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Fukushima shakes nuclear industry

The massive earthquake and subsequent tsunami that damaged the Fukushima Daiichi nuclear power plant has not only left Japan reeling but has shaken the entire nuclear industry to its core. **Junior Isles**

Although AC power has been restored to replace the emergency diesel generators at the damaged Fukushima Daiichi nuclear power plant, it may be some time before the situation is brought fully under control. In the meantime, the industry is assessing the future role of nuclear power while Tokyo Electric Power (Tepco) is preparing to face unknown liabilities.

Restoring power to the damaged units is an important milestone as it will in theory energise motors, valves and switches that help deliver cooling water to the overheated reactor cores and spent fuel pools. Although officials said the plant could be brought under control in a day once the cooling system is operational, it was discovered that some of the pumps for Unit 2 are no longer functional.

Tepco said it had placed emergency orders for new pumps, but (at the time of writing) it was unclear how long it would take for them to arrive.

On March 21st, an official of the US Nuclear Regulatory Commission said in Washington that Units 1, 2 and 3 have all seen damage to their reactor cores, but that containment was intact. The assessment dispelled some concerns about Unit 2, where an explosion damaged a pressure-reducing chamber around the bottom of the reactor core.

Bill Borchardt, the commission's executive director for operations commented: "I would say optimistically that things appear to be on the verge of stabilising."

However, that same day workers had to be temporarily evacuated from the plant after grey smoke began rising from the spent fuel storage pool of the plant's problem-plagued Unit 3, Tepco spokesman Hiroshi Aizawa said. Unit 3 also alarmed plant officials on March 19th when there was a sudden surge of pressure in its reactor pressure vessel.

The Fukushima Daiichi Nuclear Power Plant has six nuclear reactors onsite, all of which are GE-designed boiling water reactors (BWRs) installed in the 1970s.

All six plants were designed to handle the perceived worst-case scenario earthquake (8.0 on the Richter scale) and resulting tsunami (5.8 m). The earthquake that hit on Friday March 11th at 2:46 pm (Japan time) registered 8.9 and was later upgraded to 9.0. The actual tsunami that hit the Fukushima plant was reportedly upwards of 13.7 m high.

When the tsunami hit land, the Japanese electric grid began failing and the Fukushima plant switched over to diesel generators.

Units 4, 5, and 6 were already off-line as part of a planned outage. Units 1, 2 and 3 shut down automatically as planned when motion sensors detected the tremors. The following tsunami then damaged the diesel storage tanks for Units 1, 2, and 3, thus shutting down the diesel backup generators that were pumping cooling water around the core. Batteries kept the circulation going for another eight hours until they went flat. The multiple cooling systems required to remove heat from the core then failed.

The quake caused widespread power outages, with the automatic shutdown of several nuclear power plants in northeast Japan, including Tepco's 4696 MW Fukushima Daiichi and Fukushima Daini plants, Tohoku Electric Power's 2174 MW Onagawa and Japan Atomic Power's 1100 MW Tokai Daini.

The earthquake not only knocked out 10 of Tepco's operational nuclear reactors – six at Fukushima Daiichi and four at nearby Fukushima Daini – it also damaged oil, coal and gas fired plants accounting for 7 GW of power (20 per cent of Tepco's capacity).

It has left the Japanese power industry in crisis. Tepco is tapping the country's biggest bank for an emergency loan of Yen 2000 billion ($25.3 billion) as it faces escalating cleanup and rebuilding costs.

Tepco has also notified local authorities that it will indefinitely shelve the Higashidori nuclear power plant project in Aomori prefecture. Tepco began initial work at the start of this year, ahead of the start of scheduled construction in December of the 1385 MW No. 1 reactor at Higashidori. It was originally targeted for a March 2017 commissioning.

Higashidori is the first new nuclear power plant project for Tepco since 1981. The company last year secured Yen450 billion ($5.7bn) in equity sales, half of which was to fund Higashidori.

Japanese electricity wholesaler and producer J-Power has also told authorities in Aomori prefecture that it has temporarily suspended its 1383 MW Ohma nuclear power project. Ohma is J-Power's first nuclear power plant and Japan's first nuclear

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Fukushima shakes nuclear industry

(Continued from page 1)


Radiation alert: public concern about potential health risks

power plant to run solely on burning mixed oxide, a recycled nuclear fuel that is controversial because of concerns that it encourages nuclear proliferation.

The start-up of Ohma has been delayed by three years to November 2014 for additional earthquake-resistant work ordered by the government. In 2006 Tokyo tightened safety guidelines for new nuclear power plants, after tremors bigger than its design limits threatened the operation of Tohoku's Onagawa nuclear power plant in Miyagi prefecture.

The decisions followed Chugoku Electric Power's decision to put on hold its 2746 MW Kaminoseki nuclear power plant project. The company only recently restarted initial construction work at Kaminoseki following a 15-month suspension forced by local protests against its go-ahead.

The situation in Japan has caused many countries to re-assess their nuclear plans. Germany reacted most strongly by temporarily halting operation of seven of its oldest plants and is considering reversing a decision to extend the lifetime of its nuclear plants. Even China has decided to freeze construction of its nuclear plants pending a safety review.

Meanwhile, the public remains concerned about the potential damage to health as a result of the accident.

Tepco said radioactive iodine about 127 times normal levels and radioactive caesium about 25 times above the norm were detected in seawater about 100 metres off the Fukushima nuclear plant.

Despite that concentration, a senior official at the International Atomic Energy Agency said the ocean was capable of absorbing vast amounts of radiation with no effect and that, comparatively, the radioactivity released so far by the plant was minor.

"I would stress that the levels concerned are really very, very small, compared to the natural radioactivity that you find in the oceans," said Graham Andrew, senior adviser to IAEA chief Yukiya Amano. "The quantities are tiny compared to the reservoir of natural radioactivity in the oceans."


Rupert Edwards: head of research and market analysis at Climate Change Capital

UK adopts carbon price floor as CCS levy dropped

- "A tax-based mechanism is subject to annual votes in Parliament"
- CCS demo projects to be funded from general spending

The UK is basing its efforts to build a low carbon economy on a carbon price floor. But although the government's efforts to encourage investment in clean energy has in essence been welcomed, some argue that the tax-based mechanism may create long-term uncertainty in its current form.

