the government of Cameroon to develop 100 MW of solar capacity at a cost of around $200 million. Joule, the developer of the 607 MW Kpep hydropower project, will identify five sites suitable for hosting the photovoltaic facilities. The sites are likely to be in the north of the country and would increase Cameroon's electricity generating capacity by 15 per cent.

Special Project Supplement

Block Fortuna: as good as it looks

A new cogeneration plant under construction in the harbour area of Düsseldorf, Germany, will be a striking visual addition to an already impressive skyline. But more importantly, with the promise of three world records, it will also be a new industry landmark in terms of performance. **Junior Isles**



As might be expected of an international business and financial centre, the Düsseldorf skyline is striking. Renowned for its fashion and trade fairs, the German city is no stranger to impressive architectural works. Yet the latest 'work of art' currently being erected in the middle of the city has as much substance as it does style.

The modern glass-enclosed building going up at Lausward in the harbour area of the city will not only be a visible landmark, it will also set a landmark in the power industry when it begins operation about 18 months from now.

Lausward Block F offers a glimpse of future possibilities. When complete, the combined heat and power (CHP) plant being built by Siemens will boast three world records: it will have an electrical output of 595 MW, the highest ever for a single combined cycle unit; it will have an electrical efficiency of more than 61 per cent, a new benchmark for a combined cycle gas turbine (CCGT) power plant; and for the first time it will be possible to extract 300 MWth of thermal energy from a single power plant unit in combined cycle operation. When producing both heat and power, the plant will have an overall fuel efficiency of 85 per cent.

Lausward Block F, also known as Block Fortuna, is an example of the type of project that can still succeed in the changing German power market.

Due to several factors the business case for gas fired combined cycle plants has altered dramatically in recent years.

In reaction to the 2011 disaster at the Fukushima Daiichi nuclear plant in Japan, Germany took the decision to phase-out nuclear power by 2022. The country began its "Energiewende", or energy transition – an accelerated drive to bring more wind and solar generation on to the grid.

The decision, however, has not been without its casualties. This move to heavily subsidised renewables combined with unfavourable gas prices compared to coal, low carbon prices and a general slump in electricity demand across Europe has seen gas fired generation pushed down the merit order, leaving coal as the main replacement for nuclear for baseload generation. Numerous CCGT plants have been mothballed or closed as a result.

Although currently at an economic disadvantage, the superior flexibility, better performance and lower emissions of gas fired generation compared to coal means it is technically still the favoured option for complementing the increasing amount of variable generation on the grid. Notably in some instances, with the help of subsidies, there can also be an economic case if there is also a need for heat from the plant.

Lothar Balling, Head of Global Project Management, Siemens Energy commented: "Under the current conditions, Germany is no longer a market for gas fired combined cycle plants – except for those that also produce heat or process steam. In fact this is the main logic for the Lausward project. Also, if you look at the projects in Germany that are under development, all of them are 'brownfield' developments that are being integrated into an existing heat and power generation infrastructure."

The economic case for Lausward was enhanced by Germany's decision to encourage cogeneration. Like renewables, CHP is part of the EU's policy of decarbonisation. Based on the EU Combined Heat and Power legislation, Germany introduced its CHP-legislation, the so-called KWK (Kraft- Wärme-Kopplung i.e. Combined Heat and Power) law, in 2009. This was improved in 2012 to further promote CHP and achieve 25 per cent of power generation from CHP plants in 2020.

The revision gave a boost to large-scale CHP plants such as Block Fortuna. Stadtwerke Düsseldorf (SWD) the plant's owner runs an extensive district-heating network on both sides of the Rhine river. With its three generation centres at Flingern, Garath and Lausward, SWD provides approximately 950 000 MWth of district heating each year over its 200 km network to its customers.

Having demolished its coal fired plant at Lausward, SWD was looking for state-of-the-art power plant technology to ensure its competitiveness on the market, by increasing its share of self-produced electricity and producing district heating at lowest costs.

With the site being in the city centre it decided that due to emissions, noise and dust, another coal-fired plant was not the best option. However, with the challenges facing combined cycle power plants the company needed a plant that would offer the highest fuel efficiency, operational flexibility and economy of scale.

This led the utility to award a contract to Siemens for Block Fortuna just over two years ago, signing the contract to build the plant on May 29, 2012. Siemens started construction in early 2013 after receiving the final construction and environmental approvals.

As well as being responsible for full turnkey engineering, procurement and construction (EPC), Siemens will also supply the main plant components: an SGT5-8000H gas turbine, an SST5-5000 steam turbine, an SGen5-3000W generator and a Benson heat recovery steam generator (HRSG) with an in-house design. The SPPA-T3000 instrumentation and control (I&C) system, transformers and other auxiliary systems are also part of the package. On top of this, Siemens has signed a long-term maintenance contract for the main components.

The gas turbine, generator and steam turbine are all arranged on a single shaft. The same configuration was used at the record-breaking Ulrich Hartmann power station in Irsching, Germany. This plant, the first CCGT plant to break the 60 per cent barrier for electrical efficiency, began commercial operation in June 2011.

Commenting on the decision to opt for the 8000H gas turbine, Balling said: "The plant size is mainly determined by the heat requirement and the economics of smaller units worsens the business case. Using smaller turbines with multiple boilers to provide the 300 MWth of heat could work but not as economically under the required operating and commercial regime in Lausward."

The SGT5-8000H 50 Hz version is a single-shaft machine of single-casing design. With a gross power output of 400 MW, it is the world's most powerful gas turbine. The machine is designed to deliver nearly 400 MW in simple cycle operation and nearly 600 MW in combined cycle operation. In combined cycle condensing operation

the turbine can achieve a plant electrical efficiency depending on site conditions of more than 61 per cent with the recent operational experience.

Using the same configuration, the Ulrich Hartman plant, the world's first H-class combined cycle plant, achieved a power output in excess of 575 MW and an efficiency of 60.75 per cent. As of May 2014, this lead unit had racked-up 20 000 equivalent operating hours (EOH).

The successful operation of this and nine other 8000H machines now in commercial operation around the world, continues to give the industry confidence in this advanced technology. So far, a total of 32 units have been contracted.

Most recently, in May Petronas subsidiary Pengerang Power Sdn Bhd awarded the engineering, procurement, construction and commissioning (EPCC) contract for its Pengerang Cogeneration Plant (PCP) project in Johor, Malaysia to a consortium of Siemens AG, Siemens Malaysia and MMC Engineering Services Sdn Bhd. Siemens' 8000H gas turbines have been selected as the technology for the plant's four units, the first of which is expected to be commercially operational by mid-2017.

By mid-June 2014, 8000H units in operation globally will have accumulated more than 100 000 of EOH and made 1350 starts. These units have all demonstrated impressive levels of efficiency, flexibility and operational records in both 50 Hz and 60 Hz markets.

Experience gained from these plants combined with its physical location will allow Block Fortuna to push the performance envelope even further.

Balling explained: "Firstly, there's a little difference between 50 and 60 cycle because of the physical size of the turbine. Generally a larger unit means longer blades. This means smaller gaps and therefore lower losses. So the 50 Hz unit is slightly more efficient than the 60 Hz higher speed machine, which is smaller than its 50 Hz sister. Then there is the cooling water of the Rhine, which provides better cooling with once-through water cooling. Also many of the other plants use dry cooling."

Siemens also used feedback from the first 16 000 hours of operation at the Ulrich Hartmann station to make further performance improvements.

"Nothing substantial has really changed on the engine but we tweaked the combustion, the cooling system according to the operating experience and used the excellent performance of the compressor/ turbine blades and the balance-of-plant to get a bit more out of it," said Balling.

Siemens Energy began the design of its H-class SGT5-8000H gas turbine in October of 2000. After years of careful development, the first unit entered combined cycle operation at E.On's Ulrich Hartmann plant near Munich, Germany in 2011.

The engine is the world's largest gas turbine, weighing 440 metric tons and measuring 13 m long by 5 m high with a nominal base load inlet mass flow of 800 kg/s at ISO conditions.

Its basic design, adopted from previous gas turbine models, includes: a disc-type rotor with central tie-bolt and radial serrations; two journal bearings and one thrust bearing; generator drive at the compressor intake end; and axial exhaust diffuser.

The turbine section of the machine has four stages with air-cooled blades and vanes on the first three stages, and thermal barrier coatings on the first and second stages. Stage-four is uncooled.

The use of air-cooling in the gas turbine as opposed to steam offers much faster start-up and greater plant flexibility because it means the gas turbine cooling system is decoupled from the water/steam cycle. With a steam-cooled machine, steam quality has to be strictly controlled, which becomes more difficult as more complicated condensing and heat exchanging equipment is introduced into the water steam cycle.

The gas turbine has 13 compressor stages operating at a pressure ratio of 19.2:1. It has four inlet guide vanes, which further increases its operational flexibility.

The fuel gas system has five stages, two of which are pilots to control NO_X. The combustion system consists of 16 low-NO_X burners and baskets with air-cooled transitions. An annular combustor arrangement provides excellent uniformity of exhaust-gas temperature field. The result is significantly reduced emissions per kWh, which is especially important in an urban environment such as the city of Düsseldorf.

NO_X emissions will be as low as 25 ppm NO_X and CO is kept to 10 ppm. Meanwhile CO_2 is less than 325 g/kWh (based on electrical generation only). This means the plant will emit approximately 700 000 fewer tons of CO_2 each year than the worldwide average for electricity generation plants. This is equivalent to the quantity of CO_2 produced by about 350 000 cars, each driving 15 000 km a year.

The gas turbine has 13 compressor stages and a four-stage turbine section

Operating flexibility is a key aspect of Block Fortuna. A major contributor to the unit's high level of flexibility is a specially designed HRSG. The H-class HRSG is based on the proven Siemens Benson HRSG design but sets a new benchmark, exceeding F-class HRSG technology in all aspects. Compared to the F-class HRSG, the steam temperature and pressure are 35 per cent higher, while steam mass flow has been increased by 30 per cent.

Benson technology avoids the use of a thick-walled, slow warming HP drum. When combined with the 8000H gas turbine, it also enables fast start times compared with conventional combined cycle plants. The plant is designed to reach full load in 30 minutes from a hot start.

The boiler operates with main steam temperature of more than 600°C and a pressure of 170 bar. Reheat steam is 600°C/36 bar.

Steam from the boiler flows to an SST5-5000 steam turbine, which consists of a combined high- and intermediate-pressure casing (HP-IP) and a double-flow low-pressure (LP) section. These two turbines are coupled on one shaft and the steam will be guided from the IP turbines exhaust via a crossover pipe to the LP section.

Steam in the steam turbine HP section has a temperature of 600°C and pressure of 170 bar, IP steam is 600°C/36 bar and LP steam is 245°C/5 bar.

