

THE ENERGY INDUSTRY TIMES

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The combination of two emerging technologies that together enable the construction of smaller, cheaper nuclear fusion reactors could open up the way to commercialisation.

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Clean energy investment not slowed by low oil prices



Liebreich: figures highlight improving cost competitiveness of wind and solar

Recent figures show that global clean energy investment hit an all-time high in 2015 and despite the fall in fossil fuel commodity prices, the momentum from the Paris climate agreement looks set to carry through to 2016. **Junior Isles**

Investment in clean energy is not slowing as a result of falling oil prices, according to Bloomberg New Energy Finance (BNEF).

New figures released by the clean energy analysts show global clean energy investments hit an all-time high of \$329.4 billion in 2015. The figure is up 4 per cent from 2014's revised \$315.9 billion and beats the previous record set in 2011 by 3 per cent.

The growth comes despite several factors that were expected to constrain clean energy development, one of which was the dramatic plunge in fossil fuel commodity prices.

Over the 18 months to the end of

2015, the price of Brent crude plunged 67 per cent from \$112.36 to \$37.28 per barrel, international steam coal delivered to the northwest Europe hub dropped 35 per cent from \$73.70 to \$47.60 per tonne. Natural gas in the US fell 48 per cent on the Henry Hub index from \$4.42 to \$2.31 per million British Thermal Units. Oil prices have since dropped below \$30 per barrel.

Commenting on the clean energy investments, Michael Liebreich, chairman of the advisory board at Bloomberg New Energy Finance, said: "These figures are a stunning riposte to all those who expected clean energy investment to stall on falling

oil and gas prices. They highlight the improving cost competitiveness of solar and wind power, driven in part by the move by many countries to reverse-auction new capacity rather than providing advantageous tariffs, a shift that has put producers under continuing price pressure."

Almost two thirds of last year's investment in clean energy went to utility-scale projects such as wind farms, solar parks, biomass and waste-to-energy plants and small hydropower schemes. According to BNEF, this totalled \$199 billion, up 6 per cent on the previous year.

The total wind capacity added in

2015 is expected to be around 64 GW, accounting for over a quarter of the overall net capacity added last year, including fossil fuel-powered and nuclear-powered capacity. Solar was expected to end up at around 57 GW.

The biggest projects financed last year were offshore wind arrays in the North Sea and off China's coast. These included the UK's 580 MW Race Bank and 336 MW Galloper, with estimated costs of \$2.9 billion and \$2.3 billion respectively, and Germany's 402 MW Veja Mate, at \$2.1 billion.

In China, the two 300 MW offshore

Continued on Page 2

Renewables scale-up could boost world GDP

Achieving a 36 per cent share of renewable energy in the global energy mix by 2030 would increase global gross domestic product (GDP) by up to 1.1 per cent, roughly \$1.3 trillion, according to new analysis by the International Renewable Energy Agency (IRENA).

The report – *Renewable Energy Benefits: Measuring the Economics*, released at IRENA's sixth Assembly – provides the first global estimate of the macroeconomic impacts of renewable energy deployment. Specifically, it outlines the benefits that would be achieved under the scenario of doubling the global share of renewable energy by 2030 from 2010 levels.

"The recent Paris Agreement sent a strong signal for countries to move from negotiation to action and rap-

idly decarbonise the energy sector," said Adnan Z. Amin, IRENA Director-General. "This analysis provides compelling evidence that achieving the needed energy transition would not only mitigate climate change, but also stimulate the economy, improve human welfare and boost employment worldwide."

Beyond finding that global GDP in 2030 would increase by up to \$1.3 trillion – more than the combined economies of Chile, South Africa and Switzerland as of today – the report also analyses the country-specific impact.

Japan would see the largest positive GDP impact (2.3 per cent) but Australia, Brazil, Germany, Mexico, South Africa and South Korea would also see growth of more than 1 per cent each.

According to the report, improvements in human welfare would go well beyond gains in GDP thanks to a range of social and environmental benefits. The impact of renewable energy deployment on welfare is estimated to be three to four times larger than its impact on GDP, with global welfare increasing as much as 3.7 per cent. Employment in the renewable energy sector would also increase from 9.2 million global jobs today, to more than 24 million by 2030.

A transition towards greater shares of renewables in the global energy mix would also cause a shift in trade patterns, as it would more than halve global imports of coal and reduce oil and gas imports, benefitting large importers like Japan, India, Korea and the European Union. Fossil fuel ex-

porting countries would also benefit from a diversified economy.

"Mitigating climate change through the deployment of renewable energy and achieving other socio-economic targets is no longer an either or equation," said Amin. "Thanks to the growing business case for renewable energy, an investment in one is an investment in both. That is the definition of a win-win scenario."

Renewable Energy Benefits: Measuring the Economics, builds on previous IRENA analysis on the socio-economic benefits of renewable energy and on REmap 2030, a renewable energy roadmap to doubling the global share of renewable energy by 2030. IRENA says the study provides a first glimpse of the full range of benefits offered by a renewable energy transition.

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wind farms developed by Longyuan Power – Longyuan Haiyan Jiangiasha OWF and Datang & Jiangsu Binhai OWF – cost around \$850 million each.

After asset finance, the next largest segment of clean energy investment was spending on rooftop and other small-scale solar projects. This totalled \$67.4 billion in 2015, up 12 per cent on the previous year, with Japan by far the biggest market, followed by the US and China.

Geographically, investments surged in China, Africa, the US, Latin America and India. Europe, however, saw 18 per cent less investments in green energy in 2015 than in 2014. This was largely due to a slowdown in the European economy.

Liebreich, commented: “Wind and solar power are now being adopted in many developing countries as a natural and substantial part of the generation mix: they can be produced more cheaply than often high wholesale power prices; they reduce a country’s exposure to expected future fossil fuel prices; and above all they can be built very quickly to meet unfulfilled demand for electricity. And it is very hard to see these trends going backwards, in the light of December’s Paris Climate Agreement.”

There is strong evidence that the momentum from Paris will carry through into 2016. The National Bank of Abu Dhabi (NBAD) recently said it would invest \$10 billion in environmental projects.

The NBAD established a dedicated Sustainable Business team in August 2015, which is designed to “evaluate and create new financing products that will support the development of renewable energy and sustainable businesses”.

The new \$10 billion investment pledge will see the Sustainable Business team begin an engagement programme with policy makers, regulators, and industry players, “to capture up-to-date market trends and promote continued partnership between the financial sector and environmentally sustainable businesses”.

In early January Masdar Group, the Abu Dhabi-based renewable energy company said it will expand its clean energy development



Dr. Belhoud: Masdar boosting investment in Egypt, Jordan and Morocco

across the Middle East and North Africa region.

Dr. Ahmad Belhoud, Masdar’s Chief Executive Officer, said that the company is aiming to boost investments in renewable energy projects in Egypt, Jordan, and Morocco.

Masdar plans to invest more than \$1.7 billion in the renewables sector and is aiming to deliver nearly 1 GW of clean energy in the United Arab Emirates and across the MENA region.

Analysts have estimated that the demand for energy in the MENA region will double by 2030, requiring the installation of significant renewable energy capacity in the region.

GE could face backlash over planned job cuts

GE’s proposed job cuts in Europe following its deal with Alstom look set to run into stiff French opposition. **Junior Isles**

General Electric may be on course for clashes with the French government and union bosses over plans to axe 6500 jobs in Europe following its acquisition of parts of Alstom’s power business.

The US company, which closed the €9.7 billion deal last year, is proposing to cut 1700 posts in Germany, 1200 in Switzerland, 765 in France and 570 in the UK. The move to cut jobs in France, however, is likely to prove tricky as it contradicts conditions agreed in order for the acquisition to gain the blessing of the French government.

Key conditions demanded by the government included the setting up of several joint ventures and a promise to create 1000 jobs in France over three years.

GE says it will keep its promise on French jobs, while planning to get rid of 765 positions mainly in the Paris area. These cuts will include jobs at Alstom’s main headquarters.

According to GE, no job cuts are planned at the Alstom and GE turbine factories in Belfort. It also says new jobs will be added in other parts of the business such as renewable energy.

GE, which has promised \$3 billion of synergies from the deal, said in a statement: “This is a necessary step to increase the competitiveness of the former Alstom businesses and generate the synergies we have targeted.” It added that it would “work constructively” with unions.

Union bosses, however, have reacted angrily to the proposals. The Force Ouvrière, one of the five major union federations in France, criticised the “naivety” of those who let the deal go ahead in the first place. It called on politicians to stop the “dismantling” of Alstom in France “before there is nothing left”.

The French government has a stake in Alstom, which still has three joint ventures with GE, and is so essentially



Macron: keeping “a close eye” on GE

a partner of GE in Europe.

The government says it would “monitor” GE’s promise. French economy minister Emmanuel Macron, commented: “We will keep a close eye on General Electric and its commitment to create jobs in France.”

GE has set a target of raising its earnings per share by about 50 per cent over the next three years, and says raising profit margins will be one of the main strategies for achieving that.

In mid-January it selected Boston for its corporate headquarters, in the Seaport District of the city. Its offices in Fairfield and 30 Rockefeller Plaza in New York city will be sold to help offset the cost of the move.

Boston was selected after an evalua-

tion of the business ecosystem, talent, long-term costs, quality of life for employees, worldwide connections and proximity to other important company assets. The content of the company’s headquarters will change and emphasis will be on innovation, it said.

■ GE has announced that it has signed a purchase agreement to acquire Metem Corporation, a US-based provider of precision cooling hole manufacturing technologies for turbine blades. GE said that it made the decision to bring cooling hole-drilling capability in-house by acquiring Metem in order to allow it to realise supply chain efficiencies and reduce costs. GE and Metem expect the deal to close in the first quarter of 2016.

Obama highlights need for clean energy

Investing in clean energy and thus reducing reliance on fossil fuels was one of the key highlights in US President Barack Obama’s State of the Union address.

Obama said the country needs to accelerate the transition away from “dirtier” energy sources and increase its level of commitment in developing clean energy sources.

“Seven years ago, we made the single biggest investment in clean energy in our history,” Obama said. “And meanwhile, we’ve cut our imports of foreign oil by nearly 60 per cent, and cut carbon pollution more than any other country on Earth.”

According to the US Department of Energy (DoE), the country has 69 471 MW of installed wind capacity (as of October 2015) and 4000 GW of off-

shore wind potential. The country’s first offshore wind farm is currently under construction.

A comprehensive modelling analysis of the Environmental Protection Agency’s (EPA) final Clean Power Plan (CPA) recently published by M.J. Bradley & Associates found that the plan can achieve significant reductions of carbon pollution from the nation’s power sector while preserving a diverse energy mix.

Further, the analysis shows that the CPA will increase investment in cost-effective clean energy resources, such as renewables and energy efficiency, and can result in savings for customers on their electric bills.

States and utilities that increase investment in energy efficiency programmes will see a reduction in the

costs of complying with the CPA because plants will purchase less fuel and fewer new plants need to be built, the analysis shows.

Last month the EPA’s Administrator Gina McCarthy said moving toward solar and wind energy is good for the environment and the economy, noting that states that are pushing back against clean energy are missing a chance to add jobs. Two dozen states are currently challenging the CPA.

Meanwhile Obama has stopped issuing coal mining rights on government land as the government launches a sweeping review of their economic and environmental effects.

Obama had hinted at the move during his State of the Union Address. The move is significant as Federal land accounts for 40 per cent of all US

coal production.

The freeze on permits was immediately condemned by Republicans as the latest attack in an Obama-led “war on coal”, which they say is destroying parts of the US that depend on mining and cheap coal power.

Roger Ballentine, who ran climate policy for President Bill Clinton and is now head of Green Strategies, a consultancy, said the administration’s goal was to adjust the price of mining rights to ensure they reflected all of coal’s effects, including harm to the climate.

“It would be a misinterpretation to say what they are trying to do is eliminate mining on federal lands,” he said. “It is seeking to apply a more rigorous, modern process that takes into account all costs and benefits.”

Electricity investment must double

A new report from the World Economic Forum estimates that non-OECD countries will have to double their investments in electricity by 2040 to keep pace with demand.

The *Future of Electricity 2016* report calculates that from 2000-2014, non-OECD countries invested on par with OECD countries – about \$240 billion annually.

According to International Energy

Agency (IEA), however, meeting the electricity demands of consumers and businesses in non-OECD countries will require \$13 trillion investments by 2040 – outstripping OECD markets by a factor of 2 to 1.

Roberto Bocca, Head of the Energy Industries of the World Economic Forum commented: “Given the amount of electricity infrastructure that needs to be built in fast-growing countries to

serve growing demand, fast-growing countries will not only have to double their investments, but also ensure that these funds are used to develop all parts of the value chain so that none are left stranded or underdeveloped.”

The report offers solutions to improve the investment attractiveness of the power sector to help bridge this critical investment gap, as countries face increased competition for the

capital necessary to invest in power infrastructure.

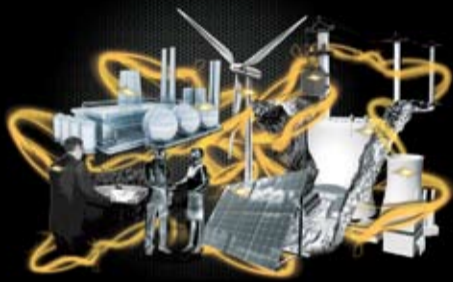
The *Future of Electricity* report is a continuation of the World Economic Forum’s Future of Electricity initiative, which launched at the 2014 Annual Meeting with the aim of providing governments, companies and communities with a platform for dialogue and learning amid the transition to a lower-carbon economy.