Rupert Edwards, head of research and market analysis at Climate Change Capital, said: "The UK government's carbon price floor proposals demonstrate that the UK has the ambition to take a leadership role on climate policy at a time when the EU as a whole seems to be losing its nerve. Investors will, however, have serious doubts about the long-term credibility of the carbon price floor policy as it is currently conceived. This is because it is a tax-based mechanism subject to annual votes in Parliament.

"A policy to reduce uncertainty must itself be certain. To ensure that certainty, a contractual obligation could be created with no costs to government if the Treasury keeps to its carbon price floor commitments. If the carbon price support was actually guaranteed, it would increase certainty, reduce the incentive for investors to 'wait and see', and lower costs for investors and the economy."

Under the plans confirmed by UK Chancellor George Osborne, the government will put a floor under the price of carbon dioxide permits – payable by power generators and traded via the EU emissions trading scheme (ETS) – as the current price of €15 ($21) a tonne – is considered too low to encourage investment in low carbon technology.

The floor price will be introduced in 2013 at £16 ($26) a tonne and will reach £30/t in 2020. The policy will raise about £1.4 billion in its third year, according to government estimates.

Redpoint Energy undertook supporting analysis for HM Treasury and the Department for Energy and Climate Change (DECC) on the Carbon Price Support. Director, Duncan Sinclair, said: "The Carbon Price Support may stimulate more investment in low carbon generation, although we expect the Feed-in Tariffs with Contracts for Difference as announced in DECC's December consultation to be a more significant factor."

One important technology that will not benefit from the carbon price support is carbon capture and storage (CCS). The budget announcement that the government will fund CCS demonstration projects from general spending may do little to provide the long-term certainty developers require to get the technology off the ground.

The government has set aside £1 billion for at least one CCS demonstration project and had been considering putting a levy on electricity bills to fund at least a further three.

Dr Jeff Chapman chief executive of the Carbon Capture and Storage Association (CCSA) said the decision to pay for four demonstration projects through central Treasury funds meant that CCS was being treated differently to other low-carbon technologies.

He warned: "It's not a good situation that the industry has to go, cap in hand, to the government for support when other renewable technologies get automatic support. It puts CCS at a considerable disadvantage."

Professor Stuart Haszeldine, an expert in CCS at the University of Edinburgh, also said that he would have preferred a more structured system of funding.

"The levy would have delivered CCS with minimal extra charge on electricity bills," he said. "[Now] the first project will be funded off the Treasury's balance sheet, but projects two to four will have to go through different spending reviews. I'm sure the DECC and the Treasury mean what they say, but the history of big spending commitments in this country suggests they are subject to people changing their minds."

The Budget announcement also saw the government confirm that the Green Investment Bank will start operating a year early in 2012 and receive an extra £2 billion. However, it will not be able to borrow until 2015. The bank will now start with £3 billion and will be able to leverage up to £15 billion.

Solar FITs come under more pressure

Feed-in-tariffs (FITs) for solar power in Europe are coming under increasing pressure as both Italy and the UK moved to reduce the level of subsidies to projects.

The Italian government last month released an updated renewable energy decree that extends the current FITs only to those photovoltaic (PV) plants that connect to the grid by the end of May. Under the previous decree, this support was to have been available until 2013.

PV installations connecting to the grid after 31 May 2011 are to receive an as yet unannounced reduced tariff.

Further talks between government and industry will take place this month but tariff cuts are expected to be applied from June.

The Italian government said the new decree is aimed at stabilising the renewable energy market and preventing a solar bubble.

"We had to act quickly to ensure continuity and stability for [the] long-term market," Industry Minister Paolo Romani said following the announcement.

Meanwhile in the UK, the government recently announced that incentives for solar power projects are to be slashed with subsidies for mid-sized facilities being cut by half and the very largest projects having their grant cut by nearly three-quarters.

The government wants to cut the subsidy for installations producing 50 -150 kW from 32.9p/kWh to 19p/kWh, while installations producing over 150 kW will have their subsidy cut from 30.7p to 15.7p. Solar farms producing over 250 kW would receive only 8.5p.

Ministers say the clampdown is intended to help protect the incentives available for smaller household schemes.

The move has come under fire from the solar industry. David Hunt, a director with Eco Environments, said: "While we accept that projects of 1 MW plus do warrant review, reducing the tariff significantly for installations of just over 50 kW is farcical."

Howard Johns, chairman of the UK's Solar Trade Association, called the proposals "a complete disaster for the solar industry".

In spite of the increasingly tough climate for solar, energy outsourcing company Eaga last month announced that it has raised £300 million ($480 million) in debt and equity financing for a programme to install up to 100 MW of solar photovoltaics on 30 000 residential buildings in the UK. The company said it is the first and biggest private financing deal of its kind in the UK to install solar power into homes.

Elsewhere in Europe, a group of investors in Spain is taking legal action over retroactive tariff cuts.

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*Source: World Energy Outlook 2009, IEA/OECD

Fukushima effect

Obama backs nuclear 'renaissance'

- Venezuela bucks the trend in the Americas
- Chile signs nuclear deal

Siân Crampsie

The nuclear crisis in Japan that resulted from the March 11 earthquake and tsunami is threatening to derail US President Barack Obama's energy policy.

President Obama has been struggling to implement his clean energy policies since taking office in 2009 and now needs to reassure the public over the safety of the USA's 104 nuclear power plants.

A 'renaissance' in the nuclear energy industry – including the life extension of existing nuclear plants and the construction of new ones – is a key part of the President's plans to reduce greenhouse gas emissions and reduce America's dependence on oil imports.

President Obama says he remains strongly in favour of nuclear energy, but has asked the Nuclear Regulatory Commission (NRC) to conduct a "comprehensive review" of the safety of all US nuclear power plant in the wake of events at Japan's Fukushima Daiichi nuclear plant.

"When we see a crisis like the one in Japan, we have a responsibility to learn from this event and to draw from those lessons to ensure the safety and security of our people," said Obama in mid-March. "Nuclear energy is an important part of our own energy future."

Nuclear power provides around one-fifth of the USA's electricity needs.