Notably, the new block allows up to 300 MWth of heat to be extracted from the plant, which is about 75 per cent of the maximum district heating demand of Düsseldorf. No further auxiliaries such as duct firing are needed to achieve this outstanding performance, especially with respect to eco-friendliness and security of supply.

This impressive performance is largely attributable to the steam turbine design, which uses sophisticated, three-stage steam extraction especially adopted for Lausward.

By using these steam extraction points, increased fuel utilisation and reduced power loss factor for district heating applications can be achieved. The power loss factor is as low as 0.16 for the important load case of 150 MWth district heating.

This is due to the fact that the multiple steam extraction can be fine-tuned to account for the most important load cases. The extraction stages correspond to steam extraction points within the water-steam-cycle of the power plant.

For district heating applications low-grade steam should be used to minimise power losses. This may mean extracting steam from the low-pressure section of the steam turbine. For process steam applications, the steam extraction points must be selected to ensure the necessary physical properties of steam: pressure and temperature.

Transporting a giant: the 8000H is the world's largest gas turbine, weighing 440 metric tonnes and measuring 13 m long by 5 m high

By using the three-point steam extraction layout, the most efficient way to balance steam export with district heating demand is achieved without the need for quenching high calorific steam from other upstream steam extraction sources.

This means that with increased district heating demand, the steam is extracted accordingly from the relevant sources, e.g. for a low to medium heating demand, only extraction from the LP section of the steam turbine is used.

With increased heating demand, further steam is extracted from the crossover pipe between the IP and LP section of the steam turbine. Subsequently at full district heating load, the steam is taken from all extraction points depending on the heat demand, which allows economic operation by high heat production paired with power generation.

The plant's flexibility means it can be operated in different modes if necessary – either in full district heating mode, as would likely be the case during winter, or in fully flexible condensing mode, for example during summer. Decoupling the heat from power generation is simply achieved by decreasing the district heat water flow so all the steam flows directly into the steam turbine. The single shaft arrangement also allows the steam turbine to be decoupled so only the gas turbine is operated. Subsequently the gas turbine can be run in low part-load if necessary.

If operated in power-only mode, the unit's fast start-up and ramping capabilities means it could potentially also provide frequency and grid support.

"From a design point of view, it can meet all current and future operating requirements. The plant is able to run flexibly, like all the plants we have been building in Germany for this purpose," noted Balling.

Construction of Block Fortuna has been progressing smoothly. As of mid-June, the gas turbine and generator were on site and erected and the steam turbine was en route. Final boiler erection was also under way. According to Siemens "everything is on track" for commercial operation around the end of 2015/beginning 2016.

Building the new plant on a site that has been used for power generation since the 1950s meant much of the necessary infrastructure, such as the district heating system and a direct connection to a 110 kV grid owned by SWD, was already in place. Also, an existing water-cooling system including pumps is being used.

"It helps a lot if the existing infrastructure is already there," said Balling. "It also made the approval process easier. We got the air permits and construction permits quickly and there have been no real challenges so far even though the construction site is very limited."

As erection work reaches its peak, the number of workers on site is approaching 600. During construction, there has been a strong focus on health and safety. Siemens notes that it has accumulated 430 000 work hours with zero incidents so far.

According to the schedule, cold commissioning will start around autumn this year with first steam production for the steam blowout in spring 2015. This steam, which is used for cleaning, will come from the gas turbine running at low load with a steam turbine bypass in place. Steam turbine commissioning and commissioning of the entire plant will follow later in 2015.

The commercial startup of Block Fortuna at the start of 2016 will be significant on several fronts. With its modern glass design, the plant is clearly an architectural showcase for SWD. Yet in addition to eye-catching architecture, it will also demonstrate impressive performance in terms of emissions reduction in the city.

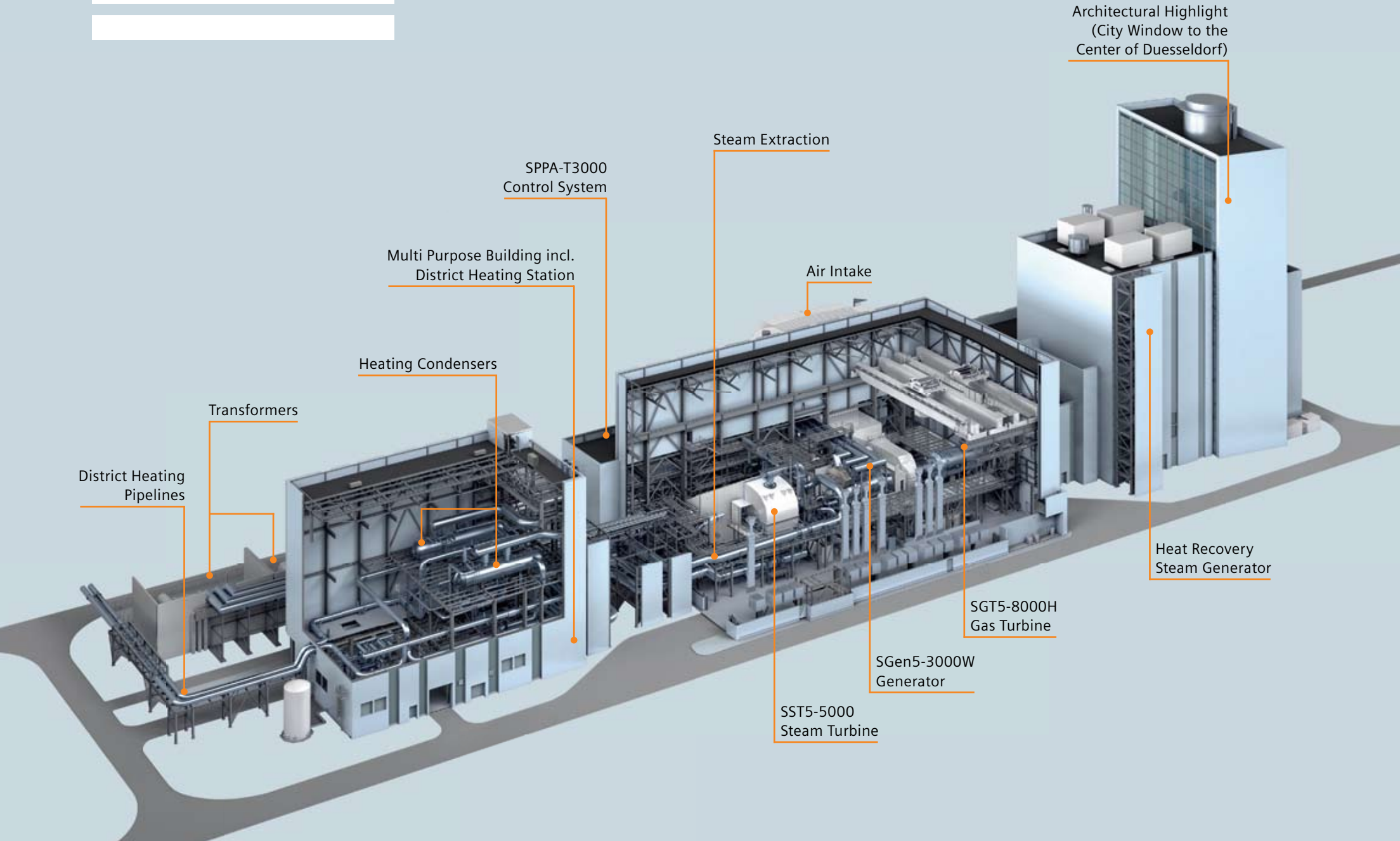
For the industry, its three world records pushes the envelope of what is technically achievable with today's latest technology.

Balling concluded: "It's a showcase for the customer to demonstrate to the vicinity their power of innovation and investment in the city. It is also a showcase for us in terms of performance; it once again proves our technology leadership in the market. At the moment, no other project of this size in the 50 Hz market has seen this level of efficiency and combination of performance."

Indeed, the new Lausward CHP plant offers a glimpse of the future of combined cycle cogeneration power plants in terms of both visual design and technical performance.

The plant will be located in the harbour area of Düsseldorf, Germany

SIEMENS



Power Plant Fortuna (Stadtwerke Duesseldorf AG, Germany)

Three world records in one power plant

Outstanding OEM EPC competence for cutting edge integrated power plant solutions:

- World Record No. 1
  At the heart of the plant will be the latest Siemens turbine generation: the SGT5-8000H. Its output is equivalent to that of 22 jumbo jet engines, and it weighs as much as an Airbus A380 with full fuel tanks. In combination with a downstream steam turbine (Siemens SST5-5000), the Duesseldorf power plant will provide an electrical output of approximately 595 megawatts (MW) in a single block.
- World Record No. 2
  The electrical efficiency of the power plant in combined cycle operation will be over 61 percent – exceeding the previous world record of 60.75 percent attained by the Siemens-built "Ulrich Hartmann" power plant in the Bavarian town of Irsching, Germany.
- World Record No. 3
  The plant's waste heat energy will be used to supply district heating for the city of Duesseldorf. The 300 MW of thermal energy that will be extracted for this purpose will set a worldwide record for the amount of power harvested by a single gas turbine generating unit.

Acciona alliance to broaden international reach

- Sale boosts balance sheet
- IPO planned for international unit

Siân Crampsie

Kohlberg Kravis Roberts (KKR) will help Acciona to finance the growth of its renewable energy business after purchasing a one-third stake in the Spanish firm's non-domestic business interests.

KKR, a private equity investor, will pay €417 million for 33 per cent of Acciona's renewable power plant business outside Spain, where drastic cuts to renewable energy subsidies have impacted Acciona's business.

Acciona posted a €1.97 billion net loss for 2013 and said in February that it would seek a partner to buy a stake in its overseas renewables business.

It said it would use the proceeds of the sale to strengthen its balance sheet and to make investments elsewhere in its infrastructure business.

"Our strategic alliance will broaden our international reach, and it will transform the scale of what we can achieve," José Manuel Entrecanales, Acciona's chairman and chief executive, said.

The deal is one of the largest in the European renewable energy sector so far in 2014. Outside of Spain, Acciona owns wind farms and solar plants in 14 countries, including the USA, Italy, Mexico, Australia and Portugal.

KKR and Acciona said that they would seek an IPO for the business in 2015 in order to access capital.

"I am really optimistic about the opportunity to partner with such a prominent renewable energy company and to help further develop what is already one of the largest operating renewable portfolios in the world," Henry R. Kravis, the private equity firm's co-founder, said in a statement.

GDF Suez seeks buyer for Australian assets

- French group continues to tackle debt
- Bonaparte LNG plan reviewed

GDF Suez is reported to be further reducing its portfolio in Australia as a means of cutting debt and enhancing its financial performance.

The European energy firm sold a 28 per cent stake in part of its Australian business to Japan's Mitsui in October 2013 and is now seeking a buyer for a 30 per cent stake in that business, according to *Dow Jones* reports.