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Beothuk plans 1 GW offshore wind farm

■ Shallow waters off Nova Scotia coast targeted ■ Canadian wind continues strong growth

Siân Crampsie

Plans have emerged for the construction of a 1 GW offshore wind farm in Canada.

Beothuk Energy Inc. says it will build the C\$4 billion (\$2.83 billion) project off the coast of Nova Scotia and export energy generated to New England, USA, via a proposed subsea cable.

The news will provide Canada's growing wind energy sector with a further boost and could help cement the technology as the country's fastest-growing source of new power

generation.

Beothuk has formed relationships with a number of partners to help it get the project off the ground, including Jacob Capital Management, Siemens, Talon Energy and Madera Engineering. The proposed wind farm will be located in shallow waters some 20 km off the coast of Nova Scotia.

The firm has already announced plans to develop a 180 MW offshore wind farm off the coast of Newfoundland and Labrador. Both sites are characterised by excellent wind resources, says Beothuk, which is

already in discussions with Canadian and US utilities regarding power purchase agreements and partnerships for the Nova Scotia project.

The proposed Can-Am power link will run for 200 nautical miles, making landfall close to existing transmission facilities near Boston.

Last month data from the Canadian Wind Energy Association (CanWEA) showed that Canada added 1506 MW of new wind power capacity in 2015, and is set to add at least a further 1000 MW by the end of 2016.

"Not only has the wind energy

industry continued its five-year trend as the largest source of new electricity generation in Canada," said CanWEA president Robert Hornung, "the industry in Canada has demonstrated a five year annual average growth rate of 23 per cent per year (an average of 1438 MW per year)."

"Canada's new wind energy projects in 2015 represent over C\$3 billion in investment," said Hornung. "Wind energy is now providing economic growth and diversification to well over 100 rural communities across Canada through land lease income,

tax payments and community benefits agreements."

With the cost of utility-scale wind plummeting 60 per cent over the past six years, as reported in November by US investment bank Lazard, wind energy is now cost-competitive with virtually every other potential source of new electricity generation, CanWEA added. That downward trajectory is expected to continue, said CanWEA, while the costs of wind energy's main competitor, natural gas, are exposed to both future carbon and commodity price risk.

EGP begins Ituverava build

Enel Green Power (EGP) says it is investing \$400 million in the construction of a new solar photovoltaic (PV) plant in Brazil.

EGP announced that it has started the construction of the 254 MW Ituverava solar plant in Bahia state, making it EGP's largest solar power plant currently under construction.

The new solar plant, which is owned by three special purpose vehicles held by Enel Green Power Brasil Participações Ltda., is expected to be completed and enter into service by the end of 2017. The project will be supported by a 20-year power purchase

agreement (PPA) with the Chamber of Commercialisation of Electric Energy (CCEE - Câmara de Comercialização de Energia Elétrica).

■ Cubico Sustainable Investments has acquired two wind farms in Brazil – the 182 MW Caetés and 210 MW Ventos do Araripe I plants – from Casa dos Ventos for R\$2 billion. The purchases mark Cubico's first investments in Brazil, where it has opened an office. It said that it would examine further opportunities in the country as well as other key Latin American markets including Mexico, Uruguay, Peru, Colombia, Panama and Costa Rica.

Puerto Rico utility in crisis

Energy supplies in Puerto Rico are under threat because of a worsening cash crisis in the US territory.

Government officials have warned that the Puerto Rico Electric Power Authority does not have enough cash to meet creditor payments through to July and say that a comprehensive restructuring deal is needed to keep the utility afloat.

Last month the Puerto Rico government reached a last-minute deal with Total Petroleum Puerto Rico Corp. over \$16 million owed for the supply of gasoline, while the Electric Power Authority agreed a deal with creditors in December that forgives a portion of its \$9 billion debt.

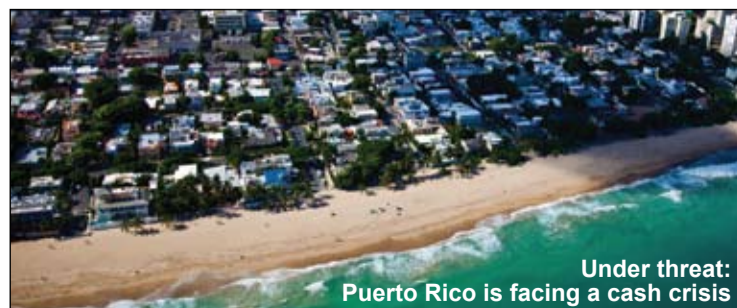
The latter deal forgives \$600 million through a 15 per cent discount and delays a more than \$700 million debt payment for five years. However it is

dependent on Puerto Rico implementing an increase in utility rates.

Lisa Donahue, Electric Power Authority's chief restructuring officer, told a congressional hearing in January that the company faces payments of \$700 million due on fuel lines of credit and roughly \$428 million due in principal and interest on outstanding bonds.

This represents more than twice the amount of cash that the company has available, Donahue said, adding that it would have already run out of cash if it were not for the December restructuring deal.

Puerto Rico's power bills are on average almost twice those in the US mainland and have contributed to the island's economic crisis by scaring away potential investors and forcing some businesses to close or lay-off workers.



Under threat: Puerto Rico is facing a cash crisis

DOE funds reactor research

The US Department of Energy (DOE) is funding further research into advanced nuclear reactor designs.

The DOE said it is providing \$40 million grants to two companies to support the development of pebble bed modular reactor (PBMR) and molten chloride fast reactor (MCFR) designs.

X-energy will develop its PBMR design while Southern Company has been awarded the funding for MCFR development. Both firms will provide cost share.

X-energy will partner with BWX Technology, Oregon State University, Teledyne-Brown Engineering, SGL Group, Idaho National Laboratory and Oak Ridge National Laboratory to solve design and fuel development challenges of the Xe-100 Pebble Bed Advanced Reactor.

Southern Company Services, partnering with TerraPower, Electric Power Research Institute, Vanderbilt University and Oak Ridge National Laboratory, will perform integrated effects tests and materials suitability

studies to support development of the MCFR.

"Nuclear energy currently accounts for about 20 per cent of the nation's energy mix, and its importance will continue to grow as America transitions to a low-carbon energy future," said Southern Company Chairman, President and CEO Thomas A. Fanning.

"This collaborative research effort will help accelerate the development of next generation nuclear reactors."

New energy goals adopted in Chile

- 70 per cent renewables by 2050
- 1 GW renewables added in 2014

Santiago, Chile: planning for a brighter future



Bachelet says Chile can confront "great challenges"

The Chilean government has signed off a new set of ambitious energy goals.

The country's new 'Energy 2050' strategy sets a target of generating 70 per cent of electricity from renewable resources by 2050 and also includes targets for energy efficiency, reliability and access to energy.

Chilean President Michelle Bachelet and members of her government signed off on the Energy 2050 plan at the end of December.

Bachelet said: "Chile is a mature country, with capacity to confront


great challenges and meet the challenges we can and make the necessary changes so that the country can emerge stronger. As a government we must act... and do what it takes to have a better future tomorrow today."

Chilean energy minister Maximo Pacheco said that the energy plan would "build a shared vision for the future development" of Chile's energy sector using the right social, political and technical support.

Last month the Chilean renewable energy association, Acera, said that the country added more than 1 GW of

non-conventional renewable energy (NCRE) capacity in 2014, and that it would most likely reach its goal of a 20 per cent contribution from NCRE to the national energy mix five years ahead of schedule.

■ Enel Green Power (EGP) has agreed to invest \$125 million in the construction and development of Sierra Gorda wind power plant in Sierra Gorda, Antofagasta region, Chile. The total installed capacity of the power plant will be 112 MW and the facility is scheduled to start operating by the end of 2016.



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Emissions trading vital for Southeast Asia

The Asian Development Bank (ADB) says a global emissions trading scheme (ETS) is vital for Southeast Asia's efforts to address climate change.

A recent report from the ADB said Southeast Asia had the fastest growth in carbon dioxide emissions in the world between 1990 and 2010, with its continued reliance on coal-fired power plants making it one of the biggest contributors to global greenhouse gas emissions.

The report said: "A global market for greenhouse gas emissions could benefit countries in the region, as Southeast Asia is a net exporter of emissions allowances... Naturally the most efficient way to achieve mitigation is generally to have a carbon market."

Carbon trading schemes in Europe and China have gathered significant momentum in recent months although a global system is yet to be established.



The ADB: carbon trading is the most efficient method of carbon mitigation

Taiwan setting new energy landscape

This year looks set to be a pivotal year in shaping the future of Taiwan's energy sector. Following news of plans to restructure state utility Taipower, the country also elected its first female President, which could signal the end of nuclear and a greater focus on renewables.

Syed Ali

Taiwan may soon be the first nation in Asia to resolve to become a nuclear-free nation following the election of Tsai Ing-wen.

Ms Tsai, who will not take up office until May, has publicly committed to turning Taiwan into a "nuclear-free homeland" by 2025. This would mean phasing out the nation's three 1970s-built nuclear power plants operated by the state-owned Taiwan Power Co (Taipower).

Taiwan had planned to build a fourth nuclear plant but large street demonstrations following the Fukushima disaster led to those plans being finally mothballed in April 2014.

The process of ending Taiwan's dependency on nuclear power "will be painful, but a short-term pain is better than sleeping next to a ticking time bomb," said Shieh Jyh-cherng, former Executive Director of a national earthquake relief foundation formed in the

wake of a devastating tremor that hit Taiwan on September 21, 1999.

An opinion poll of 1071 Taiwan adults (i.e. over 20 years of age) released December 16 by the Risk Society and Policy Research Center of National Taiwan University showed that nearly 79 per cent of respondents supported using alternative energy sources to reduce greenhouse gas emissions and 59 per cent opposed the use of nuclear power to curb carbon emissions, with only 38 per cent backing the nuclear option.

Moreover, the poll indicated that 85 per cent are willing to pay higher electricity prices for renewable energy.

Taiwan Renewable Energy Alliance (TRENA) Executive Director (Ms) Kao Yu-ping said the goal of a nuclear-free homeland by 2025 is "definitely feasible".

Taipower has already started taking steps to raise its levels of renewable

energy. In January the company said it plans to invest more than NT\$400 billion (\$12.02 billion) in renewables in the next 15 years, with a major focus on offshore wind and solar.

Taipower has identified Fangyuan, Changhua County, as the hub for its offshore wind programme, aimed at expanding the country's offshore wind power capacity to 1800 MW. Work on the first offshore wind farm 8 km off the coast of Fangyuan are planned to start in 2018.

In December the government increased solar feed-in tariffs by 12.5 per cent. It is targeting to add 500 MW this year and reach a cumulative capacity of 8.7 GW by 2030.

This year looks set to be a pivotal year in plotting the future of the country's energy sector. At the start of the year Taipower announced a corporate restructuring for the first time in its 70-year history.

The company intends to establish four business units to increase efficiency and lower management costs: a power generation division, nuclear power division, a transmission system division and a distribution and service division.

"Being a state-run utility, Taipower carries great expectations of its efficiency and performance. This business restructuring is necessary in order to improve the firm's efficiency," company chairman Hwang Jung-chiou said.

Minister of Economic Affairs John Deng said it takes time to gradually privatise the nation's energy market, but Taipower must continue to improve its operational efficiency to become more competitive.

"As to whether Taipower will be privatised, the government has to have further discussions and come up with a deliberate plan," Deng said.

India solar investment hits nearly \$11 billion

Investment in India's renewable energy sector reached \$10.9 billion in 2015, says a recent Bloomberg New Energy Finance (BNEF) report. The figure is close to the highest ever investment of \$13.1 billion achieved in 2011.

Notably, investment in solar energy reached \$5.6 billion in 2015, up 80 per cent from \$3.1 billion in the previous year. The capacity addition last year was more than double the level in 2013 and 2014 combined, at 2 GW.

The focus on grid-connected solar capacity meant that money flowing into the sector surpassed that of the wind sector for the first time. The report also notes that investments in wind have stayed relatively flat at \$4.1 billion in 2015, which is also the average achieved in the last three years.

As a result of the government's push to install 100 GW of solar power capacity by 2022, India has witnessed a staggering growth in solar, with capacity growing from just 22 MW in 2011 to 2.5 GW in 2014.

The BNEF report estimates that 2016 will see an increase of 140 per cent in solar capacity additions, to around 5 GW.

The first month of this year has already witnessed the signing of two significant deals.

At the start of January the state of Uttar Pradesh in northern India signed deals for large-scale renewable energy projects worth a total of \$6 billion. This includes agreements to add 10.6 GW of solar power and 3.5 GW of biomass-based power capacity by 2022.

In the middle of January the Himachal Pradesh government announced it was setting up a joint venture to generate 1000 MW of solar power in the cold desert of Spiti.

■ The Solar Energy Corporation of India (SECI) and the Russian Energy Agency (REA) announced the signing of a Memorandum of Understanding (MoU) to set up large-scale solar photovoltaic projects in India from 2016 to 2022.