"A review of our nuclear plants is an appropriate step after an event of this scale and we expect that the Nuclear Regulatory Commission will conduct its own assessment," said Marvin S. Fertel, president and chief executive officer of the Nuclear Energy Institute. "The industry's highest priority is the safe operation of 104 reactors in 31 states and we will incorporate lessons learned from this accident at American nuclear energy facilities.

"The commitment, along with the strict regulation of the industry by the Nuclear Regulatory Commission, has made US reactors the safest in the world."

Experts in the USA have expressed concerns not only about nuclear power plants in seismically active regions such as California, but also about those that are vulnerable to storm surges, such as Turkey Point in Florida. Other areas of concern include spent fuel pools, which in the USA hold a combined 63 000 tonnes of spent fuel, according to the NRC.

Other countries in the Americas have taken a similar line to the USA in their responses to the events in Japan, including Mexico, which said it would inspect its only nuclear power plant, Laguna Verde. The country is keen to expand the use of nuclear energy in order to combat carbon emissions.

Chile also reiterated its commitment to introducing a nuclear energy programme by signing a nuclear accord with the USA just days after the magnitude 9.0 earthquake and tsunami struck Japan.

Scepticism about nuclear energy has been rising in Chile but President Sebastian Pinera said that the country needs nuclear energy to reduce dependence on energy imports and combat global warming. The accord with the USA is mainly focussed on training Chilean engineers, according to reports.

President Obama: reassuring the public on nuclear safety

In contrast, Venezuela brought a halt to its nuclear energy programme, which was designed to reduce its dependence on hydropower. President Hugo Chavez said in a televised speech that the disaster in Japan showed that nuclear energy was "risky and dangerous".

The country was planning to build up to 4 GW of nuclear capacity and had asked the Russians for assistance. The Venezuelan national assembly passed a law in December last year concerning the construction and operation of nuclear plants.

In Canada, the Canadian nuclear regulator (CNSC) and nuclear utility Ontario Power Generation, which operates ten of the country's 18 reactors, sought to reassure the public over safety.

"The CNSC, as the Canadian nuclear regulator, is confident about the safety of Canada's fleet of nuclear reactors regarding seismic activity," said a March 12 statement from the CNSC. "The CNSC would like to reassure Canadians that nuclear power plants located in Canada are among the most robust designs in the world and have redundant safety systems to prevent damage in the case of an earthquake."

Chevron, BHP buy into shale gas

Energy companies continue to move into the booming US shale gas business in spite of weak energy prices.

Chevron Corporation has closed its acquisition of Atlas Energy, which has unconventional gas reserves in six US states, while BHP Billiton has announced a deal to buy Chesapeake Energy's Arkansas-based gas business for $4.75 billion.

Both companies are taking a long-term view of the market, as analysts say that the economics of gas production in the USA are currently questionable. For both Chevron and BHP, the deals will give them access to major shale gas resources with operating lifetimes of around 40 years.

A boom in the production of natural gas from unconventional reserves such as shale gas in the last few years has resulted in a 'gas glut' and driven prices down to around $4/million BTUs. In 2008, gas prices in the USA reached a high of $13.69/mBTU.

Chevron acknowledges that gas prices in the US need to reach $6-7/mBTU in the long term in order to cover the cost of investment, according to the *Financial Times*. Atlas Energy owns the rights to an estimated nine trillion cubic feet (254.9 billion m^3) of natural gas resource, which includes approximately 850 billion cubic feet (24.07 billion m^3) of proved natural gas reserves with approximately 80 million cubic feet (2.265 million m^3) of daily natural gas production.

BHP's deal will give the company 487 000 acres of leasehold gas properties in the Fayetteville shale which currently produce around 400 million cubic feet (11.33 million m^3) of gas per day. The company sees potential to triple the production from the Fayetteville acreage during its 40-year operating lifetime.

The exploration of the USA's shale gas reserves has caused controversy in the country, with environmentalists concerned about the impact of the industry on water resources.

There is also concern that continued low natural gas prices could harm the uptake of renewable energy.

Alberta approves 300 MW wind project

- Major boost for Alberta wind capacity
- Ontario approves FIT projects

Alberta is to host the largest wind farm in Canada after the Alberta Utilities Commission (AUC) gave its approval to the Blackspring Ridge I project.

Project developer Greengate Power Corporation says it is expecting to start construction on the 300 MW project in 2012, with a target commercial operation date of 2013.

Alberta is famous for its oil tar sands industry but also has one of the largest installed capacities of wind power of all the Canadian provinces with 806 MW, according to the Canadian Wind Energy Association (Canwea). Ontario has the largest share of wind power with 1558 MW.

Ontario is continuing to boost its renewable energy credentials, announcing in March the approval of contracts for 40 projects, including 615 MW of onshore wind energy.

The renewable energy projects were approved by the Ontario Power Authority under the province's feed-in tariff (FIT) regime. They also included 35 solar power projects totalling 257 MW and one 500 kW hydropower project.

In April 2010 Ontario approved 184 renewable projects.

Ontario has a generous renewable energy FIT programme, which pays projects a guaranteed rate over 20 years for solar and wind installations, and over 40 years for water power projects.

No offshore wind power projects have been approved under the scheme, however, after the Ontario government imposed a moratorium on offshore developments pending research into the technology and its impact on the environment.

"The Feed-In Tariff programme is continuing to meet its objective to encourage more renewable energy to be developed in Ontario," said Colin Andersen, Chief Executive Officer of the Ontario Power Authority. "Interest in the programme continues to be strong, and Ontario will benefit from the new clean, renewable energy that these FIT contracts will deliver."

Ontario's FIT scheme has caused controversy because projects are required to source a large proportion of equipment and services from Ontario.

The EU, USA and Japan claim that the domestic content requirement violates World Trade Organisation (WTO) rules.

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Fukushima effect

Asia continues pursuit of nuclear

South Korean President Lee Myung-bak: ordered a safety check on local nuclear reactors

Despite a pause to assess safety systems, most Asian countries look likely to press ahead with their nuclear power programmes. **Syed Ali**

The nuclear crisis in Japan does not seem to have deterred the rest of the region from its pursuit of nuclear power.

Although the incident at the Fukushima Daiichi nuclear power plant is a blow to the nuclear industry, the nuclear renaissance at least looks set to continue in what will be the main market for new nuclear build.

Following the incident, the Chinese government decided to temporarily stop authorising construction plans for nuclear power stations.