GDF Suez is also reconsidering plans to build a huge floating gas liquefaction plant off the coast of northern Australia because the project does not meet its current commercial requirements.

According to *Dow Jones*, GDF Suez has appointed Deutsche Bank to find a buyer for approximately 30 per cent of a business unit that owns around 2400 MW of generating capacity in South Australia and Victoria states as well as Simply Energy, a retail business with 350 000 electricity and gas accounts.

The move is part of a wider plan to sell non-core assets globally.

Last month GDF Suez and its partner in the Bonaparte floating LNG project said that they would "consider other potential development options" to develop three natural gas fields located 250 km offshore west of Darwin.

The two companies maintain that the innovative floating LNG concept is "technically robust", but said in a statement that they would not take the proposed Bonaparte project forward to front-end engineering design (FEED) stage.

The project would help Australia to become a leading supplier of LNG to Asian markets. Alternative options for GDF Suez and Santos include the construction of a pipeline to Darwin where an LNG liquefaction plant already exists.

The generating assets up for sale are largely merchant and include the 46 MW Canuda wind farm, the 1542 MW Hazelwood coal fired power plant, the 396 MW Synergen gas-fired peaking plant complex and the 479 MW gas-fired Pelican Point power plant.

In 2013 GDF Suez sold 50 per cent of its Portuguese power assets to Japan's Marubeni and a 20 per cent stake in a large-scale hydropower project in Brazil to Mitsui. In 2012, GDF Suez sold a 60 per cent stake in a wind and solar power project in Canada to Mitsui and a consortium led by Fiera Axium Infrastructure.

RWE, E.On weather the storm

Germany's utilities are becoming more confident of an improved business environment with recovering power prices, reforms to electricity markets and adjustments to business models all set to take effect in the next two years.

Peter Terium, RWE's CEO told the *Financial Times* that power prices were bottoming out and that they could start to pick up. He also said that Germany's proposed capacity market would benefit the country's traditional utilities.

Analysts remain less bullish, however. In a research note, Investec said that power prices would be slow to recover because of the continuing overcapacity situation and likelihood of further renewables growth. This would also mean that capacity payments would be slow to emerge "and bedevilled by politics".

Investec Analyst Harold Hutchinson said in a note that E.On and RWE should be commended on their "clear and ruthless" strategies to weather the storm", which has been caused by a combination of economic recession and the closure of nuclear power plants. However, he added that Germany's nuclear issues posed risk and that there would be "no easy wins" for the utilities in the courts.

RWE confirmed that it has received a €400 million refund from the government after a Hamburg court ruled that nuclear taxes paid by Germany's utilities were unconstitutional. The verdict has been referred to Germany's constitutional court and the European Court of Justice.

Terium told the *Financial Times* that RWE would use the rebate to reduce its net debt of more than €30 billion.

Metso, Dale tie-up targets servicing

Metso says that an agreement with Dale Power Solutions will help it to strengthen its power automation business around the world.

The two companies have signed a deal to work together on servicing gas turbine power generator packages. Metso has already signed similar deals with companies in China, India and Russia and says that the agreement with UK-based Dale echoes this strategy of working closely with strong local partners.

Metso and Dale will provide upgrades, re-packaging, servicing, and long-term maintenance services for power generation packages. Combining their expertise will reduce maintenance and servicing costs by up to 30 per cent, Metso said in a statement.

"We have achieved this by combining Metso's most up-to-date open architecture DCS platform and controls expertise with Dale Power's experience in turbine package design manufacturing, maintenance and servicing," says Neil Buckland, Sales Director, EPS, Automation, Metso. "References have proven this capability. Turbine packages that we have serviced and maintained over their lifetime are achieving well above the industry standard utilisation rates for over 150 000 operating hours."

Sungevity expands with E.On partnership

E.On is deepening ties with solar panel installer Sungevity just a few weeks after making a strategic investment in the US firm.

Sungevity and E.On Benelux have announced a partnership under which Sungevity will offer its turnkey solar energy services to E.On's customers in the Netherlands on a co-branded basis.

The partnership could expand to other countries if successful and is in line with California-based Sungevity's strategy to expand overseas.

In May E.On helped Sungevity to raise $70 million in new equity finance and says that the new partnership will help it to expand its solar energy footprint. Sungevity has converted its minority stake in Dutch solar startup Zonline to full ownership and rebranded the company as Sungevity Netherlands.

Sungevity Netherlands will serve as the company's European headquarters and will manage and support the solar services provided to E.On customers as well as other Sungevity customers acquired through separate marketing initiatives and partnerships.

"As the second-highest priced energy market in Europe, the Netherlands is an ideal place to begin our strategic partnership with E.On," said Andrew Birch, Sungevity's Chief Executive Officer. "Being able to tap into their customer base, their brand recognition and their credibility as one of the largest utilities in Europe gives us a solid route to market with extensive growth potential in the face of rising demand for alternative energy sources."

Sungevity first entered the European market through a joint venture with Zonline in late 2011. It has also launched its brand in Australia.

Americas

GE inks MOU for new gas engine project

GE has inked a memorandum of understanding (MOU) with independent power producer, Sky Global Partners, to develop a power project featuring its new gas engine.

The new 10 MW-class size Jenbacher gas engine for the 60 Hz North American market was launched by GE in June.

The J920 FleXtra has one of the highest electrical efficiencies commercially available today for engines of its type and has a five-minute start up time.

The J920 FleXtra gas engine provides a capacity of 8.6 MW in the 60 Hz segment, with total efficiency of more than 90 per cent for combined heat and power applications. This is attained due to advanced technological features such as two-stage turbocharging.

ECO turbines destined for Brazil

Alstom has signed a contract with CPFL Renováveis to deliver, install and commission 19 ECO 122 wind turbines at the Pedra Cheirosa wind complex in Ceará state, Brazil.

The contract is the first between Alstom and CPFL Renováveis in the wind sector. The wind farm will have an installed capacity of 50 MW and will be ready for commercial operation by the end of 2017.

Con Edison orders DRMS

Con Edison has awarded Alstom a contract to supply a demand response management system (DRMS) as part of a smart grid project in New York City.

Con Edison will use Alstom's DRMS technology to manage energy supply and demand using consumer loads, offering electricity customers incentives to reduce their electricity usage during peak times.

At the heart of Alstom's solution will be its e-terraDRBizNet 3.0 software, which can be integrated with Con Edison's tools to manage resources on the grid.

Asia-Pacific

Gamesa closes third Philippines contract

Gamesa has reinforced its presence in the Philippines with a new turnkey contract for the construction, supply and installation of a 54 MW wind farm for Alternergy. This marks the third contract closed by Gamesa in this market, having signed orders totalling 144 MW in recent months.

Gamesa will install 27 of its G90-2.0 MW turbines in the Pililla wind farm, located on the island of Luzón. The company will also provide the operations and maintenance (O&M) services at the facility for five years.

Under the terms of the agreement, Gamesa will build the infrastructure needed to install and operate the facility, including a substation. The civil and electrical works will be executed by Gamesa together with the local Philippine consortium CASA.

The wind farm is scheduled for completion during 2015.

Lucy wins TNB contract

Lucy Switchgear has won the largest ever contract for ring main units in the South East Asia region. The contract, awarded by Malaysian utility company Tenaga Nasional Berhad (TNB) via Lucy Switchgear's regional partner, Sun System Engineering, is worth over £11 million ($18 million).

Under the two-year contract, Lucy Switchgear will provide over 3500 Sabre ring main units (RMUs) to support TNB's strategic development of the electricity distribution infrastructure across Malaysia. The firm said that the contract would help it to build its business in South East Asia.

Lucy Switchgear will start supplying RMUs in 2014, and deliveries will continue through to 2015.

J-Series win for Pocheon CCGT

Daewoo Engineering & Construction has awarded Mitsubishi Hitachi Power Systems (MHPS) a contract to supply the key components for the Pocheon combined cycle gas turbine (CCGT) power plant in Korea.

MHPS will supply two M501J gas turbines, one steam turbine and three generators to the new plant, which is being built by Daewoo Energy to the north of Seoul.

The plant is scheduled to start operating in November 2016.

Maiden order for Suzlon

ReNew Wind Power, a leading Indian wind sector independent power producer, has awarded Suzlon Group a 100.8 MW order.

Suzlon will provide ReNew with 48 of its S97-120m wind turbine generators for installation at the Bhesada wind site in Rajasthan, India. Suzlon will also oversee operations, maintenance and service of the units.

The order is Suzlon's first for its new towers with a 120 m hub height, designed with a combination of lattice and tubular steel for low wind sites. The towers make the S97-120m the tallest wind turbine generators in India.

Firms vie for Tongyang

Three companies are reported to be in the running to acquire Tongyang Power, which owns the license to build a 2000 MW power plant in Samcheok, South Korea.

The companies competing in the final stage of bidding are POSCO Energy, a Daewoo Engineering & Construction-led consortium, and a consortium led by Daelim Industrial.

Last year, Tongyang Power, an energy affiliate of Tongyang Group, won a Won3 trillion ($2.9 billion) license to build and operate the coal-fired thermal power plant to be located in Gangwon Province. The first phase of the 2000 MW power plant is expected to be completed in 2019.

The power industry forecasts that Tongyang Power will generate an estimated annual profit worth Won1.5 trillion ($1.5 billion) and Won300 billion in operating profit for 30 years after the power complex is completed.

Europe

Horns Rev tender published

The preliminary tender documents for the Horns Rev 3 offshore wind farm have been published by the Danish Energy Agency.

The documents have been issued to the four pre-qualified bidders for the project – Vattenfall, Dong Energy, E.On and Statoil. They contain preliminary specifications, a draft of the concession agreement, model licenses and authorisation, which will make it easier for the winner of the tender to commence construction and operation of the wind farm.

Horns Rev 3 will have an installed capacity of around 400 MW. The four pre-qualified bidders must submit their first offers by mid-September, 2014.

TSE orders SCR retrofit

Turun Seudun Energiantuotanto Oy (TSE) has placed an order with Foster Wheeler for the design, supply and installation of a retrofit selective catalytic reduction (SCR) system for the Naantali unit 3 power plant in Finland.

Foster Wheeler will commission the SCR system at the 125 MWe pulverised coal-fired unit by October 2015. The supply includes a new SCR reactor with catalyst and steel structures, ammonia water storing and feeding system, flue gas ducts and new ID-fans.

"TSE-Naantali Oy has made a decision to continue the operation of Naantali unit 3 in parallel with the new Naantali unit 4 combined heat and power plant," said Tapani Bastman, Chief Executive Officer of TSE-Naantali Oy. "Due to the new emission directive, an effective and reliable DeNOx system is needed to reach the new demanding emission level. This is a considerable investment for air pollution prevention."