China cuts coal use as power demand slows

- Electricity demand grows by 0.5 per cent
- Thermal generation could fall by 2-4 per cent per year

China's electricity demand grew only 0.5 per cent in 2015 (the slowest rate of growth since 1998), while coal imports were down 35 per cent year-on-year (y-o-y) in December 2015, according to data released by the National Energy Administration (NEA).

Based on the data available, the Institute for Energy Economics and Financial Analysis (IEEFA) estimates that coal fired power generation declined by 4 per cent y-o-y and coal consumption fell 5 per cent y-o-y, building on the decline reported in 2014.

The figures not only reflect a dramatic slowdown in the country's economy but also the positive progress being made in the shift towards a cleaner economy.

Following the release of the figures Li Junfeng, Director General, National Climate Change Strategy Research and International Cooperation Center, said: "A few other figures coming from

today's announcement and recent news is sending the strong signal that there is a clear acceleration of China's energy transition while the economy is declining.

"I think thermal power generation will continue to drop with an annual speed of 2-4 per cent and the non-fossil power generation will stay in a high growth rate of 20 per cent."

A recent report by research and consulting firm GlobalData said China was the world's leading market across a number of renewable energy technologies in 2015 and helped to drive global renewable installed capacity to an estimated 913.48 GW.

Lauri Myllyvirta (Mr), Energy Desk, Greenpeace commented: "The growth of power generation from non-fossil sources in China in the past few years is the largest deployment of renewable energy in history, for any country. This has enabled China to cover a 20 per cent increase in power

demand from 2011 to 2015 by clean energy while reducing coal use in the power sector."

Commenting on the latest data Ben Caldecott, Programme Director, Smith School of Enterprise and the Environment, University of Oxford said: "This has significant implications for coal-fired power stations in China – in terms of utilisation rates and profitability – as well as for thermal coal miners that have made big bets on seriously flawed projections of China's future demand for imported coal."

Latest figures confirm coal imports declined 30 per cent y-o-y over January-December 2015.

Meanwhile, in early January China said it will not approve any new coal mines for the next three years in a bid to reduce carbon emissions. According to the NEA, more than 1000 existing mines will also be closed over 2016, reducing total coal production by 70 million tonnes.



Emissions fall set to continue in EU

A new report forecasts strong declines for EU power sector emissions this year, but there are uncertainties over the decline of coal and the growth of renewables.

Siân Crampsie

European power sector emissions are expected to resume a fast downward trend in 2016 after taking a “pause for breath” in 2015, climate group Sandbag has said.

In an analysis of the region’s power sector in 2015, the London-based think-tank said that although 2015 saw a record increase in renewable energy generation, power sector carbon dioxide (CO₂) emissions are expected to fall by only 0.5 per cent.

While renewables generation grew rapidly in the UK, Germany and Italy, coal generation increased in the Netherlands, Spain, Portugal and Poland, it

said. Gas-fired generation also increased in Europe last year for the first time since 2010.

Sandbag said that the small change in power sector emissions last year was most likely a “pause for breath” after a massive 7.5 per cent fall in 2014. A downward trend in emissions is expected to resume in 2016 because of the forecast closure of old coal plants in the EU with a capacity of over 12 GW, the resolution of nuclear reactor problems in Belgium, Sweden, Switzerland and the Czech Republic, and a reduction in coal-fired generation in Spain.

The organisation added in its report that it expects EU emissions to fall by a further 21 per cent from 2014 to 2020,

putting the EU economy on track for 30 per cent emissions cuts by 2020.

There are uncertainties in its forecast, however, including how quickly renewable energy capacity will continue to be built, and how quickly coal-fired capacity will be phased out.

Sandbag notes that Germany has committed to pay to keep a small number of lignite units open as reserve capacity, and that increased interconnections in Europe is boosting demand for the country’s cheap lignite-fuelled power.

In the UK, while the government has committed to phase out all coal-fired power plants by 2025, it has yet to decide how to legislate this. In addition, seven coal-fired plants in the UK have

decided to sign up to EU emissions limits under the new Industrial Emissions Directive (IED), which came into force last month.

Under the IED coal fired power plants can opt to run limited hours up until the end of 2023 before closing, or upgrade their sulphur dioxide and nitrous oxide emissions technology to meet new standards, which are being phased in between 2016 and 2020.

Sandbag says 2.7 GW of Dutch coal-fired capacity will close by 2017, 5.8 GW in the UK by March 2016 and a further 4.3 GW across the rest of the EU in 2016, but none in Germany.

A number of coal fired power plants in the UK are converting to biomass firing.

Last month the European Commission launched an investigation into the use of subsidies to fund the conversion of part of Drax power station in northern England to biomass.

Drax said the investigation was “in line with expectations” as it was part of the process for obtaining state aid approval for a contract for difference (CFD) contract.

The Commission said it would investigate whether public funds are limited to what is necessary to support the conversion of Drax’s third unit to biomass, and whether it would distort the market. It said it “fully supports member state efforts to increase the use of renewable energy and pursue EU energy and climate objectives”.

Northern seas should be European powerhouse, say MEPs

European lawmakers are calling for greater deployment of marine renewables and offshore wind in Europe’s northern seas.

Twenty members of European Parliament (MEPs) have signed a new manifesto entitled “Northern Seas as the Powerhouse of North-Western Europe”, which proposes an action plan supporting renewables deployment offshore as well as implementation of an offshore grid.

According to Green MEP Claude Turmes, Europe’s northern seas could deliver more than eight per cent of Europe’s power supply and realise savings of €5-13 billion per year by 2030.

The manifesto aims to develop the potential of renewable energy located in the North Sea, surrounding Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Sweden and the UK.

Among its proposals are a seven-step action plan, the creation of a high-level working group, development of a 20-year grid plan by TSOs, and the establishment of a special finance vehicle designed to kick-start investment.

The manifesto also calls for greater regional coordination in areas such as tenders and regulatory frameworks to help cut red tape and streamline costs.

First stage of Kilroot 100 MW storage project completed

Work on a 10 MW energy storage facility in Northern Ireland has been completed, according to global power company AES.

The project is the first step in a plan to develop a 100 MW storage array at Kilroot that would be the largest of its

kind in the world.

The array consists of 53 000 batteries arranged in 136 separate nodes and will help balance supply and demand and support the all island transmission grid via system operator, SONI.

AES said that the system will also enhance power supply, enable more efficient dispatch of existing generation assets, and increase the ability to integrate renewable power sources. Its control system can respond to grid changes in less than a second.

Gas Natural Fenosa to make wind investments in Canary Islands

Gas Natural Fenosa Renovables is to invest €91.2 million in the construction of several new wind farms in the Canary Islands.

The Spanish firm registered plans to build 70 MW of new capacity under a special taxation regime launched by the government. Its plans include the setting up of 12 wind power parks on Gran Canaria, Fuerteventura and Tenerife islands.

The Ministry of Industry, Energy and Tourism opened the tax incentive scheme for the development of wind farms, aiming for a quota of 450 MW. The addition of renewable energy to the islands’ grids will help to reduce

emissions and reduce the cost of electricity production.

Gas Natural Fenosa said it would now start the process of obtaining all the remaining permits needed for construction of the wind farms in order for them to begin operating before 31 December 2018 – the deadline set by the Ministry of Industry, Energy and Tourism in the regulations governing the quota.

The firm registered a total of 46 MW in Gran Canaria, 18.4 MW in Fuerteventura and 6.3 MW in Tenerife. It said it would develop the wind farms either alone or as part of a consortium with third parties.



Several new wind farms in the Canary Islands will help reduce emissions and the cost of electricity

Lagisza progresses

Construction of a new gas-fired combined cycle (CCGT) power plant is set to start in Poland after Tauron Polska Energia announced that it had completed project financing.

Tauron said in January that it had completed project financing of €188 million for the construction of the Lagisza power plant in Bedzin Lagisza, Poland.

The 413 MW power plant will be

constructed by Tauron and Polskie Inwestycje Rozwojowe (PIR). It will be one of the largest investments made by Tauron in the Silesian province and is due to start operating at the end of 2018.

Tauron and PIR, a state investment vehicle, agreed a deal in 2014 on the co-financing of Lagisza. PIR said it would provide up to zloty750 million (\$182 million) for the project.

Energy firms discuss Iran opportunities

■ Italian, Danish firms mull investments ■ Iran seeks cooperation agreements

Siân Crampsie

International energy firms are considering investments in Iran after Western sanctions on the regime were lifted.

Companies in Italy and Denmark are reported to have been seeking deals in Iran's electricity and oil and gas sectors as Iranian President Hassan Rouhani embarked on his first European tour last month.

Kristian Jensen, Foreign Affairs Minister for Denmark, said that Denmark's exports to Iran could increase after the lifting of sanctions. Together with Hamid Chitchian, Iran's Minister of Energy, they announced that Denmark will be constructing a wind turbine facility in Iran.

Media reports last month also indicated that Eni, Enel and Finmeccanica would attend meetings between the Italian and Iranian governments during Rouhani's tour.

Renewables are at an early stage of development in Iran, contributing less

than 1 per cent to the country's total energy consumption. However, the Iranian Government has said that it plans to install around 4500 MW of wind power and around 500 MW of solar power under its 6th Development Plan. The Renewable Energy Organisation of Iran (SUNA) has identified some prospective areas in Iran for installing close to 15 GW.

Mostafa Rabie from SUNA said: "Iran can supply over two-thirds of its energy through wind power. The long-term policy over the next decade is to supply 50 per cent of required energy through renewables."

Iranian Deputy Energy Minister Houshang Falahatian said in January that contracts to set up 1000 MW of solar and wind power plants would be concluded by 19 March 2016. He said that the country's existing wind and solar installed capacity currently stood at 250 MW.

Iran is examining the feasibility of increased energy cooperation with its

neighbours in the Caspian region by establishing an energy trading network, which could export electricity rather than natural gas to regional customers.

"We can import natural gas from Caspian Sea to generate and export electric power, Mahmoud Khaqani, a member of the Iranian Association of Energy Economics, was quoted as saying by *Irna*, Iran's official news agency.

Iran is keen to boost electricity cooperation with its neighbours. In early January officials noted that it could export as much as 3000 MW to Pakistan.

According to the Foreign Office, Pakistan currently imports 74 MW of electricity from Iran for its coastal Makran division. This import was set to increase to 100 MW by the end of January. The two countries are currently considering two projects, involving the export of 1000 MW of power.



Iran is keen to boost electricity cooperation with its neighbours

Abu Dhabi bank pledges sustainable funds

The National Bank of Abu Dhabi (NBAD) has pledged funds for environmental projects in a bid to make "a real contribution" to the energy challenge.

NBAD announced at the World Future Energy Summit in January that it would invest \$10 billion in the next ten years on projects focused on environmentally sustainable activities.

The commitment is the first of its kind for a Gulf Council Country bank, and

would support areas of need identified by NBAD in its recent report, 'Financing the Future of Energy'.

That study identified a funding gap of \$48 trillion over the next 20 years to meet global energy demand with renewable energy playing a critical role in the energy mix.

"The world is heading towards a very significant funding gap for energy globally," said Alex Thursby, Group CEO of NBAD. "This is par-

ticularly true across the West-East Corridor, the rapidly growing super-region that stretches from Africa through the Middle East to Asia – and filling it is going to be a big task. We want to make a real contribution to the region's ability to rise to the energy challenge."

NBAD said that even in the current climate of low oil prices, the expansion of renewable energy would continue because of long-term, strong drivers.

"It is for this reason that we have made this commitment of \$10 billion today," said Thursby. "Through our Sustainable Business team we hope to become a positive force in the banking sector in the region, accelerating the transition to a much needed new world of energy."

Nathan Weatherstone, Head of Sustainable Business Banking at NBAD, commented: "Our research has identified that there is approximately \$640

billion of investment required for renewable energy projects across the West-East Corridor. But sustainable business is wider than just renewables and includes activities like clean transportation, sustainable water, waste management and energy efficient real estate.

"The scale of the opportunity is significant and today we commit NBAD to an ambitious but much needed goal."

Solar funding set for strong 2016



Global corporate funding in the solar sector fell slightly in 2015 but is set to rebound in 2016.

Mercom Capital Group says that total global corporate funding in the solar sector, including venture capital/private equity (VC), debt financing, and public market financing, raised by public companies came to \$25.3 billion, compared to \$26.5 billion in 2014.

Raj Prabhu, CEO of Mercom Capital Group, commented, "Overall it was a good year for the solar sector considering the turbulence in the stock markets and trouble with yieldcos in the second half of the year. The extension of the Investment Tax Credit (ITC) was a much needed boost for the sector, paving the way for a strong 2016."

In a new report on funding and M&A activity in the solar sector, Mercom

said that corporate M&A transactions also fell in 2015 to over \$3 billion in 80 transactions. The downstream sector of the market dominated M&A activity with 49 transactions, it said, with the largest disclosed transaction being the \$1 billion acquisition of an 80 per cent stake in Gestamp Asetym Solar from Gestamp Renewables by KKR, an investment firm.

There were a record 204 large-scale solar project acquisitions for over 12.7 GW, double that of 2014 where 6.4GW changed hands in 163 transactions. Spurred by yieldcos, 2015 has been by far the best year for solar project acquisitions.

Mercom also tracked 373 large-scale project announcements worldwide in Q4 2015 totalling 12 GW and 1118 project announcements totalling 41.1 GW for 2015 in various stages of development globally.

Oman prepares for maiden wind award

A contract for the establishment of Oman's maiden commercial scale wind farm project is now likely in the first quarter of 2016, according to a key official of the Rural Areas Electricity Company (RAECO).