China is the world's fastest growing nuclear power market. The country has 13 nuclear reactors in operation and another 27 under construction. Additional reactors are planned, to give more than a ten-fold increase in nuclear capacity to at least 80 GWe by 2020, 200 GWe by 2030, and 400 GWe by 2050.

The State Council, China's Cabinet, ordered relevant departments to conduct emergency safety checks at existing nuclear plants.

Mr Zhang Lijun, China's vice-minister for environment said: "China has to learn lessons from the accident in Japan but will not give up on nuclear energy."

The industry will also be relieved that India, the world's next most lucrative market, is also keeping faith in nuclear.

India plans to invest $175 billion in dozens of new reactors over the coming years. The country has 20 nuclear power plants with a total installed capacity of 4780 MW but plans to expand this to 30 000 MW by 2020.

The Indian government says it will not reconsider plans to expand nuclear power generation. It says it will, however, re-evaluate safety issues.

"There are lessons be learned," said V. Raghuraman, a former energy adviser to the Confederation of India Industry. "That is what India will do. The question now will be one of re-examination and see whether the path on which we have been going ahead is providing the necessary safeguards and safety procedures are being incorporated; so they will be re-evaluated. So there may be some postponement, but no derailing of the process."

In particular, there is expected to be greater focus on potential safety hazards at a facility to be built at Jaitapur, in western Maharashtra. Concerns have been raised because the site is in an earthquake-prone zone.

In Asia's other major nuclear power market, outside of Japan, South Korean President Lee Myung-bak ordered a safety check on local nuclear reactors.

Lee sent Science Minister Lee Ju-ho to Gori, the site of five nuclear reactors, to assess the country's preparedness for natural disasters.

The government has ordered all new atomic power plants to be designed to resist an earthquake of 7.0 magnitude. South Korea currently operates 21 nuclear reactors capable of standing a 6.5-magnitude earthquake and plans to build 14 more reactors.

Outside of the major nuclear players, a number of Southeast Asian countries have been looking to embark on the nuclear path.

With earthquakes being the biggest concern in the region, much focus is centred on Indonesia.

Indonesian legislator Satya Yudha, from Parliament's Commission VII, which looks at energy issues, said the government should not "write-off" nuclear energy because of Japan.

"Sooner or later, we will need it," he said. "The government's task is to look at diversifying energy sources because without secure energy supply we cannot advance. In the meantime, we need to educate people properly about nuclear energy."

Indonesia says four nuclear reactors it plans to build near a fault will be safe and use technology that will be 40 years more modern than the Fukushima plant.

The four reactors will be built on Bangka island by 2022. Bangka is near Sumatra, the island where a 2004 earthquake caused the massive tsunami that killed 230 000 people.

Elsewhere in Southeast Asia, the Malaysian government sought to allay fears over its plans to build a nuclear power plant as government lawmakers and others disturbed by the unfolding nuclear crisis in Japan have begun to publicly call for a review of the nation's nuclear power strategy.

Deputy Prime Minister Muhyiddin Yassin said that while there are lessons to be learned from the Japanese experience, government authorities in Malaysia "know what they are doing".

Malaysia plans to build a two-reactor nuclear power plant with a total capacity of 2 GW. The first unit is targeted to be in operation by 2021, and the second a year later.

Officials in Vietnam, which is eager to continue its economic rise, have said that safety will be a priority but that they will continue to work toward nuclear power as a way to ensure the country is able to meet its energy needs.

In the days immediately following the incident the Philippines' presidential spokesman Edwin Lacierda said that the Japan crisis prompted President Benigno Aquino III to prioritise the development of non-nuclear sources of energy.

However, according to the country's socio-economic planning chief, in its recent Medium Term Philippine Development Plan (MTPDP) for 2011-2016 the Aquino administration has proposed the establishment of a nuclear power plant.

Socio-economic Planning Secretary Cayetano Paderanga said that the proposed nuclear plant in the draft MTPDP is just one of the possibilities that was mentioned during the consultation with the civil society as an alternative source of power.

"The assessment of nuclear energy as a safe source will depend on scientific judgments which we hope Philippines society will be able to get," Paderanga said.

n At the end of February, Bangladesh signed a primary deal with Russia to build its first nuclear power plant. The 2000 MW plant in the country's western Pabna district, 216 km from Dhaka, will cost $1.5-2 billion and is to be completed in 2017-18.

Gillard continues emissions battle

- Carbon tax could be set at between $19.6 and $29.4 a tonne
- Tax to be replaced by emissions trading scheme in 2015

Australia's Prime Minister Julia Gillard continued the battle to make polluters pay for emissions as the government launched its third attempt to introduce a carbon tax.

Gillard announced the government's proposal to implement a carbon price from July 1, 2012, warning that "Australia is at risk of falling behind the rest of the world".

Australian federal government climate change adviser Ross Garnaut suggested that the carbon tax should be set at between $19.6 and $29.4 a tonne. He said the price should then rise at four per cent per year before being replaced by a floating price in an emissions trading scheme in 2015.

Climate Change Minister Greg Combet said the move from a fixed carbon price to a trading arrangement will give emitters time to understand their carbon liabilities and enable a smooth transition to a trading scheme.

Tom Jordan, an equity research analyst at Deutsche Bank in Sydney, said the proposal reflects growing momentum for a price on carbon, but there is a "wide gulf" between decision-makers on issues such as what the starting price will be, the ambition of the national 2020 emissions target, access to international permits and assistance arrangements for trade-exposed firms, generators and households.

Carbon research firm RepuTex said companies in the Australian Stock Exchange top 200 will face annual carbon costs of up to A$3.3 billion ($3.3 billion) following the introduction of a carbon price, based on the forecast maximum price of A$25 per tonne.

Professor Garnaut said half of the revenue from a carbon tax should be returned to low to middle-income households through tax cuts, welfare changes and energy efficiency measures. He has also suggested some revenue go to businesses to invest in emissions-reducing technologies.

Julia Gillard: Australia "falling behind"

Opposition leader Tony Abbot described the proposal as a "betrayal", in reference to Labor's past commitment not to introduce a carbon tax.

The carbon price introduction remains subject to legislative approval in both houses of federal Parliament.

Ms Gillard's predecessor was dumped after two failed attempts to address climate change.