Siemens supplies Jaworzno III

SPV-Rafako has placed an order with Siemens for the supply of a turbine island for the Jaworzno III steam power plant in Poland.

The new power plant will replace older power units at the Jaworzno site with ultra-supercritical steam technology. Siemens will provide one SST5-6000 steam turbine that will give the new plant an installed electrical capacity of 910 MW.

Siemens will also provide an SGen-3000W generator, an SCon-7000 condenser, the condensate and feedwater system and the high-voltage components. The order includes technical consulting for the installation and commissioning of the supplied components and systems.

Joworzno III will be one of the most efficient steam power plants in Europe, reaching net efficiencies of approximately 45.9 per cent.

Alstom contributes to Vendée smart grid

Alstom has been awarded a contract to deliver its Distributed Energy Resources Management System (DERMS) for the Vendée, a French administrative district, located on the west coast of France.

Smart Grid Vendée is a €28 million consortium-led demonstration project launched in June 2013 that will last five years. It will pilot a range of smart grid technologies to tackle the changing energy landscape, integrating renewable energies and modernising the electricity distribution grid.

Alstom-Saft supply storage innovation

A consortium of Alstom and Saft will contribute to the first demonstration launched by EDF on a megawatt scale for frequency regulation using a lithium-ion (Li-ion) battery storage system.

The two firms have signed a framework contract with EDF to supply an initial energy storage system using a container of Li-ion batteries, demonstrating the system's ability to regulate grid frequency. Alstom's MaxSine eStorage solution, connected to Saft's Intensium Max 20M storage system, will be installed on EDF R&D's experimental concept grid, dedicated to the development of grids and smart electrical systems.

Located on the EDF site of Les Renardières south of Paris (Seine-et-Marne region), this is the first installation of its kind in France. The storage system and the power converter will be delivered in late 2014.

Areva wins Vattenfall fuel contract

Vattenfall has selected Areva to supply fuel assemblies for four of its seven reactors in Sweden.

The contract is for four years covering 2016-2020 and includes services associated with the fuel supply. Areva will manufacture the assemblies in Germany.

The contract allows Vattenfall to secure a significant portion of its nuclear fuel supply needs.

International

Nordex secures three Turkey contracts

Nordex has won contracts to supply over 44 MW of wind power capacity to projects in Turkey.

The three contracts were awarded by Sancak Enerji, Yeni Enerji and Bicakcilar Enerji. Nordex will execute all the projects between spring and summer 2015, and will source all of the towers and some of the rotor blades locally, making the projects eligible for higher-rate feed-in tariffs.

Nordex will supply six Generation Delta N117/3000 wind turbines for the Urla wind farm in Izmir for Sancak Enerji, nine Generation Gamma N117/2400 turbines for Yeni Enerji for the Yenihisar wind farm, and two N117/2400 turbines for the Pitane wind farm for Bicakcilar Enerji.

Wärtsilä wins Saudi cement order

Umm Al-Qura Cement Company has placed an order with Wärtsilä to supply a turnkey power plant for a cement factory near Taif City, Saudi Arabia.

The 47 MW captive power plant will consist of five 20-cylinder Wärtsilä 32TS engines, a new 2-stage turbocharged version of the Wärtsilä 32 series. This new engine is designed to operate at outstanding efficiency even in extreme ambient conditions, such as high ambient temperatures and high altitudes.

The equipment will be fast-tracked for delivery by October 2015, according to Wärtsilä. The plant site is located in the mountain desert 1000 m above sea level, where temperatures can reach up to 50°C.

Kahramaa awards $108 million grid contract

The Qatar General Electricity & Water Corporation, Kahramaa, has awarded Prysmian Group an order for power transmission system expansion projects worth approximately €80 million ($108 million).

The contract comprises engineering, procurement, construction, installation and commissioning services for extra high voltage underground cable systems for a total of 173 km of 220 kV cable and related network components.

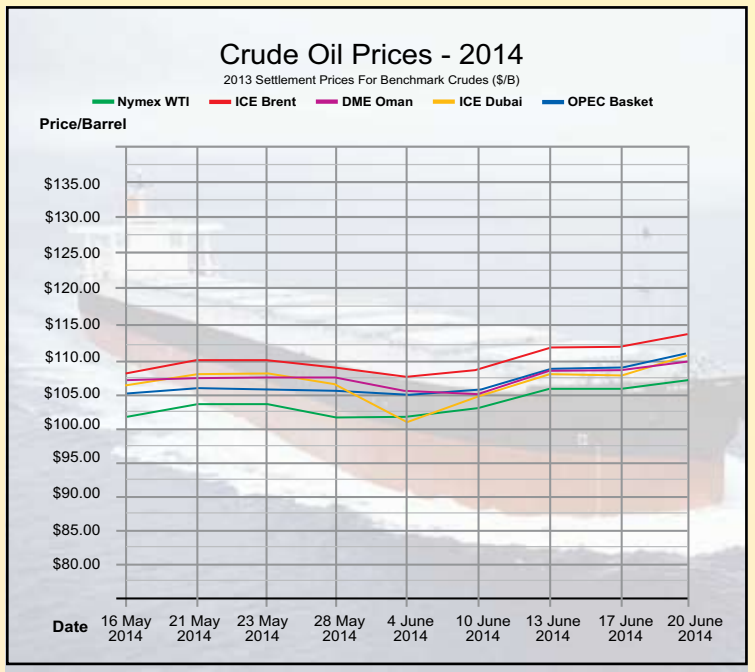
The deal is part of stage 2 of Phase XI of the Qatar Power Transmission System Expansion project aimed at strengthening the main transmission networks and securing power supplies to the industrial and residential sectors.

The upgrade also includes the replacement of an overhead line with an underground cable system. Installation of the first circuits will start in 2014 and the scheduled completion date is in 2016.

Oil

Iraq insurgency promises oil market uncertainty

- Iraq's plans to expand production and boost exports on hold
- Opec's power to meet global demand in doubt



David Gregory

The capture of Iraq's key northern refinery in Baiji by the Islamist State of Iraq and al-Shams (ISIS) signals a major disruption could be in the making for Iraq's oil sector and international markets.

Further advances towards or even the capture of Iraqi oil fields south of Baghdad would disrupt Iraqi production and exports, leading to higher prices in an international oil market where little spare capacity exists.

Following the capture of Baiji, ISIS said it would put the refinery under the control of Sunni supporters who will attempt to return it to operation.

Iraq's plans to expand production and boost exports are effectively on hold. In late June, at the time of the Baiji takeover, some foreign oil companies said they had removed foreign staff. Others would not comment on the status of foreign workers. Further foreign investment in the country's oil and gas infrastructure can be expected to evaporate in relation to conditions on the ground.

Oil production for Iraq had been looking up before the eruption of the ISIS insurrection – or what is becoming known as the Sunni Revolt. With output at around 3.4 million bpd and exports topping 2.5 million bpd, Iraq was tipped to become a major oil producer, eventually nearing the oil muscle of Saudi Arabia, Russia and the US. Now, that can be put into question. It remains to be seen how far the new cycle of violence in Iraq can push the country's oil sector back.

Iraq's Ministry of Oil had set a production target of 4 million bpd by the end of the year and 9 million bpd by 2020. There were plans to expand production and export facilities in Basra, rehabilitate the Kirkuk-Ceyhan oil pipeline, which is now under ISIS control, and build a new export pipeline to Jordan's port of Aqaba. In late June, at the time of seizing the refinery, ISIS took control of most of Iraq's western border, including that with Jordan, prompting Amman, which is already struggling to cope with 1 million Syrian refugees, to put its troops on alert. In its latest *Medium Term Oil Market Report*, released in mid-June, the agency said Iraq "remains the source of most of the expected capacity growth [within Opec], but this expansion looks increasingly at risk".

According to the projections made in the report, the IEA said roughly 60 per cent of the growth in Opec crude production capacity for the rest of this decade will come from Iraq.

"But while Iraq's production potential is huge, so are the political hurdles it is facing – and nothing provides a clearer example of that risk than the military campaign launched on June 9 by Sunni insurgents and the significant gains it promptly achieved in the country's north. News of the lightning advance sent Brent prices above $112/barrel at the time of writing, a gain of roughly $2.50/barrel from previous levels and their highest level for the year," the report said. On June 19, Brent crude settled at more than $115/b.

If Iraqi production is lost from the market, the global economy could wind up confronting new constraints just as it is beginning to improve. A number of other Opec members are facing problems of their own, so Opec's power to produce enough to meet global demand is in doubt.

There are questions as to whether Saudi Arabia, which is producing just under 10 million bpd and which has spare production capacity of around 2.5 million bpd could cover the Iraqi shortfall. Further, the country is facing its own growing demand for oil.

Iran, which was the number two Opec producer until it was unseated by Iraq, has plenty of resource potential in both oil and gas, but is hindered by international sanctions that may continue to be in place for some time, depending on negotiations over its nuclear programme.

Libya, which produced 1.6 million bpd before the ouster of dictator Moammar Qadhafi in 2011, is barely producing 200 000 bpd as a result of incompetent government, protests, and the control of production and export facilities by regional militias and political rivalries. Nigeria, which produced 1.9 million bpd in May, and Venezuela, which produced 2.5 million, are facing industry as wells as domestic political problems of their own.

Gas

China gearing up for its own 'golden age' of gas

Booming demand in China will lead to a near-doubling of the country's gas requirements through 2019. Accordingly, China is stepping up efforts to explore for and exploit its gas resources as it reduces its reliance on coal.

Mark Goetz

The next five years will see the advent of a 'golden age' of gas in China, similar to the one now firmly established in North America, the International Energy Agency (IEA) said in its *Medium-Term Gas Report*, released last month.

Booming demand in China will lead to a near-doubling of the country's gas requirements through 2019 and demand growth in China will compensate for a slight slowdown in demand growth in other parts of the world, the IEA said.

The Paris-based agency said poor air quality is prompting the Chinese government to adopt tough measures to reduce air pollution through the expanded use of natural gas.

China's power, industrial and transport sectors will drive overall Chinese gas demand to 315 billion cubic metres (bcm) in 2019, an increase of 90 per cent over the forecast period, the IEA said. It added that while China will remain a significant gas importer, half of its new gas demand will be met by domestic resources, most of them unconventional. Chinese production is set to increase by 65 per cent, from 117 bcm in 2013 to 193 bcm in 2019, the report said.

The IEA forecast that global gas demand would rise by 2.2 per cent per year to 2019 and said that much of this demand would be met by LNG, although new pipelines would also play an important role. Private sector operators in Australia, Canada and the US will lead the expansion of the global LNG trade, the agency said, adding that LNG production would grow by 40 per cent and reach 450 bcm in 2019.

"We are entering the age of much more efficient natural gas markets, with additional benefits for energy security," IEA Executive Director Maria van der Hoeven said at the report's presentation in Montreal.