RAECO is developing the 50 MW project alongside Masdar. Four international companies are in contention for an engineering procurement construction (EPC) contract to implement a 50 MW wind energy project at Thamrait in Dhofar governorate.

Khalil al Mantheri, section head for renewable energy at the wholly government-owned utility, said the selection process leading to the keenly awaited contract is yet to be completed.

"The evaluation process is almost complete, but a decision on the winner is yet to be finalised," Al Mantheri said. "An award may be likely in the first quarter of 2016," he added.

An international operator will be appointed to run the wind farm, said Al Mantheri, while a number of Omani staff will be trained in various technical areas encompassing the operation and maintenance of the facility.

Also as part of the EPC contract, a 12 km long overhead line will be constructed to link the wind farm with the Salalah grid. The wind farm will start operating in 2017.

Austrian-based international firm ILF Consulting Engineers is providing

consulting and engineering services in the establishment of the venture.

■ Doha-headquartered Nebras Power has entered into an agreement to acquire Qatar Electricity and Water Company's (QEW) stake in Phoenix Power Company, which owns and operates one of the largest Independent Power Projects (IPPs) at Sur in the Sharqiya South governorate. The acquisition, which is expected to be completed in January 2016, covers OEWC's 9.75 per cent stake in Phoenix Power and a 15 per cent stake in Phoenix Operating and Maintenance Company, which carries out the operation and maintenance activities of the 2000 MW plant.



Implementation of Oman's first wind project is to start in the first quarter of 2016

E.On launches new look business

■ Premier buys UK E&P assets ■ Uniper set for spin-off

Siân Crampsie

E.On says that the division of its business into two separate units marks an important milestone in its strategy.

The German energy giant completed the split at the beginning of January, creating a new unit that will be responsible for operation of the firm's conventional power plants and energy trading functions.

E.On will now focus on renewable energy, energy networks and customer solutions in a bid to take advantage of opportunities in Europe's changing energy landscape.

The firm has also announced that it will sell its UK oil exploration and production (E&P) business to Premier Oil, completing a strategic review of its North Sea E&P sector that began in 2014.

The new unit – Uniper – will operate independently from Düsseldorf, while E.On will operate from a new campus in Essen. E.On hopes to complete a full spin-off of Uniper later in 2016 after gaining shareholder approval.

E.On announced just over a year ago that it would split its business in response to the different challenges of the new and conventional energy worlds. While renewable energy has expanded rapidly in Europe, conventional power plants have struggled to compete in an environment characterised by slack electricity demand and low power prices.

"This liberates us from continually having to make compromises," said E.On CEO Johannes Teyssen. "Our ambition is for both companies, which soon will be legally independent of one another, to become leading

players in their respective energy worlds."

E.On announced in January that the UK's Premier Oil would buy 100 per cent of its shares in its UK E&P subsidiaries in a transaction valued at \$0.12 billion. E.On's UK oil and gas upstream portfolio comprises equity interests in 40 licenses, including a 5.2 per cent interest in the Elgin-Franklin field, a 47 per cent interest in the Babbage field and a 50 per cent interest in the Tolmount discovery.

E.On CFO Michael Sen said: "The successful sale of our E&P business in the UK represents the final step of the strategic review, with all E.On E&P North Sea assets having now been divested.

"This transaction further strengthens our financial profile and provides flexibility to implement our strategy

and to reposition the group."

Uniper will be led by Klaus Schäfer as CEO and Bernhard Reutersberg as Chairman. It will operate approximately 40 GW of coal, gas and hydro-power plants and have a strong position in global energy trading.

"Economic prosperity is and will continue to be fuelled by energy," said Schäfer. "The global population is growing and so is its consumption of energy, which people take for granted. Ensuring that people have a secure and cost-effective supply of power and gas will remain a crucial task.

"Hardly any other European company has a comparable power and gas portfolio and knows global energy flows and the success factors in this business as well as we do."

E.On is not the only German utility restructuring its business in line with

the changing energy landscape.

In December RWE announced plans to spin-off its renewable energy business in response to Germany's move away from nuclear power. In a move resembling that of its rival E.On.

RWE said it would bundle its renewable energy, power-grid and retail businesses into a new company, and float at least 10 per cent of it in an IPO at the end of 2016.

"According to current planning, a good half of the proceeds of the IPO will be used for further developing renewable energy," RWE Chief Executive Peter Terium told journalists.

In January the company said it expects to have more than doubled the operating result of its renewable energy business last year from the €186 million (\$201.9 million) achieved in 2014.

Enel puts renewables first

■ Shareholders approve EGP deal
■ Gains foothold in Germany

Enel is finalising details of a corporate restructure that will put renewable energy at the core of its business strategy.

Enel Green Power (EGP) shareholders last month approved the integration of the firm and most of its assets into Enel, with the latter taking its stake in EGP from 63 per cent to 100 per cent.

Following the move, renewable energy will account for 52 per cent of Enel's power capacity, up from 38 per cent in 2004. Wind and solar power plants will account for the majority of the increase.

EGP will retain ownership of its Italian assets and a small number of overseas investments, it said in a statement after gaining shareholder approval in an extraordinary general meeting in January. Enel shareholders have also approved the deal.

Earlier in January EGP announced that it had started construction of a 108 MW wind farm in Oklahoma, USA, and that it had entered the German market with the acquisition of a majority stake in Erdwärme Oberland (EO) from Erdwärme Bayern, a

specialist geothermal energy development company.

"This acquisition is very significant because it opens the door for Enel Green Power to a major, stable renewable energy market such as Germany," said Francesco Venturini, CEO of EGP. "We intend to build a solid platform for future investment opportunities in the country, both in geothermal power and in other sectors, contributing to achieving the target for the share of renewables in the European energy mix."

EO has recently developed a project for the construction of a geothermal plant with a maximum expected capacity of about 26 MW. The project, located 50 km southwest of Munich, will be developed under a mineral exploration concession granted by the Bavarian Ministry for Economic Affairs, Media, Energy and Technology. EO will begin geological exploration activities in 2016.

EGP operates around 740 renewable energy plants in 16 countries across Europe, the Americas, Africa and Asia. It has an installed capacity of over 10 GW.

Arcapita seeking Viridian bids

Bahrain-based investment firm Arcapita is seeking bids for Viridian, the Irish energy firm.

The UK's Centrica is likely to be preparing a deal for Viridian, according to reports. Viridian operates in generation and supply across Northern Ireland and the Republic of Ireland, and was bought by Arcadia in 2006.

Viridian would interest Centrica

because of its customer base. Through Energia and Power NI, Viridian has a 23 per cent share of domestic electrical sales and a 27 per cent share of business energy sales on an all-Ireland basis.

Centrica could bid alone for the group, and later invite partners to take on Viridian's generating assets, which include the 744 MW Huntstown power plant and over 50 wind farms in

Ireland and Northern Ireland. Centrica could place a bid of just over €1 billion, slightly short of the €1.3 billion Arcapita is seeking, the *Financial Times* reported, citing people familiar with the deal.

Arcapita filed for bankruptcy protection in the USA in 2012 but exited bankruptcy a year later after securing a loan from Goldman Sachs.

Nordex lays future foundations

Nordex has secured new funding to support its operations for the next five years.

The wind turbine firm said it was "laying foundations for the future" with a new syndicated guarantee facility from 14 national and international banking partners tailored to meet the requirements of its future growth.

Nordex said it has also reached an agreement on a cash facility of €450 million with a duration of up to 18 months.

With a value of €950 million, the new credit line has been structured in such a way that following the completion of the merger with Acciona Windpower (AWP), it can be widened to

include banks covering the Spanish wind turbine manufacturer's markets, particularly growth markets such as South Africa, Mexico and India. The facility could also be increased to up to €1.2 billion, Nordex said.

The cash facility will cover the cash component of the AWP deal, Nordex said.

Shell presses ahead with BG deal

Shell is hoping to persuade shareholders to vote in favour of its £36 billion bid for BG Group in spite of concerns that the deal is not workable in the current climate of low oil prices.

The firm's management last month held a series of meetings with investors ahead of a shareholder vote on

the deal. Shell's CEO, Ben van Beurden has pledged additional capital spending cuts and other savings in a bid to prove that the deal will work at lower oil prices.

Crude oil prices have fallen drastically over the last 18 months, from around \$110 per barrel in July 2014. In

mid-January oil prices hit a 12-year low of \$28/barrel before rallying slightly.

When Shell announced its bid for BG Group in 2015, its long term planning range for the oil price was \$70-100, and there have been calls from shareholders for it to renegotiate the terms of the deal.



10 | Tenders, Bids & Contracts

Americas

ViZn wins INL contract

Energy storage firm ViZn Energy Systems Inc has received an order for a 128 kW/320 kWh redox flow battery system based on its zinc-iron chemistry from Idaho National Laboratory (INL), part of the Department of Energy's (DOE) complex of national laboratories.

ViZn's flow battery system will be installed as part of a microgrid research, development and demonstration testbed and is expected to be commissioned in the second quarter of 2016. The firm says it is seeing "increased interest" in its flow batteries from organizations looking to initiate large-scale energy storage projects.

ViZn's zinc-iron redox flow battery is the only flow battery on the market with a non-toxic, non-flammable, non-explosive alkaline chemistry, allowing it to be deployed safely in densely-populated areas or adjacent to utilities and sub stations without the risks associated with other battery technologies.

Areva signs uranium enrichment contracts

Areva says that it was awarded long term contracts worth more than \$300 million in 2015 for uranium enrichment services in the USA.

Four US utilities signed contracts with the French nuclear company. The agreements will help the US nuclear industry to sustain security of supply and are in line with Areva's strategy to develop long-term partnerships in the nuclear sector.

CG to help expand Dominican grid

CG has been awarded a contract to equip seven transmission substations in the Dominican Republic with ZIV Substation Automation and Telecommunication Systems.

CG will deliver and commission the project for of Dominican Republic Transmission Utility ETED by June 2016. The project is part of the expansion of the electricity transmission system in the southern region of the Dominican Republic where the largest wind farm in the country is located.

Westar orders Siemens wind turbines

Westar Energy has placed a turbine delivery order with Siemens for the 280 MW Western Plains wind power plant in Kansas.

Siemens will deliver 122 of its SWT-2.3-108 wind turbines for the project and will also be responsible for turbine installation support and services. It is expected to start turbine installation in 2016 with commissioning scheduled for early 2017.

Siemens will also be offering advanced remote monitoring and diagnostics as a part of its service and maintenance for the project.

Asia-Pacific

Gamesa wins second solar order

Gamesa has received a new order in India from renewable energy developer New Era Enviro for the development of 23 MW of solar power capacity across three projects in the state of Telangana.

The order is the company's second in the solar sector, having established a foothold in the photovoltaic segment last July with a 10 MW project – now up and running – also in India.

Under the terms of the EPC contract signed with New Era Enviro, Gamesa will develop three solar power plants – 5 MW, 10 MW and 8 MW – on a turnkey basis in the towns of Bujarampet, Ellanthakunta and Mankondur, respectively. Gamesa will perform the engineering work, procure the photovoltaic inverters and commission the facilities.

New Era Enviro will supply the solar panels and structures.

MHPS wins Lamma contract

The Hong Kong Electric Co (HK Electric) has awarded Mitsubishi Hitachi Power Systems (MHPS) a contract to provide the main equipment for the Lamma power station Unit 10 extension project.

MHPS will manufacture and supply its M701F4 gas turbine, a steam turbine, heat recovery steam generator and air quality control system for the HK Electric's new GTCC power generation plant. Unit 10 will be built adjacent to the existing Lamma Unit 9 and is scheduled to enter commercial operation in January 2020.

HK Electric is one of Hong Kong's leading power providers and is the sole supplier of electricity to Hong Kong Island. The Lamma extension project is part of wider efforts in Hong Kong to boost gas-fired power generation.

New heights for Gamesa in China

Gamesa has won an order to supply wind turbines for the Cangfang wind farm, located at a site 3400 m above sea level.

Gamesa will provide 24 of its G90-2.0 MW turbines, especially configured for high altitudes. The firm has also announced another order for wind turbines for phase two of the Senjitu II complex, located in the province of Hebei.

The Cangfang wind farm is being developed by Concord New Energy in Yunnan province, southern China. The turbines will be configured to withstand low temperatures and low air density, and will be delivered and commissioned in 2016.

At the Senjitu II complex, Gamesa will install and commission 25 of its G97-2.0 MW wind turbines for Hebei Construction & Investment Group.

PLN orders CCGT

Indonesia's PT PLN Persero has placed an order with Mitsubishi Hitachi Power Systems (MHPS), Mitsubishi Corporation and PT. Wasa Mitra Engineering for the construction of an 880 MW natural gas fired combined cycle power plant.

The Jawa 2 power plant will be built at the site of an existing 750 MW combined cycle power plant near Jakarta and is scheduled for commissioning in 2018. It forms part of a programme by the Indonesian government to expand power generation capacity by 35 000 MW.

MHPS will supply two M701F4 gas turbines, two heat recovery steam generators (HRSG), one steam turbine and the balance of plant (BOP). Mitsubishi Electric Corporation will supply the generators.

Doosan bags Vietnam order

Doosan Heavy Industries & Construction Co. has clinched a 670 billion won (\$566 million) order to build a power plant in Vietnam.