Egco plans expansion following Tepco stake

Egco Group Plc, Thailand's second-largest private power producer, plans to spend Baht 7 billion ($231 million) this year to expand its operations. The move comes after Japanese utility Tokyo Electric Power Co (Tepco) announced it will pay 21 billion Yen ($260 million) to take a stake in the company.

President Vinit Tangnoi said the major investments included $215 million to double Egco's stake in Quezon Power (Philippines). Late last year Egco signed an acquisition agreement to purchase another 26 per cent in the venture raising its stake to 52 per cent. Quezon Power operates a 460 MW coal-fired plant, a 230 kV transmission line and related infrastructure in Quezon province.

Mr Vinit said the company was also considering an additional budget to build three new plants for which it received licences from the Electricity Generating Authority of Thailand (Egat) in February. The plants' combined capacity would be 325 MW.

In February, Tepco, Asia's largest power company, announced that it will buy a 12.29 per cent stake in Egco through the Japanese trading group Mitsubishi Corp, which will purchase the shares from Hong Kong's CLP Holdings Ltd, and sell on a portion to Tepco.

The deal comes amid a push by Tepco to expand business in Asia as shrinking demand in its home market continues to put pressure on its bottom line.

As part of a plan to invest in renewable energy projects, Egco has joined with Mitsubishi and CLP Holdings to build a 73 MW solar power plant, one of the world's largest solar energy projects, in Lop Buri province.

Egco will now spend Baht 1 billion to expand solar power production from 73 MW to 84 MW in the province.

ETS unlikely to play a big role in China's low carbon plan

China's 12th Five Year Plan (FYP) will increase the proportion of generation from clean energy resources as part of its efforts to cut emissions. However, emissions trading is unlikely to play any significant part in those efforts within the five-year period.

China has set a target of building 235 GW of power generation capacity from clean energy sources in the next five years, in an effort to trim the country's heavy reliance on fossil fuels.

China says it will boost the proportion of non-fossil fuels in primary energy consumption to 11.4 per cent (up from 9.6 per cent at the end of 2010). Energy consumption and carbon dioxide emissions per unit of GDP should be reduced by 16 per cent and 17 per cent respectively, during the five years.

Some observers claim that the targets are conservative, and near the bottom range of figures considered by the government, but that they fall on the trajectory of the 40-45 per cent carbon intensity reduction below 2005 by 2020 that China pledged under the Copenhagen Accord.

The plan continues the theme of sustainable and "scientific" development set out in the 11th FYP, adding policies to restructure the economy and setting new targets to reduce China's reliance on energy imports, improve energy efficiency and slow the pace of environmental degradation.

China's National People's Congress approved the country's 12th five-year plan (FYP) last month, affirming a decision made last year by the central economic planner, the National Development and Reform Commission (NDRC), to use energy and emissions trading to help achieve the plan's energy and carbon-intensity targets.

However, according to a report from the Climate Group Carbon, emissions trading is unlikely to result in significant reductions of greenhouse gas emissions in the next five years.

Trading mechanisms are to be piloted under a low-carbon development programme in five provinces and eight cities. Guangdong province in southern China is furthest along, with plans for a trading scheme based on carbon intensity in 11 major cities, said Changhua Wu, head of greater China at the Climate Group.

But in a recent closed-door meeting, representatives from the energy sector expressed "very, very strong resistance" to a proposed sectoral emissions trading scheme, said Wu. "Whether or when the NDRC rolls that out remains to be seen," she added.

The FYP also calls for a statistics and accounting system for energy and emissions data. Such data, currently lacking in China, is just one component of trading infrastructure that must be developed before meaningful reductions can be expected, said Wu.

"Even though we said last year that we were going to try out carbon trading, we have to be realistic. You cannot expect in five years time that we're going to have a very well-developed trading mechanism in place that is very effective at all," she added.

The FYP projects 7 per cent annual GDP growth for the next five years. Observers wonder if Beijing can succeed in slowing down the economy (the previous plan aimed for 7.5 per cent, while in reality the economy grew by more than 11 per cent per year on average), but Wu says the official figure should help achieve the energy and carbon efficiency goals.

China also intends to reduce coal consumption, despite plans to increase coal-fired power capacity by 260 GW in the next five years, according to the Climate Group report. Under the FYP, natural gas will replace coal to the largest extent – increasing from 4 to 8 per cent of the energy mix.

The finalised targets for nuclear, hydro, wind and solar power expansion will be published in the "New Energy Industry Development Plan" in the coming months.

Renewable efforts eye "Ring of Fire"

The World Wildlife Fund (WWF) Philippines has joined forces with Energy Development Corp. (EDC), the Philippines' biggest geothermal energy producer, to accelerate development of power generation from geothermal sources in Asia through the landmark "Ring of Fire" Project.

The initiative hopes to exploit the huge geothermal resources in the Pacific Ocean basin to increase installed geothermal capacity in the region by more than 150 per cent in the next five years, and 300 per cent by 2020.

The project's proponents aim to establish a "Gold Standard Geothermal Showcase" at EDC's 50 MW Mindanao 3 geothermal project in North Cotabato as a benchmark for all upcoming projects.

Geothermal development is already an important part of the government's efforts to increase electricity generation from renewable sources.

In February, the Department of Energy (DOE) issued draft rules governing the minimum off-take for renewable energy sources by power distributors and suppliers. Based on the draft rules for the renewable portfolio standard (RPS), all power generators would be mandated to generate a minimum one per cent of their total supply from renewables.

"The DOE shall increase the RPS rate by at least one per cent annually within the period of 10 years from effectivity of this circular," the department said.

Meanwhile neighbouring Indonesia, which holds approximately 40 per cent of the world's conventional geothermal reserves, is also moving to increase the amount of geothermal in its energy mix.

The country will benefit from a recently awarded $500 million (Rp 4.4 trillion) loan from the Asian Development Bank (ADB) to build three geothermal power plants with a total capacity of 165 MW.

Renewables and low carbon technology continues to be a focus of the ADB. In late February it announced plans to launch a multi-billion dollar equity investment fund this year to tap the world's top pension funds for clean energy infrastructure projects in Asia. The fund is the first of its kind to mobilise pension and institutional funds for low-carbon technology investments in Asia.