"While demand growth is driven by the Asia-Pacific region – and especially China – supply growth for the international gas trade is dominated by private investment in LNG in Australia and North America," she said, but added that high LNG prices "are threatening to crimp demand as many countries are increasingly unwilling, or unable, to afford these supplies – and that could open the door to coal."

Chinese President Xi Jinping acknowledged recently during an energy policy speech that gas is of growing importance to China as the country moves away from its heavy use of coal. According to *Xinhua* news agency, Xi said China would step up efforts to explore for and exploit its gas resources and build more pipelines and storage facilities. He also said China's unconventional gas potential is a means of improving energy supply stability.

China's quest to establish long-term gas supplies has led to a number of recent agreements. In May, China signed with Russia a 30-year gas purchase agreement reported to be worth $400 billion for the delivery of 38 bcm/year of Siberian gas via a new pipeline. Shipments are to begin in 2018.

In mid-June, BP and the China National Offshore Oil Corporation (CNOOC) signed a heads of agreement for the supply of 1.5 million tons/year of LNG for a 20-year period beginning in 2019. A final deal, reported to be worth $20 billion, is expected to be signed in the coming months.

China's imports of LNG during 2013 amounted to 18 million tons/year, according to data released by the General Administration of Customs. Most contracted deliveries arrive from Qatar, Australia, Malaysia and Indonesia, but spot purchases were made from Algeria, Angola, Egypt, Equatorial Guinea, Holland, Nigeria, Trinidad, South Korea and Yemen.

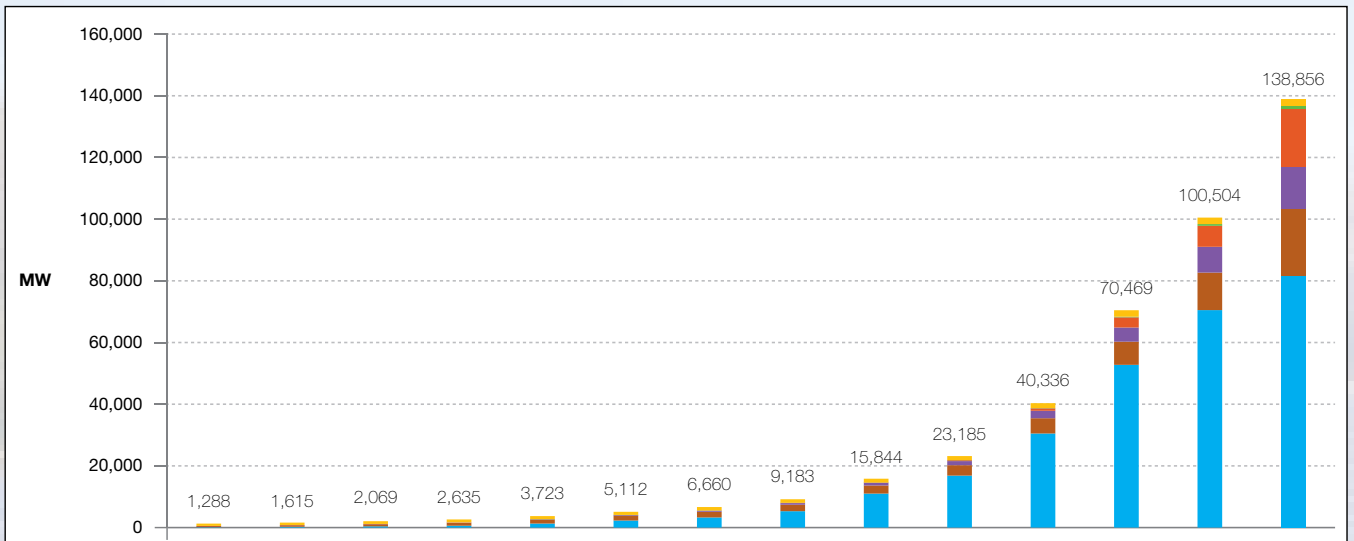
Last year China put three new LNG receiving terminals into operation, increasing the country's regasification capacity by 9.2 million tons/year. China has 10 LNG terminals and recently announced that it would construct three more by 2016.

Chinese companies have bought in to three Canadian companies involved in developing that country's LNG export business.

China's shale gas potential is estimated by the US Energy Information Administration (EIA) to be 50 per cent larger than those of the US, and Chinese companies have begun to establish partnerships with North American companies to draw on their expertise in the hydraulic fracturing process. China has set a target to produce 6.5 bcm of shale gas by 2015.

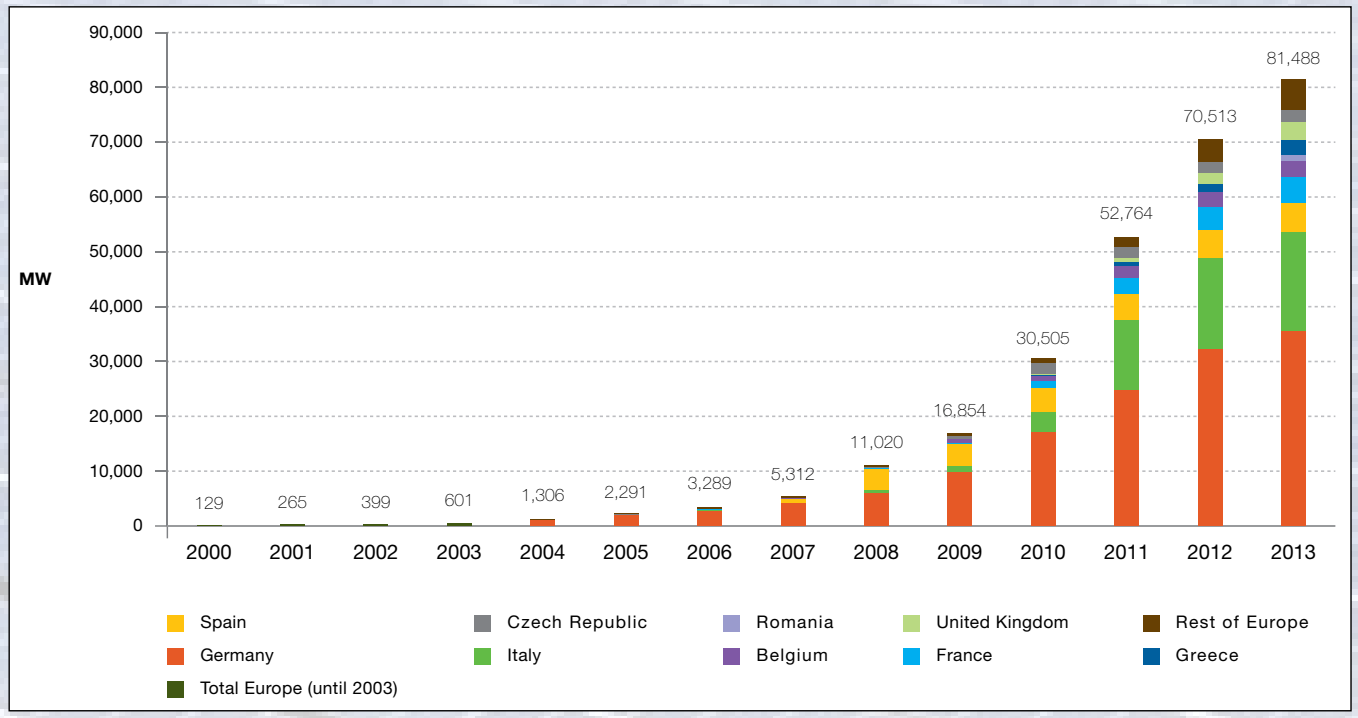
Industry experts argue that China could produce 50 bcm/year within five years and 200 bcm, including coalbed methane, within 10 years.

PV market development

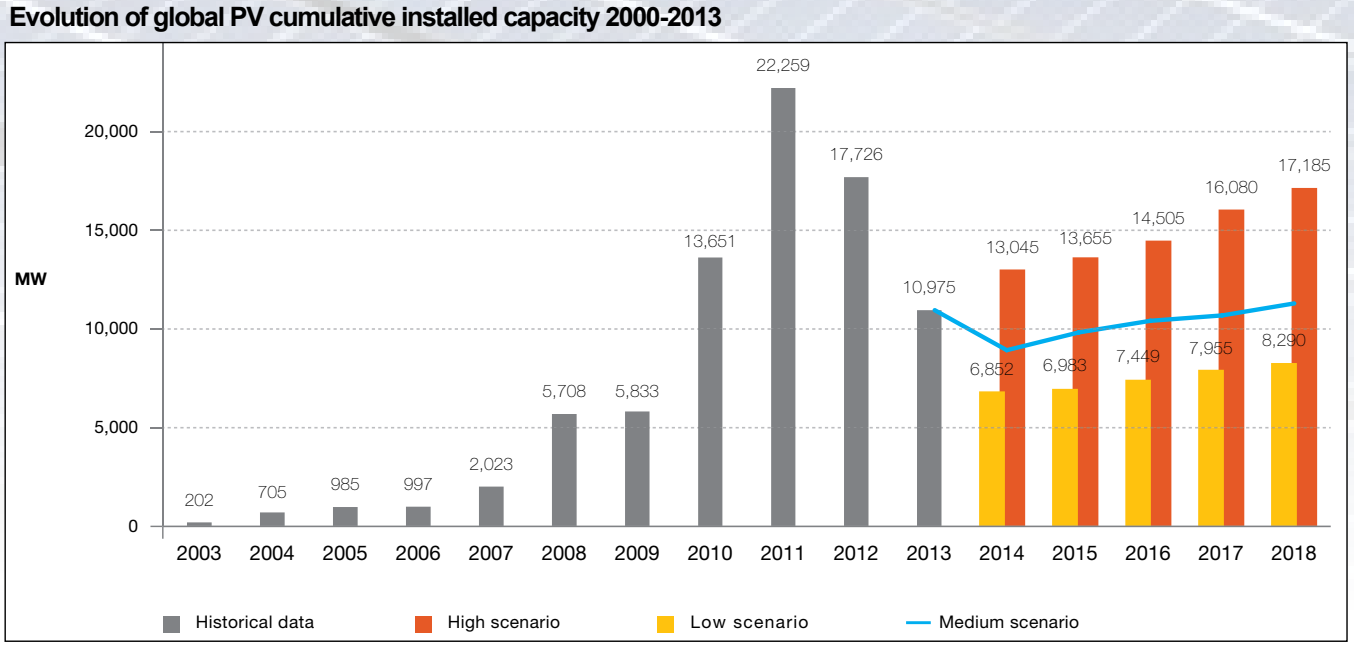


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
RoW	751	807	887	964	993	1,003	1,108	1,150	1,226	1,306	1,590	2,098	2,098	2,098
MEA	n/a	n/a	n/a	n/a	1	1	1	2	3	25	80	205	570	953
China	19	24	42	52	62	70	80	100	140	300	800	3,300	6,800	18,600
Americas	21	24	54	102	163	246	355	522	828	1,328	2,410	4,590	8,365	13,727
APAC	368	496	686	916	1,198	1,502	1,827	2,098	2,628	3,373	4,951	7,513	12,159	21,992
Europe	129	265	399	601	1,306	2,291	3,289	5,312	11,020	16,854	30,505	52,764	70,513	81,488
Total	1,288	1,615	2,069	2,635	3,723	5,112	6,660	9,183	15,844	23,185	40,336	70,469	100,504	138,856

Evolution of global PV cumulative installed capacity 2000-2013



Evolution of global PV cumulative installed capacity 2000-2013



European annual PV market scenarios until 2018

For more information, please contact:

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Source: Global Market Outlook for Photovoltaics 2014. © European Photovoltaic Industry Association

Community spirit

As Europe's large utilities struggle, community-scale generators backed by financial institutions are on the rise. *TEIT Times* speaks to **Volker Beckers**, a man who has been on both sides of the fence.