Under a deal with Vietnam Electricity (EVN), Doosan Heavy will construct the 600 MW power plant in Binh Thuan, 230 km east of Ho

Chi Minh City.

The power plant will be commissioned in August 2019.

Europe

Energinet orders Kriegers Flak components

Energinet.dk has awarded €33.5 million in contracts for the supply of components for the Kriegers Flak grid connection.

The components include switchgear and transformers to connect the offshore wind farm with the Danish power grid. The purchases have been divided into seven contracts and represent the largest purchase of AC components in the firm's history.

CG will deliver power transformers and Gas Insulated Switchgear (GIS), ABB and Siemens are in charge of providing reactors, and Royal SMIT will provide a phase shifter transformer.

SgurrEnergy bags Levenmouth O&M

Offshore Renewable Energy (ORE) Catapult has appointed SgurrEnergy to operate and maintain the recently acquired Levenmouth 7 MW demonstration offshore wind turbine.

The turbine, acquired from Samsung Heavy Industries (SHI), is the world's most advanced, open access, offshore wind turbine dedicated to research, and offers opportunities for considerable training and development of skills vital for the future of the offshore wind industry.

SgurrEnergy's engineers and consultants will provide full operational support, knowledge and expertise for the day-to-day operations and maintenance of the turbine, combining 24/7 remote monitoring and onsite management.

100 MW order for Nordex

Nordex has signed contracts with Bilgin Enerji for the supply of turbines for four projects in Turkey with a combined capacity of 100 MW.

The orders are for 33 turbines from Nordex's Delta series, the firm's latest product offering. They will be installed at the Bandirma, Bergama, Soma and Mazi wind farms.

Nordisk Vindkraft signs up Mirova

Swedish wind power developer Nordisk Vindkraft and Mirova have signed agreements for the sale, construction and operational management of the 27.6 MW Väsberget wind farm in Gävleborg County, Sweden.

The Väsberget wind farm project is located 8 km southwest of Ramsjö and comprises eight Vestas V117 turbines with a rated capacity of 3.45 MW. French asset manager Mirova will acquire 80 per cent of the wind farm while Nordisk Vindkraft will retain a 20 per cent ownership share.

Nordisk Vindkraft will build and operate the wind farm, which is due to be energised in September 2016.

Centrax to power Italian chemical plant

Centrax has won an order to supply a generator package to BASF Italia Srl to power the firm's chemical site in Pontecchio Marconi, Italy.

Centrax will provide a CX501-KB5 DLE generator package with an output of 3.8 MW. It will meet the electrical demands for the factory and will be coupled to a heat recovery steam generator that will generate steam for the chemical process.

The units are due to be delivered in the first quarter of 2016 and han-

dover of the plant is expected at the end of August 2016.

RES marks first UK energy storage project

Renewable Energy Systems (RES) has this week announced its first UK contract to build and support a battery energy storage system (BESS).

The contract represents one of the first energy storage projects in the UK to be delivered under a fully-wrapped engineering, procurement and construction (EPC) contract. The project is being led by Western Power Distribution (WPD) and will demonstrate nine different applications of energy storage on the grid.

RES will install a 300 kVA/640 kWh battery energy storage system and will also provide ongoing warranty support during the battery's operation. RES will utilise RESolve, its energy storage control and dispatch system to provide 24/7 management of the battery's operation.

The BESS will be supplied by BYD and will be fully self-contained including hundreds of individual battery cells, power conversion equipment and safety and monitoring systems.

The energy storage project will be RES' tenth globally and will see its total energy storage construction portfolio reach 78 MW/48 MWh. It will be installed alongside a British Solar Renewables Ltd (BSR) solar park in Somerset.

International

Mitsui consortium seals \$2.3 billion Oman deal

A Mitsui consortium has won a major contract from Oman Power and Water Procurement Company (OPWP) to develop two \$2.3 billion power plant projects in the sultanate.

The Mitsui consortium, which also includes ACWA Power and Dhofar International Development and Investment Holding Co of Oman, will build two natural gas fired combined cycle power plants with a total capacity of 3150 MW. The sites will be in Ibri (1450 MW), and Sohar (1700 MW), northern Oman.

Mitsui will operate both plants and sell electric power under a 15-year power purchase agreement with OPWP.

GE to build 1390 MW power plant

GE has been awarded a landmark contract valued at nearly \$1 billion for the engineering, construction and provision of gas turbine services for the Waad Al Shamal combined cycle power plant in Saudi Arabia.

Under a contract with the Saudi Electricity Company (SEC), GE will supply four GE 7F.05 heavy-duty gas turbines, a steam turbine, and solar technology. The 1390 MW combined-cycle plant is scheduled for completion in 48 months.

Prysmian wins Oman contract

Prysmian Group has received a contract from Larsen & Toubro to supply a new high voltage underground cable system for Oman Electricity Transmission Company.

The new cable will strengthen the power supply to the city of Salalah. Prysmian will design, engineer and manufacture the HV cable, which will be installed between Saada Grid Station and Lilo.

The project will be completed by the end of June 2016.



Fuel Watch

Oil

Stage set for further oil price decline

- Saudi oil minister remains “optimistic”
- Supply could exceed demand for third successive year

David Gregory

As the price of crude oil slips below \$30/b and the prospect that a sanctions-free Iran bringing additional barrels to market, speculation is rife that crude prices could fall further.

In today's world that's hard to imagine, given that \$100/b oil has become the norm. Some of us can recall when \$20-30/b was the range and were shocked when prices began to climb to then dizzying heights. But as crude price seems poised to fall further – to \$20/b as some analysts are predicting – it might be useful to ask if Saudi Arabia has out-smarted itself.

Recently there has been a lot of comment about the Saudi ‘strategy’ and how it is proving to be effective, but as prices continue to fall and more oil is expected to come on-stream this year from not just Iran but also Iraq, those comments aren't convincing.

The strategy to defend market share requires clarification of what it genuinely means to achieve, and once that goal is met how it will be maintained.

Initially it was about forcing high-cost producers out of the market,

essentially targeting the ‘frackers’ in the US who had succeeded in producing large volumes of shale oil, leading to a decline in demand for imports. The fall in price has forced some to shut operations and as the price goes lower some frackers might face bankruptcy. But when will Saudi Arabia know when its goal has been reached?

And when that goal is achieved and supplies to the oil market begin to decline and a so-called ‘balance’ comes back to the market and the price of oil begins to rise, what's to keep those frackers who are not bankrupt from coming back and pumping more oil? Analysts say the frackers need a price range of \$40-60/b to break even. With that in mind, it could be that oil might be destined to remain well below \$100/b for a long while.

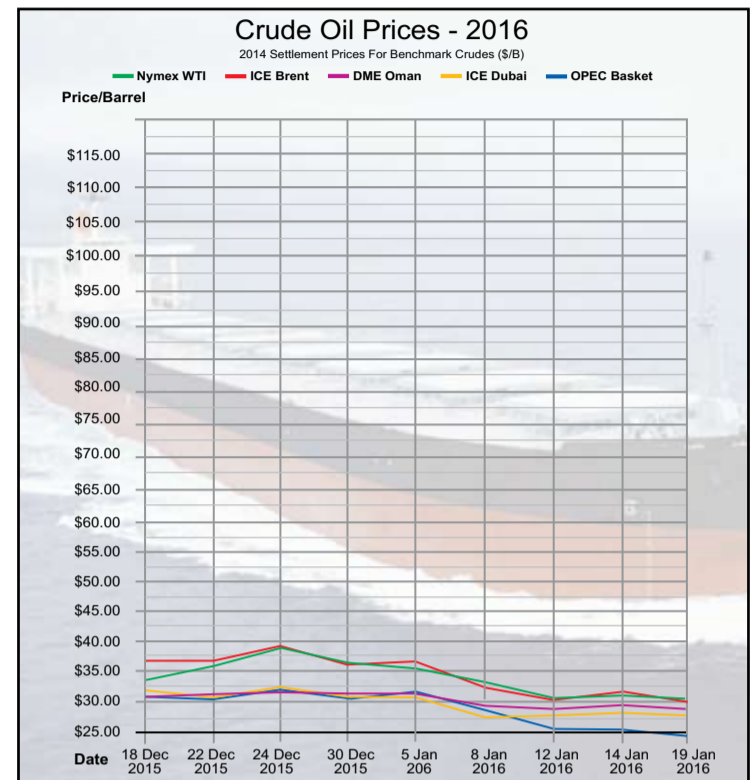
In its January 2016 monthly *Oil Market Report*, the Paris-based International Energy Agency (IEA) said: “The oil market faces the prospect of a third successive year when supply will exceed demand by 1.0 million b/d and there will be enormous strain on the ability of the oil system to absorb it efficiently.”

While non-Opec production will fall, this will be offset by higher production from Iran, the IEA added, and also pointed out that Saudi Arabia's recent sharp increase in domestic fuel prices is a sign that Opec's top producer is preparing for a long period of lower prices.

Commenting on the outlook for 2016, the IEA said in a scenario whereby Iran adds 600 000 b/d to the market by mid-year and other Opec members maintain current output – Opec is producing more than 32 million b/d – global oil supply could exceed demand by 1.5 million b/d in the first half of 2016. And it added that unless something changes, “the oil market could drown in over-supply.” This indicates, the IEA said, that the price of oil could go lower, suggesting that \$20 oil is not such a far-fetched idea.

However, Saudi Arabia, which is producing more than 10 million b/d and has been for almost a year, remains confident that it is on the correct course.

Speaking in Dubai in mid-January, Saudi Oil Minister Ali al-Naimi said



he was optimistic about the future, the return of stability to the global oil markets, the improvement of prices and the cooperation among the major producing countries.

Judging by that, Naimi knows something that no one else does. Saudi Arabia's cash reserves are down by a \$100 billion over the last year. The Saudis still have \$620 billion handy but money has a tendency to evaporate and Riyadh relies on oil sales for about 80 per cent of its budget revenue.

While Saudi Arabia remains calm, others in Opec are losing their cool, particularly Venezuela, which relies

on oil sales to cover the cost of its many imports.

Venezuela, with the backing of Ecuador, has requested that Opec holds an emergency meeting to address the glutted market, but analysts think that is unlikely without Saudi Arabia's endorsement. Life in Venezuela could get even more troublesome as oil revenues fall further.

The year ahead is going to be one of the most interesting that the oil market has seen for some time. It will undoubtedly shake things out of the industry and there is no telling where the catharsis will leave Opec, the frackers and the big oil companies.

Gas

Plan for Nord Stream 2 anything but certain

CEE members of the EU are now arguing that Nord Stream 2 is a further attempt by Moscow to isolate them from the EU energy supply system and is in reality a tactic designed by Russia to divide the EU.

Mark Goetz

Momentum is building among Central and East European (CEE) states in an effort to prevent the construction of Nord Stream 2, the second phase of Russia's offshore gas pipeline. Russia's state gas monopoly began in late 2011 to transport gas from Russia through Nord Stream, which runs through the Baltic Sea, to northern Germany and deliveries now amount to about 39 billion cubic metres per year (bcm/year).

Two pipelines with a combined capacity of 57 bcm/year make up phase 1 of the project. Now Russia is ready to proceed with laying two more pipelines along the same route with the same capacity.

Nord Stream was originally meant to be the northern component of a Russian plan to deliver gas to Western Europe through a route that would bypass the eastern European members of the European Union. Poland and

the Baltic States objected to the first phase of the project, which was originally established in 2006.

The now defunct South Stream, which would have transported Russian gas across the Black Sea with a pipeline landing in Bulgaria, would have been the second component of the plan and would have bypassed Ukraine, through which some 40 per cent of Russian gas supplies to Europe are transported.

The long, troubled energy relationship between Russia and Ukraine led Moscow to seek a means to stop sending gas through Ukraine. However, South Stream was halted because it did not conform to EU third party regulations.

CEE members of the EU are now arguing that Nord Stream 2 is a further attempt by Moscow to isolate them from the EU energy supply system and is in reality a tactic designed by Russia to divide the EU. If completed the pipeline will have a capacity of

114 bcm/year and the large, but badly in need of refurbishment pipeline system in Ukraine will for the most part be abandoned.

While not an EU member, Ukraine has the support of many member states and is making its case in Brussels. US Vice President Joe Biden recently met with Ukrainian President Boris Poroshenko to express Washington's support to Kiev on the matter. Many EU members believe that Nord Stream 2 is unnecessary. Opinion has been expressed that peace needs to come to Ukraine and that the gas pipelines should be refurbished and Russian gas continue to flow via that route.

Ukraine and other opponents to the project are arguing that first of all, Nord Stream 2 could run counter to the EU's regulatory framework on the Energy Community, and secondly that it could interfere with the functioning of the EU gas market operations.

After a meeting with European Council President Donald Tusk in mid-January, Poland's President Andrzej Duda said Russia's plan to bypass Ukraine is driven by politics rather than economics and undermines EU solidarity.

“We disagree with this investment. It has nothing to do with economics,” Duda was quoted by *Reuters* as saying. “It is an investment of a political nature,” he said, adding that Poland will argue against the project in Brussels.

“It is contrary to European law because it undermines energy solidarity in Europe,” Duda said. “We will raise these issues at the European level because we want to put forward real arguments, legal arguments.”