Fukushima effect

European governments weigh nuclear policies

- Pressure mounts to prove reactor safety
- Energy prices rise in response to disaster

Italy became the third European country in March to announce a moratorium on nuclear power plant construction or life extension as governments around the region sought to quell fears over the safety of nuclear power plants in the wake of the crisis at Japan's Fukushima Daiichi nuclear power plant.

Italy's minister of economic development Paolo Romani said that the moratorium would allow Italy to make "calm, informed" decisions on its nuclear programme and "not be influenced by the emotions of the moment".

Italy phased out its nuclear power programme in the wake of the Chernobyl disaster in 1986 but reversed its policy in the last few years to allow steps to be taken towards the construction of new nuclear plants in the country.

Its policy decision in the wake of Japan's troubles came after Germany made the decision to take seven of its oldest nuclear power plants offline and Switzerland announced the immediate suspension of its approvals process for three new nuclear power plants so that safety standards can be revisited.

The reactions of other countries were more muted, with Spain, the UK and Finland announcing nuclear safety reviews. Both Poland and the Czech Republic vowed to continue with their nuclear energy programmes.

All European Union governments have agreed to carry out stress tests on nuclear power plants across the bloc to ensure their safety against earthquakes on the scale of that which hit Japan on 11 March. The stress tests will also test nuclear units against threats such as tsunamis, terrorism, heatwaves, disruptions of cooling systems, the integrity of operational systems, back-up systems, overall

Paolo Romani: must make "calm, informed" decisions

design and the possibility of power cuts.

In the UK, the stress testing process and the review of safety ordered by Energy Secretary Chris Huhne is likely to delay the country's ambitious new nuclear build programme.

Although there is no precise timetable for the EU stress tests, industry has called for the test criteria to be stringent in order to defend the nuclear energy sector's safety credentials. This implies that some plants must fail the tests, says IHS analyst Kash Burchett.

"Much like the financial stress tests imposed upon European and American banks, the key criterion for the tests having a meaningful impact is that they must be sufficiently rigorous that not all plants pass," wrote Burchett in a research note. "Any other outcome will simply be labelled a whitewash."

In the longer run, however, nuclear energy policy in Europe is unlikely to be affected by the events in Japan, say analysts. This is because the fundamental drivers for a nuclear revival remain.

"The decision on the part of various European governments to turn to nuclear power is one of necessity; pressure to develop low-emission generation capacity is the critical driver," said Burchett. "This pressure has not abated; if anything, the European Commission has sought more ambitious emission reduction targets.

"In addition, Europe's geography means that – with the possible exception of Italy – seismic activity on anything like the scale that Japan has recently seen is virtually unthinkable. Consequently, events in the Pacific are unlikely to significantly sway the current overall policy trajectory in Europe."

Burchett says that the anti-nuclear backlash is most likely to be felt in Germany, where opposition to nuclear energy has been strong for many years. This may explain why German Chancellor Angela Merkel was quick to react to the Japanese crisis.

Merkel's reaction appeared to surprise the markets, pushing electricity prices in Germany to a three-year high. Carbon prices also surged on the expectation that any capacity shortfall arising from German (or other European states) shutdown of nuclear reactors would be replaced with gas- or coal-fired supply.

Electricity prices in other European states followed suit. UK gas and electricity prices traded at their highest levels since 2008 in the week following the earthquake and tsunami in Japan.

Gas prices in Europe are under pressure because Japan is expected to boost LNG imports to cover a shortfall in nuclear generating capacity.

Commission sets out low carbon pathway

- ETS needs to be strengthened
- Electricity sector 'carbon-free' by 2050

The European Commission wants EU member states to start developing national low carbon 'roadmaps' charting a pathway to a low carbon economy by 2050.

The EU executive body last month published its own '2050 Roadmap' and says that national roadmaps will enable the 27-nation bloc to reach a target of an 80-95 per cent reduction in greenhouse gas (GHG) emissions over 1990 levels by 2050.

The 2050 Roadmap is designed to help transform the EU into a competitive low carbon economy and looks beyond the bloc's 2020 targets for GHGs and renewable energy.

It says that meeting a target of an 80 per cent reduction in GHGs by 2050 will require the EU as a whole to reduce emissions by 40 per cent over 1990 levels by 2030. The electricity sector could "almost totally eliminate carbon dioxide (CO_2) emissions by 2050", says the report.

However the Roadmap fell short of proposing an increase in the EU's 2020 targets to a 30 per cent reduction in GHGs from the current level of 20 per cent.

"The Commission's paper shows that the case for a 30 per cent EU carbon target has never been stronger," said Greenpeace EU climate policy director Joris den Blanken. "A step up to a 30 per cent carbon target by European governments will give people and businesses lower fuel bills, efficient cars and more comfortable houses."

The Commission's Roadmap indicates that the current 20 per cent target for GHG emission reductions could be easily met if the revised Energy Efficient Plan is fully implemented.

An increase in the target to 30 per cent by 2020 was supported by the UK, Germany, Spain, Denmark and Portugal, while a report commissioned by the German government indicated recently that such an increase would boost the EU's economy and cut unemployment.

The Commission's Roadmap states that the electricity sector will play a crucial role in the transition to a low carbon economy and notes that the EU's emission trading scheme (ETS) "will be critical in driving a wide range of low carbon technologies into the market". It estimates that the share of low carbon technologies in the electricity mix will increase from 45 per cent today to 60 per cent in 2020.

This figure will be close to 100 per cent by 2050, says the Commission, provided that a sufficient carbon price signal and long-term predictability are provided. "In this respect, appropriate measures need to be considered, including revisiting the agreed linear reduction of the ETS cap. Other tools, such as energy taxation and technological support may also be appropriate to ensure that the power sector plays its full part," says the Roadmap.

Investment in smart grids will also be required to attain low carbon goals.

The Commission also says that switching to a low carbon economy would reduce the EU's average fuel bills by €175-320 billion per year.

CCS plans move forward

Enel says that its new carbon capture pilot plant in Italy will provide the basis for the technologies upon which the world's future energy systems will be built.

The Italian utility has inaugurated the pilot plant at its Federico II power plant in Brindisi and says that the post-combustion capture technology in operation there is "the most mature and appropriate for retrofitting existing thermal power plants".