During his more than 21 years in the power industry, Volker Beckers has seen many changes. Having spent part of his career heading-up RWE npower and the last nine months as Chairman of renewable energy start-up company Albion Community Power (ACP), Beckers is in the fairly unusual position of being able to assess the changing landscape for Europe's power generators from two very different perspectives.

"When I started, privatisation and liberalisation was just beginning in some parts of Europe," Beckers noted. "During my 20-plus years of experience, I have worked in almost every part of the value chain, which helps me to better understand how one part of the market relates to another."

He says that the changing outlook for the traditional utility model is the result of several changes that took place around the time of the financial crisis.

"In 2009, a lot of changes happened at the same time," said Beckers. "The historic link between economic growth and energy demand growth was broken for the first time during the financial crisis. Around 2008/09 renewables began to really pick-up; there wasn't a strong belief at the end of the 90s/early 2000s that this would be the future in some countries. Now in some countries, more than 25 per cent of the mix stems from renewable sources.

"We also saw that older coal and gas plants were replaced with more efficient plant. Then suddenly came a drop in demand along with a greater focus on cutting consumption and improving energy efficiency. The influx in renewables also brought about 'prosumers' – people who produce and use electricity at the same time."

Having made investments based on a trend in demand over the last 100 years, some of the large players, says Beckers, have consequently been left fighting with their cost structure. "Some have made investments which are not as profitable as they used to be, while others have simply invested too little, too late in what I believe is important for the future, i.e. renewables."

Beckers: We have investors that are equally convinced that this is the right sector to invest in

Germany's RWE, the parent company of RWE npower could be deemed as one such company. In April, Peter Terium, CEO of the beleaguered utility admitted that the company was "late entering into the renewables market – possibly too late".

Yet it was no epiphany of his parent company's looming troubles that led to Beckers' change in career path. Beckers says he was keen to be "part of the journey" of a UK market that needed £200 billion in investment in low carbon technology. Having spent nearly 20 years at a large utility company, Beckers is aware of the challenges of striking a balance between the sometimes different interests of shareholders, customers and others in the organisation.

> Our business model is very different. We are going down new paths in raising capital, and gaining buy-in from communities will help in this respect

At ACP he enjoys having investors that have a shared vision of the company's under-pinning belief in renewables. "We have investors that are equally convinced that this is the right sector to invest in – you don't have to argue for the case," he said.

Beckers is also attracted by the company's diverse renewables portfolio, which includes rooftop solar, wind, biomass, biogas anaerobic digestion and hydro. "The past teaches you that it is important to have a diverse portfolio. Future governments, regulators or the market itself may change and you have to be able to adapt to these changes."

ACP is a power generation company launched by Albion Ventures, one of the UK's largest venture capitalists. Albion Ventures started in 1996 but it is only during the last few years that it has started putting greater focus on the ownership and operation of renewables. It highlights a trend where the financial services sector is moving to meet the challenges of the energy market.

"Just after the financial crisis I thought the potential model going forward would be the large utilities having the financial players bringing in their capital. Now what you see is the financial players like Albion, who are really enthusiastic about the energy market, bringing in expertise from the energy sector," observed Beckers.

As one of those veterans of the power industry who has been brought in for his expertise, Beckers is intrigued by the new role.

He said: "It's very interesting when you compare running a large plc with being chairman of a startup plc. It is small-scale compared to what I am used to doing but I think it's the right model. We bring together those who are willing to invest with those who have credible projects. We are not chasing crazy money because we have almost exclusive arrangements where we are able to spend the money we are getting from our investors wisely."

ACP aims to be a major producer of community-scale renewable energy by raising up to £100 million over four years to power some 35 000 homes in the UK and has already started to invest in a number of projects. "If we raise more capital," said Beckers, "we will take it because we have a project pipeline that is already one-and-half times bigger than what we have planned to invest in."

This £100 million is being invested in what the company sees as a "first wave" of projects that will have a combined generating capacity of 26 MW. The generating target, however, hinges on several things all based on "investing wisely".

As Beckers explained: "Different technologies have different return expectations. We are targeting a 6 per cent return for our investors and want to give them a predictable dividend. Therefore we need a mix of technologies. For example, solar has lower returns but is a straightforward technology; we know how to roll it out and what it should cost. Wind, however, is at the other end of the scale. There is double-digit return but you need to put more effort and time into site investigation.

"So there will be a blend of high single-digit and low double-digit returns. Depending on which technology we deploy, the 26 MW will therfore be higher or lower because the investment per kilowatt we are making varies between the different technologies."

Ultimately the size and shape of the generating capacity is driven by returns, degree of diversity, and the needs of the community. This last point is important as ACP is hoping to eventually be able to sell power directly to households in the community.

ACP is confident of its chances of success as the shift to community-scale generation steadily takes hold.

In April this year, the UK government published its the first ever Community Energy Strategy, setting out the role that communities can play in helping to meet the UK's energy and climate change challenges, while supporting a sustainable and secure energy system and lowering consumer bills.

Ramsay Dunning, General Manager, Co-operative Energy commented: "The UK needs to tap new sources of clean energy finance to move things forward at an accelerated rate. It can't rely on the Big Six energy providers or mainstream banking establishment to drive change – they are far too wedded to their large fossil fuel assets. Pensions and investment funds will be increasingly important in the future, but in many countries a combination of community energy generation and crowd-funding has been a key additional part of the answer."

Community-scale generation is not only a UK phenomenon. According to Co-operative Energy a quarter of Germany's electricity is from renewables. It says that one reason for this is that nearly half of its renewable energy capacity is owned by individuals, community groups and private developers.

"Between them, tens of billions of euros have been leveraged to produce a community energy revolution," said Dunning.

This is something that Beckers also sees as one of the big changes in the generation landscape.

"Even in Europe you have more and more regions wanting to develop and define their own destiny. The best way to get buy-in from the community is to make them part of the journey. At Albion we see working together with communities as key."

He added: "Having said that, this was very much the case when I started working at RWE but obviously organisations have to become more efficient and leaner, so you have to centralise more. At Albion, we are more on the decentralised scale and focus on [what some believe is] the lowest level of engagement, i.e. the customer. But in my view it's the highest level of engagement because you are dealing with the people you are selling the power to."

Although selling directly to consumers is not yet part of its business model, ACP is working with UK regulator Ofgem and the government on amendments to help new entrants like ACP to become suppliers of electricity from the assets it has invested in.

For now, the company is focused on getting to its £100 million target. With the business only having started towards the end of last year, it is in "single digits" of millions in terms of money raised. However, it predicts that it will not only be in double-digits by the end of the year but will also be deploying projects using the capital raised.

Beckers is confident there is more than enough liquidity in the market and believes the main issue for investors is confidence in getting a return on investment, which currently is helped by government renewables support schemes.

Despite the current negative rhetoric around the UK energy market, which is making it more difficult for traditional energy companies to find investors, Becker remains "absolutely optimistic" in ACP's chances of success.

"Our business model is very different. We are going down new paths in terms of raising capital, and gaining buy-in from communities will help in this respect."

Companies like ACP may not lead to lower energy prices but they will enhance competition. "This will help ensure that consumers believe and trust that whatever price they pay, it is a function of a fiercely competitive market," said Beckers. In the future, companies like ACP will, as he puts it, "continue to be a nuisance to complacent suppliers or those that are less innovative".

Turning the tide

The marine energy industry is making progress towards reducing risks in key areas that will help Europe to maintain its front-runner advantage and capture a new industrial market in the next decade. ***TEI Times*** reports.

Sevin says 100 ha of the Cherbourg port area is devoted to marine energy companies

By 2050, Europe could have up to 100 GW of wave and tidal energy installed capacity delivering 260 TWh of clean and reliable electricity – enough to power 66 million European homes.

In addition to meeting electricity demand in Europe, marine renewable energy (MRE) also represents a significant export opportunity.

According to Ocean Energy Europe, the European trade association for ocean renewables, with a global potential of up to 337 GW, wave and tidal energy could be a multi-billion-euro industry offering significant exports to markets in Asia and across South and North America.

The arguments for MRE are compelling. From a technology standpoint it has certain advantages over other energy sources. It provides an opportunity to generate energy at a wide range of locations throughout Europe. Additionally, wave and tidal power produce energy at different times, and more consistently, than other renewable energy sources, such as wind and solar. MRE also provides excellent long-term potential for economic growth, energy security and job creation.

However, wave and tidal energy must find a route to market in more uncertain times than their more mature renewable predecessors. In a tough economic climate, and without binding targets, the shift from the *status quo* will be far more difficult.

Policymakers at EU and Member State level are therefore seeking innovative ways to accelerate commercialisation. Agreeing a common plan and putting in place appropriate support will be essential steps towards industrialising these sectors and putting Europe on track to its 100 GW target.

A report published by Ocean Energy Europe last month says that political support must become political action for Europe to plug in pilot arrays and create a market for wave and tidal energy.

The report, known as the *Market Deployment Strategy*, is the final deliverable of the SI Ocean project – a two-year EU-supported project conducted by Ocean Energy Europe and its partners. Funded by the Intelligent Energy Europe programme, the SI Ocean project's Market Deployment Strategy makes several high-level recommendations for commercialising the emerging wave and tidal energy sectors.

The four key areas the report says the industry must focus on are: de-risking financing; technology; project consenting; and grid-related risks.

Progress is being made, and a flurry of activity in recent months will accelerate technology deployment and thus go some way towards reducing risks in these four key areas.

In total, over €700 million in private investment has flowed into the industry in the last eight to 10 years. This has yielded good results, and market leaders are now close to securing finance for the first small pilot arrays of tidal turbines.

As a result of this progress, machines deployed in the last five years have generated over 10 GWh of electricity to the grid, and several other technologies have completed proof-of-concept with scale models in test tanks and ocean test sites across Europe.