Tusk, who is a former Prime Minister of Poland, said he and Duda agree on the issue. In December Tusk stated that Nord Stream 2 would not benefit the EU in its goals of diversifying its gas supplies and routes, but said that it

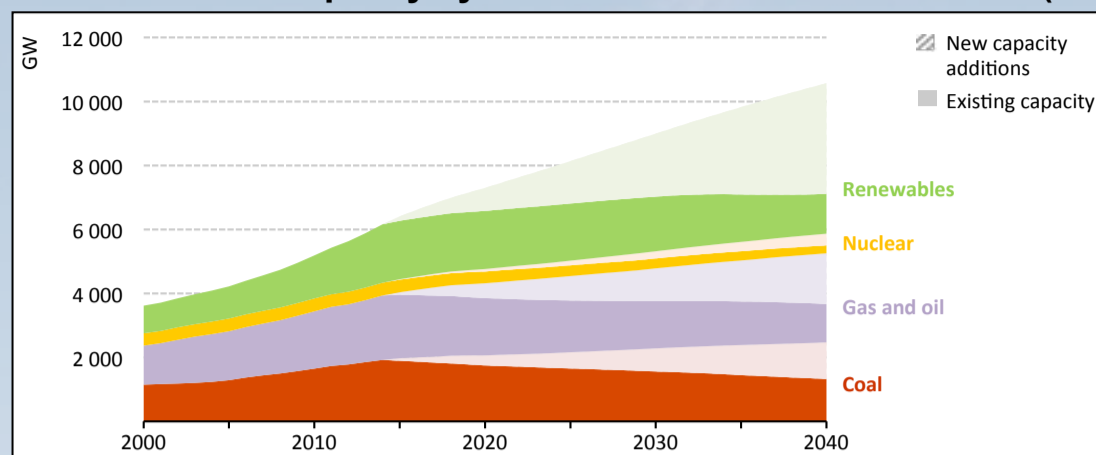
would be the European Commission's responsibility to conduct the technical and legal analysis of the project.

Russia raised its gas exports to Germany via Nord Stream by 10 per cent in 2015, its operator said on January 22. But at 39.1 bcm/year volumes remained well below Nord Stream's capacity of 55 bcm/year.

Gazprom owns a 51 per cent stake in the Nord Stream consortium. Germany's E.ON and BASF SE/Wintershall Holding each own 15.5 per cent, while Dutch firm Gasunie and France's Engie control 9 per cent each.

“We probably we need to define what type of interdependence we want with Russia,” an expert from France's Foreign Ministry told *New Europe*. “In a way, we need energy security and, on the other hand, we don't need to depend too much on Russia but Russia is very dependent on Europe as a customer so it's also a very complex issue.”

Global installed capacity by source in New Policies Scenario (GW)



World Energy Outlook 2015, © IEA/OECD, Figure 8.4, page 311

Cumulative power plant capacity retirements by region and source in the New Policies Scenario 2015-2040 (GW)

	2015-2025					Total	Coal	Gas
	Coal	Gas	Oil	Nuclear	Renewables			
OECD	171	116	124	52	37	500	160	136
Americas	87	74	57	7	11	236	59	75
United States	85	68	48	3	10	214	51	72
Europe	71	19	35	30	23	178	72	30
Asia Oceania	13	23	32	15	2	86	29	31
Japan	7	18	30	14	2	71	10	22
Non-OECD	98	101	52	10	7	268	167	137
E. Europe/Eurasia	57	71	11	9	1	149	45	46
Russia	23	52	2	8	0	85	21	38
Asia	32	5	11	1	4	52	95	35
China	20	0	2	0	0	22	52	1
India	7	0	1	0	1	10	34	7
Southeast Asia	0	2	5	0	2	10	5	20
Middle East	0	15	12	0	0	27	0	32
Africa	8	4	9	0	1	21	25	16
Latin America	1	7	9	0	2	19	2	7
Brazil	0	1	1	0	2	4	1	0
World	269	218	176	62	44	768	327	274
European Union	75	21	37	29	22	183	72	29

World Energy Outlook 2015, © IEA/OECD, Table 8.3, page 312

Cumulative gross power plant capacity additions by region and source in the New Policies Scenario 2015-2040 (GW)

	2015-2025					Total	Coal	Gas
	Coal	Gas	Oil	Nuclear	Renewables			
OECD	48	290	12	38	482	870	49	224
Americas	4	140	9	9	194	356	23	137
United States	1	110	8	8	150	279	21	93
Europe	25	94	1	11	208	338	14	64
Asia Oceania	19	56	2	19	80	176	13	24
Japan	5	42	2	3	52	104	3	12
Non-OECD	460	415	45	108	841	1 869	585	524
E. Europe/Eurasia	42	80	1	20	22	165	35	69
Russia	17	40	0	16	9	82	9	40
Asia	386	165	12	80	658	1 301	497	232
China	200	83	1	66	433	783	183	66
India	109	34	5	10	145	304	197	71
Southeast Asia	57	34	3	1	37	133	88	55
Middle East	1	83	19	6	19	128	0	67
Africa	27	52	10	0	56	145	49	105
Latin America	4	34	3	2	86	129	4	49
Brazil	1	7	0	1	55	64	1	8
World	508	705	57	147	1 323	2 740	634	748
European Union	23	91	1	11	187	313	13	44

World Energy Outlook 2015, © IEA/OECD, Table 8.4, page 313

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Following a renewable destiny

Africa is taking charge of its destiny by ramping up its drive for more renewables in an effort to deliver electricity to its population and drive economic development. Junior Isles reports

Sub-Saharan Africa presents a big challenge and opportunity from the energy market perspective. Making reliable and affordable energy widely available is critical to the development of a region that accounts for around 15 per cent of the world's population but only 3-4 per cent of its energy demand.

According to estimates by the African Development Bank (AfDB), inadequate infrastructure has been estimated to hold back Africa's growth by 2 percentage points annually and to reduce productivity by as much as 40 per cent. Africa's largest infrastructure deficit is found in the power sector, where generation capacity, electricity consumption, and security of supply are only a tenth of the service found elsewhere in the developing world.

The situation is grim. More than 640 million Africans live without electricity. According to the International Energy Agency's 'African Energy Outlook 2014', on a per capita basis, electricity demand in sub-Saharan Africa has remained largely unchanged for the last decade (at close to 400 kWh), with total consumption levels rising in line with the population.

This is the lowest rate of per capita consumption of any major world region, 75 per cent below that of developing Asia and less than the electricity needed to power one 50 W light bulb continuously for a year.

Meanwhile, those that do have access to electricity, pay very high prices for a supply that is insufficient and unreliable.

Currently a significant portion of electricity generated comes from distributed power plants based on poorly maintained reciprocating engines – at great cost to consumers. A report by consulting firm McKinsey estimates that electricity prices from expensive diesel engine generators is three to six times what grid consumers pay across the world.

Wärtsilä, which currently has more than 5000 MW of engine-based capacity in Africa, says that the biggest challenge facing owners of power plants in the region is lack of maintenance. This leads to an under-utilisation of capacity, which means plant owners usually have to rent engines.

This in turn leads to high power prices. Notably, the IEA estimates that the amount of electricity demand served by back-up generators in sub-Saharan Africa was almost 16 TWh in 2012.

Commenting on the state of existing plant, Jean-Christophe Reymond, General Manager Business Development Power Plant Agreements at Wärtsilä said: "Plant owners can either rely on the operating skills of their own employees and use partners for maintenance at some point; or they can choose an experienced partner to manage both the operation and the maintenance

of the installation.

"Out of our 5000 MW, about 1.5 GW are covered by Asset Management (O & M) Agreements, as well as simple maintenance agreements. So there is tremendous scope for improving maintenance on existing assets," he said.

In addition to a lack of maintenance, the list of issues facing the sub-Saharan Africa power sector is long.

A shortage of capacity, poor transmission infrastructure, difficulty in obtaining financing for power projects, unreliable fuel supply and a dearth of the local skills needed to develop projects, all contribute to the problems facing the region.

Many governments, however, are coming to the realisation that a greater focus on renewables such as wind and especially solar could address many of these issues.

Reymond said: "The environment is becoming more and more a priority in Africa. Renewable electricity is a solution for complying with global environmental regulations. But I am convinced that Africa will still offer opportunities for Wärtsilä to sell power plants and service agreements, either combined or separately."

Engine-based power plant suppliers argue that the technology is well suited to complementing renewables, essentially providing power during demand peaks or when solar and wind are not available.

This has certainly proven to be the case in parts of the US, where Wärtsilä has sold several flexible power plants to complement wind power production.

So while the expected rapid growth in renewables may not signal the end of power generated from reciprocating engines, Africa's power generation landscape is on the cusp of a dramatic clean energy transformation.

In October last year, the International Renewable Energy Agency (IRENA) said that Africa could generate nearly one quarter of its energy needs from renewables by 2030, four times more than the five per cent contribution made by renewables in 2013.

The organisation published the findings in a report that also claims that scaling up modern renewables in Africa is an affordable means of helping meet fast-growing energy demand while increasing energy access, improving health and achieving sustainability goals.

At the time of the launch of the report IRENA Director-General Adnan Z. Amin said: "Africa holds some of the best renewable energy resources in the world in the form of biomass, geothermal, hydropower, solar and wind.

"This, combined with the precipitous drop of renewable energy technology costs, creates a massive opportunity for African countries to both transform and expand their energy systems while providing a pathway for low-carbon economic growth."

The report identifies nearly 10 exajoules – the equivalent of more than 341 megatonnes of coal – of options for sustainable development through renewable energy. Roughly 40 per cent of this energy would be in the power sector.

Solar resources are abundant across the continent, says IRENA, while biomass and hydropower po-

tential are more plentiful in the central and southern regions. Wind resources are strongest in the north, east, and southern regions, and geothermal energy is strong in the Great Rift Valley.

In a move to capitalise on this potential, the ambitious African Renewable Energy Initiative (AREI) was launched at the beginning of December during the COP21 climate change conference in Paris.

The initiative is expected to deliver 10 GW of new and additional renewable energy generation capacity by 2020 and mobilise the African potential to generate at least 300 GW by 2030.

AREI is an outcome of African leadership in Workstream II of the Durban Platform including their May 2014 proposal for a global renewable energy support programme. It has been endorsed by African Heads of State (AU Assembly and Committee of African Heads of State and Government on Climate Change), African Ministerial Conference on the Environment (AMCEN), the G7 (Elmou Summit) and the G20 (Energy Summit).

Speaking during the launch of the project, Akinwumi Adesina, the President of the AfDB, one of the major sponsors and trustee of the initiative of the initiative, said the bank will triple its climate finance to \$5 billion every year till 2020 – which will account for approximately 40 per cent of the AfDB's total portfolio.

Adesina called the initiative a "game changer" for the continent's economy.

"Africa's per capita energy consumption averages only 162 kWh compared to the global average of 7000 kWh. And Africa loses 3-4 per cent of its GDP due to lack of energy. Lack of electricity has put the brakes on Africa's industrialisation.

"This is not acceptable. Yet, Africa has massive potentials for renewable energy."

He added: "The success of the Africa Renewable Initiative will be seen on the ground not on pages of papers. The initiative will deliver 300 000 MW of renewable energy to Africa by 2030. I believe that this can even be achieved much earlier, if we raise the level of our collective ambition.

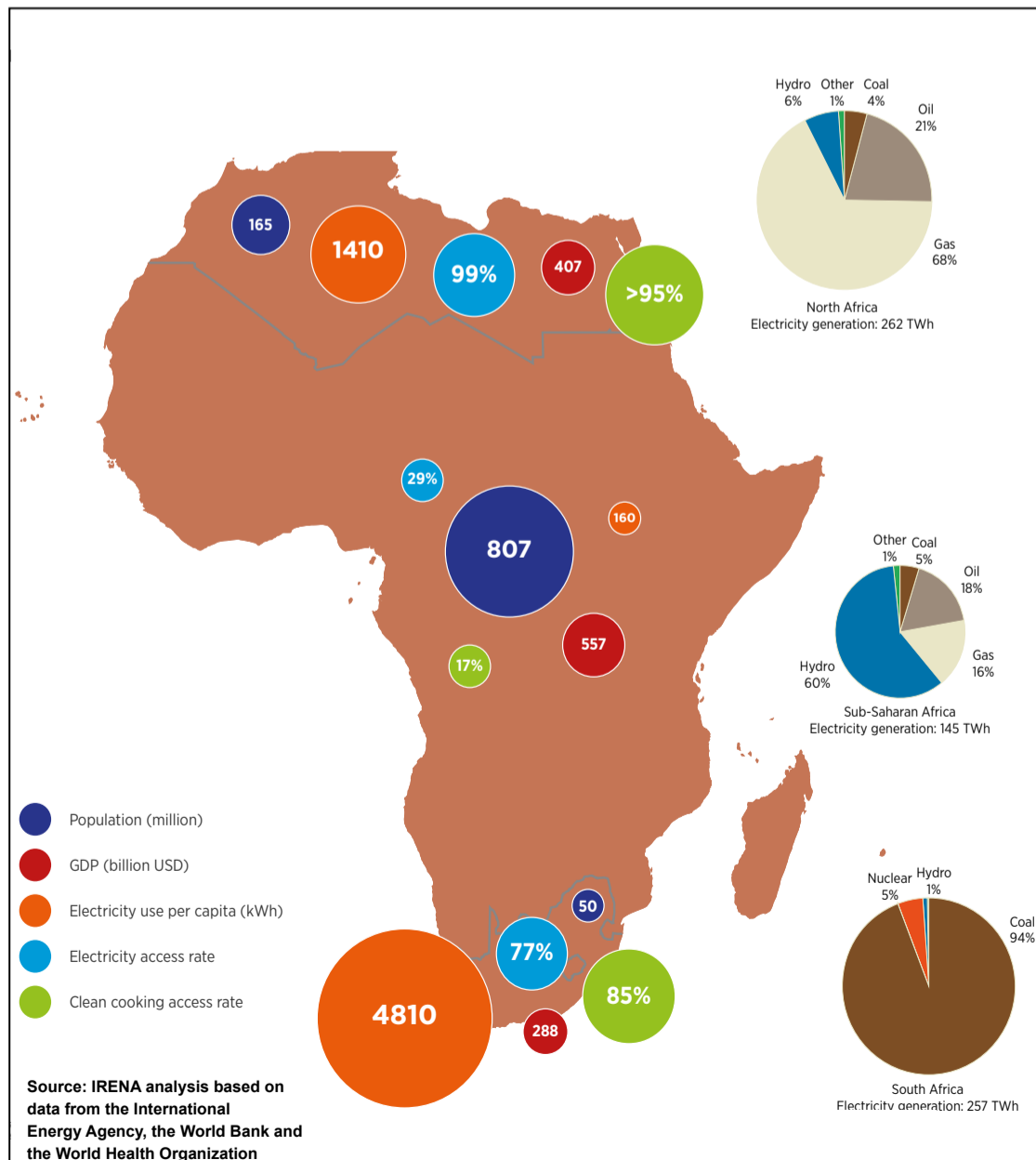
"We must not have low ambitions for Africa. That is why we at the African Development Bank have launched the New Deal on Energy for Africa to accelerate universal access to electricity in Africa by 2025."