The Brindisi project will treat 10 000 m^3 per hour of fumes from the Federico II coal plant, separating out 2.5 metric tonnes of carbon dioxide (CO_2) per hour, up to a maximum of 8000 tonnes per year. Eventually the captured CO_2 will be transported to an ENI-owned depleted oil field in Cortemaggiore where it will be injected and permanently stored underground.

The ENI storage site will be operational in 2012.

In March the Scottish government said that the Moray Firth could be the site of an emerging carbon capture and storage (CCS) industry.

The Scottish government is already moving forward with aggressive plans to capitalise on the country's renewable energy resources, and in a new report indicated that it could lead the way in the development of the CCS industry.

"This latest research further strengthens Scotland's position as the number one location for CCS technology development and deployment in the world," said Scottish Energy Minister Jim Mather. "In depleted oil and gas fields and in its natural geology, the North Sea has an amazing carbon storage potential – the largest offshore storage capacity in Europe."

The research calculates that a rock formation, known as the Captain Sandstone – buried more than half a mile beneath the Moray Firth, could store at least 15 years and potentially a century's worth of carbon dioxide (CO_2) output from Scotland's power industry.

Another report released in March indicated that decades of industrial carbon emissions from the UK and Ireland could be stored in depleted gas fields deep beneath the East Irish Sea (EIS).

The study, by CCS consulting firm Eunomia, shows that hydrocarbon fields in the EIS could store up to 1 billion tonnes of CO_2.

Fukushima effect

Russia presses on with nuclear

- UAE pledges review
- Concerns raised over Metsamor

The Russian government says that it does not intend to rethink plans for the development of its nuclear energy industry in light of the natural disasters in Japan that triggered the crisis at the Fukushima Daiichi nuclear power plant.

Both the Russian Prime Minister Vladimir Putin and President Dmitry Medvedev have said that they believe nuclear energy is safe and beneficial. They have announced plans to improve regulations and standards concerning nuclear safety.

The country is planning to expand its own network of nuclear energy facilities and is also keen to export its technology abroad.

"Probably, additional requirements are needed and, correspondingly, constraints as to building nuclear power plants in seismically hazardous zones," wrote Medvedev in his blog. "There apparently should be common international requirements; especially where severe earthquakes followed by tsunami are likely."

He also said that "the most important thing is to substantially improve trust of people in development of nuclear power in the world".

Russia's official line is in contrast to some other countries, which have announced either temporary suspension of plant operations and new build programmes, or complete moratoria on new plant construction.

Russia operates 31 reactors with a total generating capacity of 21 743 MW and has a further ten units under construction. Another 14 units totalling 16 000 MW gross generating capacity are planned and 30 more, with a combined capacity of around 28 000 MW, have been proposed, according to data from the World Nuclear Association.

Russia is also planning to build Turkey's first nuclear power plant, a project that has once again raised concerns because of Turkey's susceptibility to earthquakes. Medvedev told the Itar-Tass news agency in March that nuclear power plants are safe as long as "you correctly decide on the placement of the nuclear power plant, on the relevant project to be implemented and on the operator".

"With all of these conditions met, nuclear power is absolutely safe and very beneficial for humankind," he said.

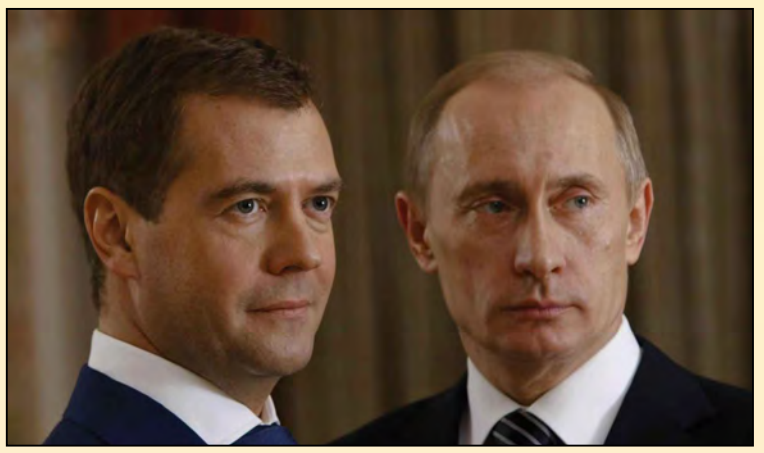
Turkey has also been in talks with Japan over the use of Japanese nuclear technology in its new build programme. In the wake of the nuclear crisis, it has sent a team to Japan to gather information about the problems at Fukushima-Daiichi.

In neighbouring Armenia, the government has sought to make reassurances about its only nuclear power plant, about which the European Union has raised concerns.

The Armenian state committee for nuclear security has told local media that there is no need for additional safety controls at the Russian-designed VVER-440 plant, which itself survived a 7.2 magnitude earthquake in 1988.

The Metsamor plant re-opened in 1993 due to an acute electricity shortage and now supplies around 40 per cent of Armenia's electricity needs. Armenia says it will close down the plant when a replacement unit has been built.

Ukraine, meanwhile, says that it will review its energy strategy in view of events in Japan. "We will seek a practical balance between the use of nuclear energy and the energy from the ecological sources," said Prime Minister Mykola Azarov in an interview with Austrian newspaper *Der Standard*. "Meanwhile nuclear power ensures half of Ukrainian needs and it is an important component of the State economical development."



Russian President Dmitry Medvedev and Prime Minister Vladimir Putin believe nuclear energy is safe and beneficial

In the Middle East, the nuclear safety regulator of the United Arab Emirates (UAE) said it would conduct a "very thorough review" of its nuclear energy programme in light of the crisis in Japan. The country's Federal Authority for Nuclear Regulation said it was examining the licensing application of the Emirates Nuclear Energy Corporation (ENEC) to build nuclear plants at the Braka site, and would use lessons learned from the Japan crisis to enhance safety measures.

In December 2009, the UAE signed a $20.5 billion agreement with South Korea for the construction of four nuclear power plants in the country.

The UAE hopes to become the first Gulf state to develop a civilian nuclear programme to help meet soaring demand for power. The first of the UAE's nuclear units is scheduled to produce electricity in 2017, the other three in 2020.

Capital must be redirected, says UN

The 'greening' of key sectors such as energy, transport and water usage would have numerous economic benefits, says the United Nations.