Assuming a good balance of capital grants and revenue support is made available, this industry could feasibly achieve financial close and approval for construction on up to 10 pilot arrays by 2020.

At present, it is likely these will be predominantly tidal arrays, and that there will be between three and five located in the UK and France, as well as one pilot array in Ireland.

Ireland and France have now put capital and revenue support mechanisms in place to drive development, which is stimulating market activity in these countries. Notably, France has offered a feed-in-tariff of £144/MWh for 20 years. Although this is less than the £305/MWh for 15 years offered by the UK, there is also a grant of £25 million per project.

Many believe that this type of support is far more attractive to technology developers than the high strike price approach.

Johnny Gowdy, Director at Regen SW, a leading UK-based centre of sustainable energy expertise and pioneering project delivery, said: "Although it does not make sense in pure financial terms on a spreadsheet, when projects are struggling to get financing because it's new technology, capex is king. Many see the UK strike price as a kind of pot of gold over the rainbow. The UK needs to find a way of unlocking capital if projects are to be built."

The new Irish and French support, together with the opportunity to secure grants from the European Commission's Horizon 2020 programme, is stimulating serious market interest outside of the UK.

In May 2014, the French government received no less than seven competitive bids after it opened a call for tenders, offering capital and revenue support for up to four tidal pilot arrays in French waters.

Notably, France is also busy preparing key ports such as Cherbourg to handle industrialisation of the sector following these pilots.

To capture the undersea turbine market, while also possibly taking up some activity in the manufacturing and logistics aspects of the offshore wind turbine industry, Port Normandy Authority (PNA) took the decision in February to increase the area available in Cherbourg harbour by 39 ha in order to provide more land by 2016. This increases the land dedicated to MRE to 100 ha.

Speaking at the Thetis conference in April, PNA Chief Executive Jean-Michel Sevin said: "The tidal investments are more mid-term and will not be for three or four years. Today 100 ha [of the port area] is devoted to marine energy companies. Signed agreements are already in place for about 70 per cent of this space. The remaining 30 per cent depends on the commercial outcome of what is being done today... we currently have DCNS working here but if other tidal turbine manufacturers want to start a factory here, we could accommodate them."

> Although it does not make sense in pure financial terms... when projects are struggling to get financing because it's new technology, capex is king

PNA has already signed eight contracts with private investors for Cherbourg. These contracts cover investment in both offshore wind and tidal. An important part of this investment is DCNS' factory for building tidal stream turbines. This represents a private investment of €200-300 million.

Cherbourg harbour will be used to produce a new tidal turbine developed by the DCNS-owned company, OpenHydro. The machine, which has recently completed testing at the Paimpol-Bréhat site off the northern coast of Brittany, is the first project featuring OpenHydro's innovative 16 m, 2.2 MW turbine.

Cherbourg harbour will be used to produce a new tidal turbine developed by the DCNS-owned company, OpenHydro

The turbine was recovered in April after more than 1500 hours of testing.

Thierry Kalanquin, Chairman of OpenHydro and Senior Vice President, of DCNS Energies and Marine Infrastructure, said the machine operated reliably and generated more than the expected amount of energy.

"The plan was to operate for 500 hours but we decided to test for longer to gather more information on the mechanical behaviour. The turbine worked without any issues and the results were promising. It generated 0.5 MW at a peak flow of 2.5 m/s."

Alstom is also at a similar stage in the path towards commercialisation. Following extensive testing of its 1 MW tidal stream turbine, Alstom is looking to produce a second-generation version of the machine for installation at pilot tidal farms. This could also possibly be manufactured at Cherbourg from 2016.

"After this pilot phase, we will start building commercial farms and expect to have several hundred machines in the water over several years," said Erwann Rio, Industrial Director at Alstom Renewable Power, New Energies, Ocean.

The Market Deployment Strategy report also noted that tidal technologies are expected to commercialise earlier than wave technologies. The number of tidal concepts that have managed to generate electricity during full-scale demonstration with devices of 1 MW or more is evidence of this.

Kalanquin noted that this is why DCNS is investing in the OpenHydro tidal turbine: "Wave has the biggest potential worldwide but its energy is very tricky to capture. We will have several commercial [tidal] projects by 2020. We have signed agreements for three in Europe and one in Canada; these will start at 100 MW."

Kalanquin says the standard size of their tidal arrays will be 300 MW. This will be the size of a project planned by OpenHydro and Alderney Renewable Energy in the Channel Islands, UK. The contract for this project was signed in April this year and is due to start development in 2020.

Although wave is not expected to commercialise as quickly, there have nevertheless been some significant developments in recent months. Despite last month's unexpected cancellation of a £10 million grant for the 10 MW Skerries tidal array in the UK planned by Siemens-owned Marine Current Turbines (MCT), the industry remains positive.

Gowdy said: "It's a bit of a setback but I'm sure the project will still go ahead. Many people had almost written wave energy off 18 months ago but we have had a bit of a resurgence down here in the southwest."

At the start of April Carnegie Wave Energy signed a commitment agreement to secure the fourth and final berth at Wave Hub, the offshore renewable energy test facility in Cornwall, UK, to demonstrate its next generation wave technology. Its UK arm, CETO Wave Energy UK (CWE UK), plans to deploy a 3 MW array of its next generation 1 MW CETO 6 technology in 2016, with the option to expand to 10 MW.

Gowdy noted: "We are seeing a slightly different type of wave energy technology developer, who is focused on the more practical issues of getting turbines in the water and testing them, which is heartening."

Meanwhile last month a new marine energy test centre was opened at the University of Edinburgh. The new £9.5 million FloWave Ocean Energy Research facility will have the capability to recreate scale version equivalents of waves reaching 28 m in height and fast-moving currents of up to 14 knots which are typical off coastlines around the UK and Europe.

The UK still needs to do more in providing capital support, whether in the form of grants, reducing the cost of capital or persuading the Green Investment Bank to put money into wave projects.

However, these developments,combined with those in France, are good for the whole industry. As Gowdy noted: "Linking in the tariffs with investment in infrastructure such as the development of Cherbourg is attractive to the industry."

Plenty in store for vanadium

With the North American market for energy storage looming large, the stage is set for vanadium flow batteries to make their US debut.

Junior Isles

Outside of pumped hydro and compressed air energy storage, the options for utility-scale energy storage remain limited. Most of today's battery-based technologies typically offer power outputs in the 1-2 MW size range and power durations of a couple hours.

Although vanadium flow batteries are able to offer much longer durations at higher power ratings, so far they have seen limited use in utility applications. However, with a looming boom in the industry driven by markets such as California, Canadian company American Vanadium Corp believes this could be about to change.

American Vanadium markets and sells CellCube vanadium redox flow batteries produced by German-based DMG Mori Seiki AG (GIL)'s Gildemeister unit, in North America. Following its transition from a mining to an integrated energy storage company last year, American Vanadium signed energy storage deals with New York's Metropolitan Transportation Authority (MTA) and US Department of Energy's National Renewable Energy Laboratory (NREL). The deals could signal the explosion of the technology in the important North American market.

Bill Radvak, President and CEO, American Vanadium commented: "Energy storage made an extremely slow start but I believe the momentum will overwhelm. There has been a massive request for proposals (RFPs) for incredible amounts of storage which I don't believe can be met – largely because everybody has been ignoring energy storage for far too long and suddenly in the last year it has become the Holy Grail."

California is probably the best example of this looming crisis. "The amount of solar that has been built or will be built in the next few years is stunning," noted Radvak. "It has two nuclear plants it is trying to get offline… but you can't make any of those changes without energy storage."

Consequently, California PUC has mandated the addition of 1300 MW of storage capacity by 2020. The need to integrate renewables, provide grid balancing and enable demand charge reduction is where vanadium flow batteries really come into their own.

Such applications could be key drivers for the technology. According to Lux Research vanadium flow batteries could become the leading battery storage technology, taking 30 per cent of the market by 2017.

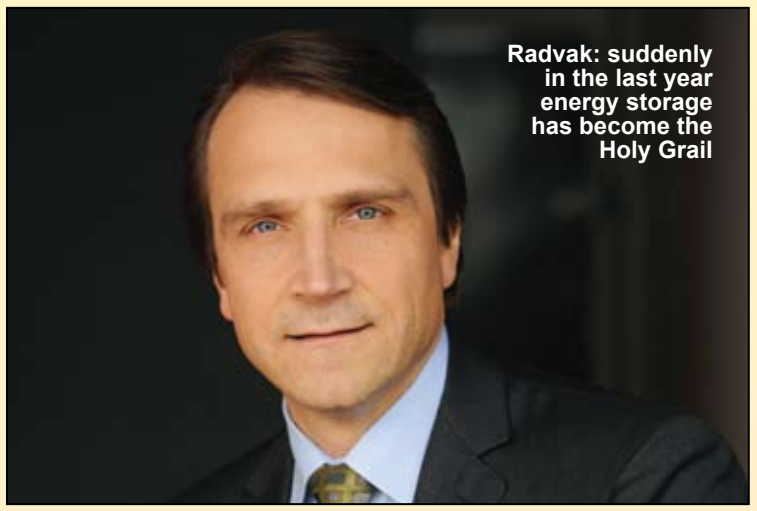
The batteries take advantage of the ability of vanadium to exist in solution in four different oxidation states. Vanadium is the only element that allows the same material to be used for both the anode and cathode.

This means there is no electrode degradation over the lifetime of the battery, unlike other batteries, which degrade with every charge/discharge cycle. Vanadium technology therefore offers a 20-plus-year battery life with unlimited cycling and no loss in efficiency. Further, they generate no heat and do not lose charge over time.

Radvak noted, however, that making these batteries work is a sizeable engineering feat. "It involves moving a tremendous amount of liquid every cycle. The technology is more akin to a fuel cell. The circulation of large amounts of liquid electrolytes means they are 30-40 per cent larger than lithium batteries but this is unlikely to be an issue in the utility-scale applications for which they are best suited."

Their relative complexity also results in high capital costs. Consequently, investment in the technology over the years has been fairly minimal – until recently. Radvak points out that there is more to the equation than capital costs.

"When you go for long duration, the capital costs are on a par with a large lithium battery. But energy storage is now being evaluated based on the levelised cost of energy (LCOE). Because these batteries operate reliably at the same efficiency for 20-plus years, the return on the battery is extraordinary. They can approach 15-20 ¢/kWh. Also, because the batteries have a 20-plus-year life, they fit in with the 20-year finance packages that are typically used for solar projects."



Radvak: suddenly in the last year energy storage has become the Holy Grail

He also notes out the economic importance of independent scalability of power and energy.