The AREI will be one of the key deliverables in the collective drive to "light up and power" Africa. According to Adesina the AfDB will also invest \$12 billion in energy in the next five years; and leverage \$40-50 billion to the energy sector and launch the "Bottom of the Pyramid Energy Financing Facility" to provide 700 million Africans with access to clean cooking energy in five years.

Wilbur Otchichilo, Kenyan Member of Parliament for the Emuhaya Constituency said the project demonstrates that Africa is in charge of its destiny.

"As a continent, we are demonstrating that we can take care of our problems and that the time for asking for favours is over. Let us use the resources we have to solve our problems," he said.

Key figures for North, sub-Saharan and South Africa



A balancing act

Floating offshore wind technology has a number of unique advantages but there are risks that come with it. *TEI Times* looks at how those risks are changing and the impact on future deployment. **Siân Crampsie**

The year 2015 was a landmark year for floating offshore wind technology with the launch of a project tender by the French government alongside measured progress in key demonstration projects such as Hywind 2 and Principle Power's WindFloat Atlantic project.

Building on existing floating offshore wind demonstration projects such as Fukushima in Japan and Statoil's Hywind Demo in Norway, upcoming projects are aiming to illustrate the advantages of floating offshore technologies as well as bring them one step closer to commercialisation. Hywind 2, for example, will showcase five 6 MW floating turbines operating in water depths of over 100 m off the coast of Scotland.

Principle Power, meanwhile, is aiming to demonstrate how its WindFloat technology can reduce the cost and risk profile of offshore technologies through a number of demonstration projects in North America, Europe and Japan.

Driving the industry is a strong belief that floating technologies have numerous benefits over fixed-foundation offshore wind turbines and will enable countries around the world to exploit wind resources in deep water offshore zones close to coastal population centres. Japan has been highlighted as a potential key market because of its deep waters and dense coastal populations, and developers are also targeting regions such as the US west coast, North Sea basin and coastal Atlantic regions in Europe and North America.

The uptake of floating offshore wind projects will depend on government policy and how quickly fixed foundation costs fall. In the UK, the world's biggest offshore wind market, the Energy Technology Institute expects

that if offshore wind deployment reaches 40 GW, around 8-16 GW of this could be provided by floating wind technology. The majority of this would be based in Scottish waters.

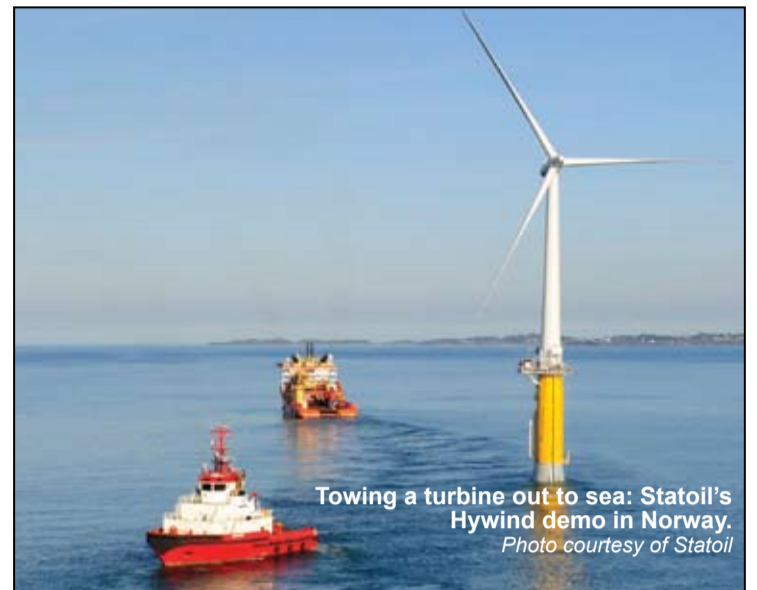
Nevertheless, with the sector still in its infancy, developers face a number of key risks and challenges.

According to Jonny Allen, Offshore Underwriter with insurance firm GCube, the most obvious challenge is that of technology risk, and proving that the wind turbines and their associated infrastructure can not only perform in the challenging marine environment, but also that operation and maintenance (O&M) practices are both commercially viable and safe.

Added to this, says Allen, is a lack of operational data from floating offshore wind turbines, which means that developers, suppliers, financiers and insurers have to ensure good due diligence throughout a project's life to understand the impact of turbine operation on components.

"There are three or four demonstrated projects on which the performance has been very good to date, but each of those sites is very specific in terms of the resource, the technology and the wave conditions, so there's very little data to get a feel of the performance of the turbines [as well as] O&M," said Allen. "There are a lot of challenges that are only overcome by having very good due diligence and a lot of focus on engineering, design, maintenance and risk management, and how transparent and responsible operators are going to be."

Another key risk includes the supply chain for floating offshore wind technologies. Many components for floating structures are bespoke and this means not only more cost for the



Towing a turbine out to sea: Statoil's Hywind demo in Norway. Photo courtesy of Statoil

developer but also the possibility of a lack of spare parts and the need to refabricate in the event of damage or failure.

As the industry develops, companies involved in demonstrations will need to ensure that they have robust frameworks in place to manage risks, says Allen.

"Trying to recognise risk as early on as possible in the development process is key," says Allen. "Engaging the insurance industry is also important. We have gone through other nascent technologies, for example wave and tidal, as well as the early fixed foundation offshore wind sector and we have a lot of knowledge and experience – good and bad – from those sectors."

"Risk management is about attitude and transparency, but it's also about dialogue and developers working out which risks they can take on and which they can transfer."

Depending on the developer's balance sheet, firms can transfer risk on to other partners involved in a project. The largest share of risk will usually be transferred through insurance but other liabilities can be offloaded through project partners and suppliers.

"The players that you partner with will assume a certain amount of risk. For example on the Statoil Hywind project we have seen Siemens take a very active role and some risk has been transferred to them not just as a supplier but also in their O&M role."

In other projects, for example Japan's Fukushima demonstration, government has played an important role in supporting development and ensuring a wide range of parties from different industries is involved in order to spread risk and ensure the project's success.

Government support will also play an important part in France's current tender for floating offshore wind projects. The tender is the first attempt to test floating technology on an industrial scale and will see successful bidders building arrays of between three and six turbines at three sites in the Mediterranean and one off the coast of Brittany.

According to Johan Sandberg, Segment Leader for Floating Offshore Wind at DNV GL, strong government support will be crucial to the ongoing development of floating offshore wind.

"The industry needs to push policy-makers to open up sites that are right in the 'sweet spot' for [floating offshore wind]," says Sandberg. "Sites with water depths of 100-200 m would be ideal and enable the offshore sector to optimise costs for floating turbines."

Sandberg adds that testing and demonstration of a wide range of technologies is essential for the development of the industry. In particular projects need to follow Hywind's

approach by demonstrating turbine operations in deep waters. More widespread deployment and the right policy environment will enable the industry to optimise engineering and design and drive down costs. Key areas for development include the industrialisation of fabrication, installation, cost-efficient mooring solutions and dynamic cables, says Sandberg.

According to the Carbon Trust, floating wind could reach parity with fixed foundation offshore wind energy in the 2020s with the right government support. In a 2015 study carried out for the Scottish government, the Carbon Trust reported that leading floating wind concepts could attain a levelised cost of energy of £85-95/MWh in large-scale commercial projects, with further cost reduction possible over time. It added, however, that there is a "critical need to demonstrate this cost reduction potential" through prototype and pre-commercial projects over the next few years.

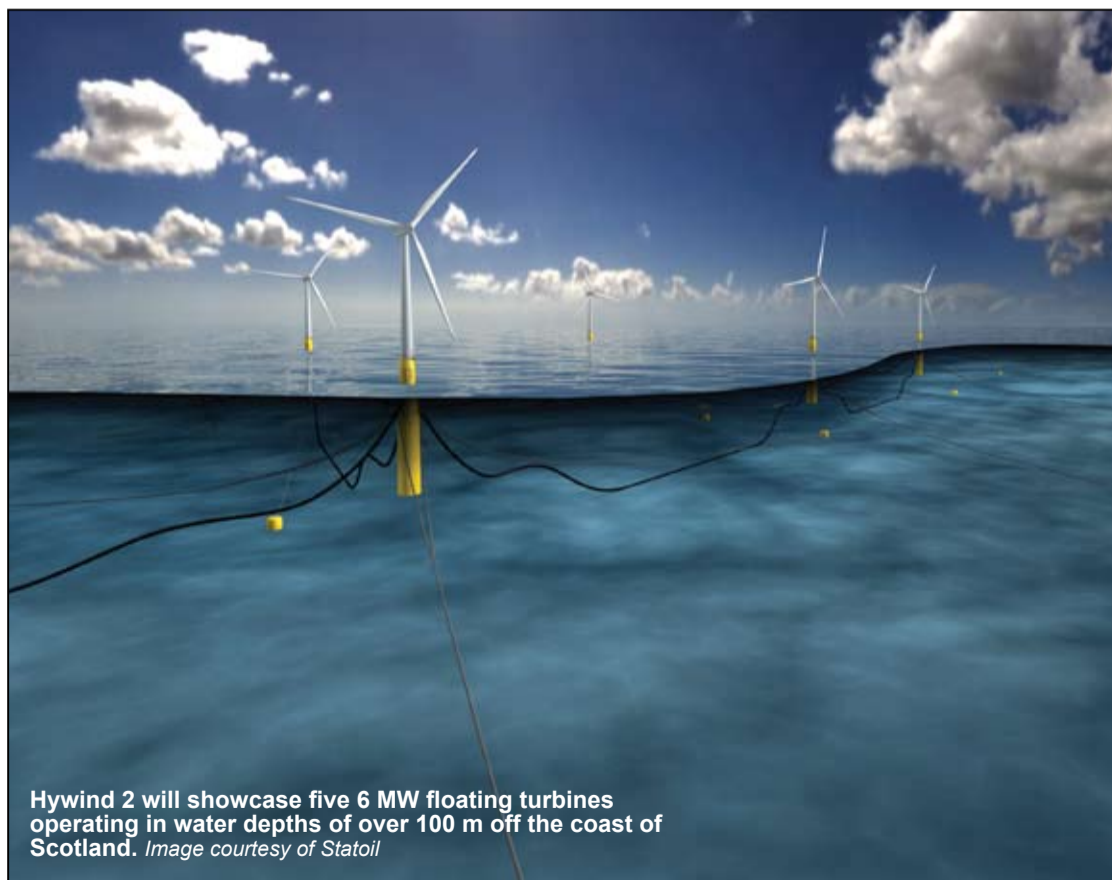
There are currently over 30 floating offshore design concepts, but only five have been demonstrated at full scale in an offshore environment. It is expected that over the coming years there will be greater consolidation in the market, with up to ten concepts reaching full-scale demonstration and only a handful of devices progressing to commercial-scale deployments.

The floating sector is essentially now in a position that the fixed-foundation offshore wind energy sector was 25 years ago and will follow a similar incremental development approach. The benefit of this is that each new project will benefit from the experience of earlier projects and be incrementally de-risked, says Allen.

"The next developers need to think bigger and need to look at larger installations that will have a greater impact in technology and experience terms," adds Allen. "However it's a balancing act; insurers should always want the lowest-risk approach but that's not realistic. At the end of the day commercial performance has to be at the forefront of developers' minds, and quite rightly. If a project is not going to produce a template that can be rolled out on a large commercial scale then there's no point in doing it."

Larger arrays developed in the future will benefit from lessons learned in earlier demonstrations, but their larger size will mean that they naturally have a higher risk profile. The way in which developers structure deals and manage risk will be key, says Allen.

"Developers will be looking to transfer some risks, both through insurance and effective contract negotiations," he says. "The major suppliers will only get involved in projects where they see that the economies of scale are being handled with a good risk management attitude."



Hywind 2 will showcase five 6 MW floating turbines operating in water depths of over 100 m off the coast of Scotland. Image courtesy of Statoil

Accelerating fusion

The promise of electricity generated from nuclear fusion is one that has always seemed too far in the future to be taken seriously. Tokamak Energy, however, believes the combination of two emerging technologies that together enable the construction of smaller, cheaper machines open up the way to commercialisation. Dr Melanie Windridge explains.

The world needs widely available energy that is reliable, affordable and does not produce carbon. The only way to accomplish that goal is by developing new tools to power the world," begins the new Breakthrough Energy Coalition on its website. Recently set up by Bill Gates and more than 20 other visionary billionaires, the Coalition is a global group of private investors aiming to accelerate progress on clean energy.

Tokamak Energy is working on nuclear fusion, the long-awaited holy grail of the energy field. The reaction that powers the sun and the stars, fusion is terrifically hard to do. But harness this stellar reaction and clean, green, safe and abundant energy could be a reality around the world. The promise is tantalising.

However, it has been a long road. Decades of research by scientists in government-funded labs and universities led to the first earthly fusion reactions in the late 1990s, with a world record output achieved of around 65 per cent of the input energy.

Good work is still being done, progress is still being made, but it is well known that government-funded research can be slow, and taking an immature technology from concept to commercialisation is notoriously tricky. The Breakthrough Energy Coalition plans to "support companies that are taking innovative clean energy ideas out of the lab and into the marketplace." Not just for fusion, of

course but for any potentially world-changing energy solutions that need that step up.

Nuclear fusion is the joining together of two small atomic nuclei to make a larger one. The easiest reaction to achieve on Earth is between two types of hydrogen – deuterium and tritium. Collide these two isotopes together at high speed and they create helium (the safe, party-balloon gas) and a fast neutron. The high speeds are required to overcome the repulsive force between the two positively charged nuclei. It ensures that fusion reactions only occur under very high temperatures – hundreds of millions of degrees – when the fuel is in a 'plasma' state of freely moving electrons and nuclei.

This high-temperature, fluid plasma needs to be held trapped and steady. The world-leading concept is the 'tokamak', a ring-doughnut-shaped device that uses a complex pattern of magnetic fields, generated by large electromagnetic coils, to isolate the plasma away from the walls of an evacuated inner chamber. This isolation is important not because plasma-wall contact is dangerous or explosive, but because touching the wall would cool the plasma so much as to extinguish any fusion reactions.

Tokamaks are the most researched of any fusion device and have a good history of progress, the apex of which was the world record generation of 16 MW of fusion power by the Joint European Torus (JET) in 1997. JET has since been upgraded and continues to do cutting-edge research. At the same time a larger tokamak, ITER, is being built in France.

When it begins operation it aims to get ten times as much energy out as is put in, thereby proving the feasibility of fusion energy. But various delays mean that ITER now will not start operating until the late 2020s, and various companies in the US and Britain have sprung up with the express aim of achieving fusion faster. For the sake of our energy security, developing countries and the planet, we cannot afford to wait that long.

Tokamak Energy's difference in the fusion energy field is the combination of two emerging technologies that together enable the construction of smaller, cheaper machines and open up the way to commercialisation.

If we track back to the 1980s, two unrelated things emerged that would later have the potential to change the fusion game. One was the discovery of high temperature superconductors, a huge unexpected breakthrough that promised to revolutionise industries like electricity transmission and energy storage. The other was the concept of 'spherical' tokamaks, squashed-up versions of the conventional donut tokamaks such as JET. The spherical design showed dramatically improved performance.

Moving forward to 2010, Tokamak Energy was set up as a spin-out from Culham Laboratory in Oxfordshire (originally called Tokamak Solutions) to commercialise compact tokamaks for research applications. Then, in 2011, high temperature superconductors became available as engineering materials some 25 years after they were first discovered. Suddenly there were new possibilities.



Dr Windridge: "We are developing a technology capable of rapid global deployment on massive scale"

The high temperature superconducting magnets could be used to create high magnetic fields in a compact spherical tokamak. So instead of building ever-larger tokamaks, with huge costs and long timescales, one could increase the magnetic field in smaller machines. We are building up increasing evidence that this really could work.

The Tokamak Energy approach is to break down the problem into a series of engineering challenges and raise funding for successive steps. The first of these was to build a tokamak with all magnets made from high temperature superconductors, which was achieved in 2015.

The next is our Hundred Million Degree Challenge – reaching these fusion temperatures in a compact tokamak in the next few years. Alongside the R&D, we are using the thrill of the physics and engineering challenge of such an emotive subject to engage the public, particularly school students, in the excitement of fusion energy and science careers.

After achieving 100 million degrees, Tokamak Energy will shoot for energy breakeven, then we will go sufficiently beyond breakeven to produce electricity for the first time. From there we will go on to build reliable, economic, fusion power plants – a challenge in itself when one considers the engineering realities of creating such a hostile environment in the centre of a device with a desired operation lifetime of several decades. These are the plans, but they need money and good people to make them happen.

We at Tokamak Energy have a strong feeling that the time is right for the accelerated development of fusion energy. This is partly because of the maturity of the key technologies, but partly due to the desperate need for clean, green energy. At last, judging by the Breakthrough Energy Coalition and Mission Innovation initiative, there appears to be political and private enthusiasm to take bold steps to tackle the problem.

The UK government announced in the Autumn Statement that it will invest at least £250 million over the next five years in an ambitious nuclear research and development

programme. The vast majority of the investment will of course go to support the new generation of fission reactors, but some could help the progress of fusion energy, either directly or through solving materials and engineering challenges common to fusion and fission, such as robotics for remote handling.

The Paris Climate Change talks reached a surprising political consensus, not just that something should be done, but that carbon emissions should be zero by the second half of the century, or even sooner if the 1.5°C temperature rise goal is to be met. The question of how to do this has not been addressed, but we know from examples like the Apollo missions that big goals can be tackled remarkably quickly if political will is matched by investment. This is where the Breakthrough Energy Coalition could be so valuable, by providing "truly patient flexible risk capital" to companies in that difficult stage between concept and product.

Climate Change and Green Energy have also been major topics at the World Economic Forum Annual Meeting in Davos. Tokamak Energy is proud to have been selected as a Technology Pioneer of the World Economic Forum 2015 – a selection made on the basis of having a large potential global impact in the sphere of Decarbonising Energy. We are developing a technology capable of rapid global deployment on massive scale, as will certainly be necessary to meet the commitments made at the Paris talks.

Technology Pioneer status comes with an invitation to attend the Davos meeting. One of the sessions where Tokamak Energy was speaking was entitled "Will science save us?" The answer, we believe, is yes – at least as far as clean energy is concerned – but only so long as the science is well linked to engineers and entrepreneurs.

We need to tackle the challenge of fusion energy together. The scientific conceptual work underpinning ITER has shown that fusion power from tokamaks is technically feasible. Engineers and entrepreneurs need to take that scientific basis and make it happen. We intend that Tokamak Energy will be part of this solution.



The ST25 with high temperature superconductors. High temperature superconducting magnets could be used to create high magnetic fields in a compact spherical tokamak



Junior Isles

Beware red carpets and silk roads

The start of a new year is often littered with predictions – most of them fairly safe and somewhat predictable. This year was no different.

'Industries in 2016: A special report from The Economist Intelligence Unit' stated: "As we enter 2016 it is becoming clearer that a long-term energy transition is under way." No prizes for observation there.

The section of the report titled 'Energy: a climate of change', stated that last year's trend of "cheaper and greener" energy, characterised by lower fossil fuel prices and fast growth in the use of renewable energy" was set to continue in 2016. Those that would predict anything to the contrary are no doubt few and far between.

Perhaps more interestingly, however, the report predicts that oil prices will not return to their recent highs anytime soon and that gas and coal demand, hurt by weak demand and strong supply will recover only weakly in 2016.

This prolonged slump in oil prices along with a tumble in China's stock markets could prove to be a toxic combination for Europe's already struggling power sector.

Over the last decade most of the investment in the power sector has been in the renewables, while investment in conventional generation has broadly fallen off a cliff in Western Europe. Now, the fall in oil price has led to a fall in gas prices, which in turn make renewables look more expensive. One possible knock-on effect could be less investment in renewables.

A sluggish economy and low power demand growth has already put Europe's energy sector under pressure in recent years. Even in clean energy, where investments have surged elsewhere around the world, Europe saw 18 per cent less investments in 2015 than in 2014 according to the most recent data from Bloomberg New Energy Finance.

China has been an important investor in Europe. Its interest in investing in the region, and indeed elsewhere in the world, is being driven by increased domestic competition, a change in its own economy and the desire to acquire new technologies, brands and expertise.

China is the world's second largest economy and according to CMS, is expected to invest \$1-2 trillion globally over the next decade. The firm says

that with Europe being one of the safest places to invest, it expects a large portion of this to be in Europe.

Speaking at a recent conference focused on inbound energy investment in Europe, Robert Lane Head of Regulated Energy Industries, CMS, UK, said: "Even in times of crisis or slowdown... Europe continues to be a deeply trusted place for investors... the opportunities to invest are particularly strong in energy and infrastructure. These are among the top sectors on the Chinese investors' radar screens."

China is encouraging international investment through its 'One Belt, One Road' programme. This strategic initiative is seen as a modern day 'Silk Road'. At the heart of 'One Belt, One Road' lies the creation of an economic land belt that includes countries on the original Silk Road through Central Asia, West Asia, the Middle East and Europe, as well as a maritime road that links China's port facilities with the African coast, pushing up through the Suez Canal into the Mediterranean.

The project aims to redirect the country's domestic overcapacity and capital for regional infrastructure development to improve trade and relations with Asean, Central Asian and European countries.

In his opening keynote at the CMS conference, Jin Xu, Counsellor of the Chinese Embassy in London said the One Belt One Road programme will "spend a lot of money" in the developing world. He also noted that Europe is a very important trading partner and that the UK is its largest trading partner in the region.

In 2012 China's Three Gorges Corporation purchased a 20 per cent stake in Portugal's national energy company, Energias de Portugal and in July last year bought a 35 per cent in CDP Reti, a subsidiary of Italy's state financing agency that controls the country's electricity grid operator and gas distribution.

Indeed last year was particularly significant. In October, the UK's diplomatic elite rolled out no end of red carpet for Chinese officials as the two countries signed deals worth almost £40 billion.

The big announcement was that China would invest £6 billion in the proposed Hinkley Point C nuclear power station. The agreement also set up a wider UK partnership to develop new nuclear power stations at Sizewell and Bradwell. The Bradwell project is planned to include a Chinese-designed reactor.

Commenting on the benefits of the investment to both the UK and China, Munir Hassan, Head of Clean Energy, CMSUK said: "The Bradwell reactors would be a Hualong One design, which is about two thirds of the cost of US or European reactors. So the savings are large if it is to be built. At the same time having the UK as a platform for the Hualong One reactor will help China in exporting the technology overseas."

Foreign Direct Investment (FDI) in Europe has been increasing over the last eight years, with China leading the way. According to FTI Consult-

ing, it has injected some €13 billion annually over the last five years, with the energy sector being the largest recipient.

If we look to the past for indicators to the future, there should be no reason to believe that Europe will not continue to be a safe haven for investors or that Chinese money will not continue to flow in.

Also speaking at the conference, Anthony Legg, Senior Director, Economic & Financial Consulting at FTI said: "We expect that trend to continue going forward but the sector is evolving. There are some high level trends affecting the energy infrastructure."

He noted that factors such as increasing EU integration and regulatory changes, which have squeezed available returns, will all have an impact on future investment.

Legg highlighted the reduction in allowed returns, where many economic regulators across Europe have reduced the allowed rate of return (or cost of capital) on 'core' regulated transmission and distribution assets. He also warned of the dangers of unpredictable interventions such as retrospective adjustments to renewables subsidies across southern Europe.

Countries like Spain and the UK, with a history of policy uncertainty need to be wary of the impact of constant flip-flopping in energy policy. The UK government recently launched a far-reaching review into subsidies for solar, wind, hydro and anaerobic digestion.

Its measures include reduced feed-in tariff (FIT) rates across the board, new deployment caps to control spending, and the closure of the renewables obligation (RO) scheme for solar photovoltaic projects of 5 MW and below.

If the UK hopes to retain its coveted position as China's number one European trading partner, it will need to be more consistent.

While political risk has been seen as the main risk to energy investment, at least until now, the stock market crisis in China could prove to be another fly in the ointment.

Looking at it simply, it may mean that Chinese companies now have less cash to spend internationally.

Hassan notes, however: "If the Chinese economy is slowing down, it may be that Chinese investors look elsewhere for investment. Also, when there is turmoil in one part of the world, the money will try to find a natural hedge and go into investments in other parts of the world. And thirdly, China tends to invest strategically. For example, some investments are intended to accelerate deployment of Chinese technology."

"So even though there may be less cash available, it does not mean there will necessarily be a huge slump in investment from China."

The picture is unclear but one thing is certain – banking on investment from China may not be such a sure bet after all.

With the market turmoil and coupled with energy policy uncertainty, it would come as no surprise to see those red carpets rolled up and put away in storage for less turbulent times.

I see uncertainty and inconsistency. The Red Dragon claws back its gold, and there is weeping in the world...

... but the picture might improve with more inward investment