"What is unique about these batteries is the ability to separate power output from duration because the power stacks and tanks of vanadium electrolyte are separate. The energy of the batteries is essentially stored in tanks of vanadium in dilute sulphuric acid. This enables the different components to be scaled separately. So if you wanted to go from a 2-hour to 4-hour duration, you just double the number of vanadium tanks. This means duration can be doubled for typically less than 50 per cent increase in cost. So they become more cost-effective with longer duration. With lithium the cost would double since you have to double the power in order to double the duration."

While there is a tremendous requirement for short duration applications such as power and frequency regulation, Radvak believes the big growth in energy storage is in long duration applications for maybe 4-12 hours.

"You might be shifting three or four hours of solar during the middle of the day and storing it for use at, say, between 5 pm and 8 pm at night. This would allow demand charge reduction, where you can take three or four hours of energy off the grid in the middle of the night when it's cheap and move it to your peak period. But to do this, you need multi-megawatt, multi-hour storage, which is really the domain of vanadium flow batteries."

As utilities learn more about their needs and the pros and cons of each particular technology, Radvak believes deployment of the technology will accelerate rapidly.

"It was apparent last year that utilities had a limited understanding of energy storage applications and the technologies but I have to give them credit for how fast they are going up the learning curve," he observed. "Market immaturity has been the issue but this is evolving quickly. California's plan for 1.3 GW is an unbelievable shift; Ontario has put out a 35 MW RFP and Long Island has put out its 150 MW RFP. Hawaii is moving tremendously as it looks to move islands onto renewables. Next year the industry is expected to start purchasing ridiculous amounts of storage… and finally the market is educated enough to realise that lithium might not be *the* solution on the long duration side."

Radvak says American Vanadium will be ready for the boom. Gildemeister has already installed 65 CellCube systems worldwide, and American Vanadium is set to put the US on the map.

NREL is about to start demonstrating a CellCube storage system at its testing facility in Golden, Colorado for applications such as solar and microgrid that require long duration storage. Tests on this 20 kW/5-hour duration system will run for about three months.

The testing will demonstrate cycling of bulk energy and the performance of the unit in terms of efficiency and length of time that efficiency is maintained. Performance on short duration applications such as power and frequency regulation, which might be a secondary or tertiary function of the cells, will also be assessed.

Meanwhile the system ordered in April by NY's MTA, and expected to begin operation in November, will prove the economics of the technology over a two-year operating period. The $1.2 million project, which will be the first commercial installation of the CellCubes in North America, will feature three 30 kW vanadium-flow batteries each capable of supplying 130 kWh.

According to Radvak, energy storage could reduce the electricity bill of a building such as the MTA headquarters at 2 Broadway, Manhattan, by up to 20 per cent through demand charge reduction.

He added: "After super storm Sandy, their building was without power for two weeks and so the subway system was down for two weeks. These energy storage systems are also great cold storage. In times of trouble they can be used for backing up computers, communication systems and other mission-critical requirements."

Utility company Con Edison, also a partner in the project, will be looking at this installation carefully with an eye on state-wide applications. The utility will be looking at their ability to enable demand response, load balancing and back-up, ultimately avoiding billions of dollars in new infrastructure.

The requirement for such applications makes for an interesting near to mid-term outlook. As Radvak concluded: "In two years the industry will be in crisis mode trying to figure out how to service the demand. In five years we will have caught up and I think energy storage will be accepted on almost every system."

NREL is about to start demonstrating a CellCube storage system at its testing facility in Golden, Colorado

The ins and outs

A vanadium flow battery consists of an assembly of power cells in which the two electrolytes are separated by a proton exchange membrane. Both electrolytes are vanadium-based – the electrolyte in the positive half-cells contains VO^{4+} and VO^{5+} ions, the electrolyte in the negative half-cells, V^{3+} and V^{2+} ions. The electrolytes can be prepared using several processes, including electrolytically dissolving vanadium oxides (V_2O_5) in sulphuric acid (H_2SO_4).

Both half-cells are additionally connected to storage tanks and pumps so that very large volumes of the electrolytes can be circulated through the cell.

When the vanadium battery is charged, the VO^{4+} ions in the positive half-cell are converted to VO^{5+} ions when electrons are removed from the positive terminal of the battery. Concurrently in the negative half-cell, electrons are introduced converting the V^{3+} ions into V^{2+}. During discharge this process is reversed and results in an open-circuit voltage.

With the vanadium electrolyte accounting for about 40 per cent of the battery's cost, the volatility of vanadium prices has been a big issue for the technology. American Vanadium is therefore developing the only vanadium mine in the US to provide a critical source of vanadium electrolyte for CellCube energy storage systems.

Radvak noted: "Having a secure supply of vanadium is critical to the long-term growth of the business, this is why DMG Mori Seiki entered into the partnership with us. We have offered a long-term supply of vanadium at a stable price so they can be insulated from the historic price volatility."

Junior Isles

Tinker, tailor, soldier…

Some of a certain age might remember the old English nursery rhyme and counting game: *"Tinker, tailor, soldier, sailor…"* or at least a version of it, depending on where you went to school.

Triggered by the ongoing debate around affordability, the first two words at least came back to me while attending *The Economist*'s UK Energy conference last month. Energy affordability was one of the main issues being discussed – as it had been at several conferences throughout June.

The affordability debate has been gathering pace across Europe. Speaking to journalists at the Annual Eurelectric Conference Johannes Teyssen, CEO of E.On and current President of Eurelectric, said: "Affordability is now at the forefront of discussions and we are seeing some paradoxes. European wholesale power prices are similar to the US, although costs of producing are significantly more expensive. However, retail prices are skyrocketing for customers."

At the press conference, Eurelectric published a study prepared by Accenture looking at what is driving retail prices up. It said prices are made up of several components: energy and supply costs; network costs; and taxes and levies (policy support costs). Governments can report policy support costs in any component, which, says Eurelectric, makes a meaningful comparison of prices across Europe impossible.

Teyssen explained: "The European Commission produced a paper for the last energy summit on the level of prices with a breakdown of those prices based on statistics supplied by member states. When analysing the numbers we made some surprising findings. On digging a little deeper we found that energy levy costs, policy costs, social costs were embedded in energy costs. Sometimes they were reported as distribution charges, sometimes as part of wholesale price charges and sometimes as social cost charges."

Following its attempt to get some transparency into the numbers and analyse where the costs stemmed from, Eurelectric concluded that rising electricity prices are being increasingly driven by charges for renewables support.

It also stressed, however, that differences in taxation also affect relative price levels. It said that while the energy component has decreased and the network component has increased moderately, taxes and levies have risen sharply and account for most of the price increase for household consumers.

Eurelectric says taxes are "the prime culprit", claiming that even though levies have been increasing sharply, taxes still make up the bulk of the taxes and levies component. In 2012, every household consumer across the reporting countries paid €25/MWh in levies but €39/MWh in taxes.

> There is a lot of talk about return to markets… but every single major investment in this country in the electricity sector going forward is being determined by the state

"There is quite difference between the UK, which has very low levels of taxation, with say, Denmark, said Teyssen. "We are just tax collectors but from our perspective, clearly taxes are too high."

He pointed out that the level of energy taxes was made high at a time when energy costs across the globe were quite comparable. "Not so long ago, US energy prices were not so different to those in Europe. Then European governments decided that this was a good place to put some taxes, just like on cigarettes or alcohol. Now the world has changed and energy is no longer a good place to put taxes. Industries and retail customers are suffering because of high energy bills. A better energy policy and lower taxation would be advisable but this is totally up to parliaments."

Affordability and security of supply has certainly become the big issue, as governments have put their focus on low carbon policies. Mark Powell, Head of UK Utilities at A. T. Kearney described it as "the fourth wave" of energy policy.

"Affordability and security of supply will have to become centre-stage because of two fundamental realities. When the lights go off you will burn anything. Also, when energy is not affordable for very poor people that becomes a very serious problem. These two issues have been put aside on expediency of the coming third wave of policy [greening of the energy system]. The question is how, or whether, we re-balance this a little bit."

According to a recent report by A. T. Kearney, UK electricity prices will continue to rise by an average of 6 per cent per annum between now and 2024. This will make energy bills in 2024 some 52 per cent higher than in 2013. It claims that the biggest driver for rising bills is the absorption of costs to meet a range of national and European policies, such as the anticipated costs for emissions, the cost of implementing smart metering and those supporting renewable policies.

Affordability has become a huge political issue and arguably a huge threat to the industry itself. Powell commented: "With some even calling for renationalisation of the industry, energy companies would be wise to proactively respond to these threats – business as usual will simply not be an option."

Some would argue that the UK is already largely state-controlled, as the government continually tinkers with energy policy in an attempt to tailor it to meet the three goals of sustainability, security of supply and affordability.

Speaking at *The Economist* conference, Dieter Helm, a Professor of Energy Policy at the University of Oxford, said: "There is a lot of talk about return to markets… but every single major investment in this country in the electricity sector going forward is being determined by the state – with state-backed contracts and the state picking the technologies.

"Whether it be picking the technologies through the FITs (feed-in tariffs), or designing auctions so they are the right kind of length for a new gas station, or an auction that happens to be right for demand-side [management] – we are on a one-way track to greater and greater [state] determination."

The UK is not alone in its efforts to address the trilemma. "Europe is struggling at Commission level and every member state is thinking what to do," said Helm.

As prices continue to rise, affordability has driven the issue of utility trust high up the political agenda, especially in the UK. With this year's Eurelectric conference being held in London, it was therefore no surprise that building trust was the central theme.

During the opening session of the conference, Angela Knight, Chief Executive of Energy UK, said: "Building trust has never been so important. The industry is often in the position of having the finger pointed at it for all price increases, whether it is responsible for them or not. Price increases come from policies and taxation. They come from the green and social agendas as well."

Whether rising costs are due to ill-conceived policy, the cost of renewables, high taxation or just plain profiteering by the energy companies, one thing is certain – the witch-hunt is on for someone to blame. Rightly or wrongly, it is the big six energy companies that are in the firing line.

At the end of June Ofgem announced its decision to refer the retail energy market to the Competition and Markets Authority for investigation. Dr Doug Parr, Chief Scientist at Greenpeace UK, said: "What UK consumers need from this investigation is more than yet another ineffectual slap on the wrist for the big six's cartel. We need real change to the market…" And so, we can expect more tinkering with the market and tailoring of policy.

The old English rhyme was also used as the basis for a famous novel and film called '*Tinker, tailor, soldier, spy*'. It is the story of an intelligence officer called out of retirement to hunt down a Soviet spy within the British Secret Intelligence Service.

The last few words I recall from the rhyme are: *"…rich man, poor man, beggar man, thief"*. Were we to write a version of the novel for our industry based on the rhyme, it is clear that politicians would play the roles of '*tinker*' and '*tailor*'. If the customers are the '*rich*', the '*poor*' and maybe soon to be beggars, all that remains is to identify the '*thief*'.