Siân Crampsie

The United Nations Environment Programme (UNEP) says that investing around two per cent of global GDP each year in ten key sectors would deliver long-term stability in the global economy.

In a report released in late February, UNEP concludes that annual investments of around $1.3 trillion would boost economic growth and kick-start a transition to a low-carbon global economy.

The investments would have to be backed by supportive national and international policies and made in the 'right' sectors. They would result in strong renewable energy penetration, more sustainable fisheries and water usage and lower greenhouse gas emissions, says UNEP.

"Governments have a central role in changing laws and policies, and in investing public money in public wealth to make the transition possible," said Pavan Sukhdev, on secondment from Deutsche Bank and head of UNEP's Green Economy Initiative. "By doing so, they can also unleash the trillions of dollars of private capital in favour of a Green Economy."

The report challenges the belief that there is a trade-off between environmental investments and economic growth, and argues that a green economy is a key catalyst for growth and poverty eradication in developing nations.

The report has modelled the outcomes of policies that redirect around $1.3 trillion a year into green investments and across ten key sectors. According to UNEP, the world currently spends between one and two per cent of global GDP on a range of subsidies that often perpetuate unsustainable resources use in areas such as fossil fuels, agriculture, including pesticide subsidies, water and fisheries.

Many of these are contributing to environmental damage and inefficiencies in the global economy, and phasing them down or phasing them out would generate multiple benefits while freeing up resources to finance a green economy transition.

"Misallocation of capital is at the centre of the world's current dilemmas and there are fast actions that can be taken starting literally today – from phasing down and phasing out the over $600 billion in global fossil fuel subsidies to re-directing the more than $20 billion subsidies perversely rewarding those involved in unsustainable fisheries," said Sukhdev.

In addition to higher growth, an overall transition to a green economy would realise per capita incomes higher than under current economic models, while reducing the ecological footprint by nearly 50 per cent in 2050, as compared to business as usual.

In the power sector, UNEP says that investing about one and a quarter per cent of global GDP each year in energy efficiency and renewable energies could cut global primary energy demand by nine per cent in 2020 and close to 40 per cent by 2050.

The report indicates that in a green economy scenario employment levels in the energy sector would be one-fifth higher than under a business as usual scenario as renewable energies take close to 30 per cent of the share of primary global energy demand by mid century. It also shows that savings on capital and fuel costs in power generation would under a green economy scenario, be on average $760 billion a year between 2010 and 2050.

Bushehr suffers setback

Iran's nuclear programme has suffered a setback with the announcement that fuel would have to be unloaded from Bushehr, the country's first nuclear power plant.

Iran notified the International Atomic Energy Agency (IAEA) in late February that it would have to unload fuel assemblies from the core.

Russia's nuclear energy agency has said that the fuel is being removed because of concerns that metal particles might be contaminating fuel assemblies. There is also speculation that the Stuxnet computer worm that infiltrated the plant several months ago may have caused more damage than previously thought.

The plant was due to start generating electricity within weeks.

Russia's state nuclear power firm Rosatom, which is building the plant, said that internal components of a coolant pump were damaged and it was concerned that metal particles could pass through the reactor internals and get on the fuel assemblies.

Fukushima effect

Tepco seeks emergency loans

- Moody's downgrades Tepco
- Vendors weigh potential reactor sales slowdown

Siân Crampsie

The Tokyo Electric Power Company (Tepco) is starting to count the financial costs of the nuclear crisis that unfolded following the devastating March 11 earthquake and tsunami in Japan.

The Japanese utility is tapping the country's largest banks for an emergency loan of up to Yen2000 billion ($25 billion) in order to build up its financial funds to cover as-yet unknown liabilities related to the disaster.

Tepco supplies electricity to around one-third of Japan's population and has been forced to implement the first rolling blackouts seen in Japan since World War II. In addition to clean-up and rebuilding costs, Tepco will have to cover bills for compensation claims and replacement generating capacity.

The firm's share price fell after news of the disaster, which has damaged nuclear units at Tepco's Fukushima-Daiichi site beyond repair. Other companies involved in the nuclear energy sector around the world, from uranium mining companies to electric utilities, also saw falling share prices.

Ratings agency Moody's downgraded its ratings on Tepco because it believes that the unprecedented nature of the disaster will have a long-term impact on the company's operations.

Moody's expects that the utility's capital expenditures will rise considerably as a result of the twin natural disasters, requiring additional debt and adding to an already highly leveraged capital structure. It said in a statement that Tepco's financial profile would recover in the long-term.

"Ratings may be stabilised when we have a better idea of the costs to recover from these developments and the amount of time that will be needed to recover these costs, and see evidence of continued robust support from the Japanese government and banking system," Moody's said.

Moody's also said in March that GE faces "credit negative risks" to its reputation and nuclear business as a result of the disaster in Japan.

The US-based industrial conglomerate designed the boiling water reactor (BWR) units at Fukushima-Daiichi and quickly set up an emergency response centre at the headquarters of its nuclear business in Wilmington, North Carolina after the tsunami struck to provide round-the-clock assistance to the Tepco team at the Fukushima site. The company is also reported to have had engineers working at the shut-down unit 4 reactor at Fukushima-Daiichi when the earthquake struck.

While GE is unlikely to face liabilities related to the nuclear crisis in Japan, it could, like other reactor vendors, be affected if the disaster results in a global slowdown of nuclear plant sales.

Several countries around the world have already announced moratoria on the construction of new nuclear power plants in response to the disaster in Japan, while others have temporarily halted construction programmes while safety reviews are carried out.

In addition to GE, the events in Japan affected share prices of companies such as Cameco, the world's biggest uranium producer, French nuclear engineering group Areva, French utility EDF as well as leading German utilities such as E.On and RWE.

GE and other vendors have been at pains to point out that the third generation reactors being sold around the globe at present feature passive safety systems that do not require an external power source in order to function.

Iberdrola to buy back renewable energy stake

Iberdrola says that the de-listing of its renewable energy subsidiary, Iberdrola Renovables, will allow it to gain greater control of activities that lie at the heart of its corporate strategy.

In a move that has angered investors, the Spanish energy group has announced plans to buy back the 20 per cent stake in Iberdrola Renovables that it listed in Madrid three years ago. The shares have been consistently trading below their flotation price, largely due to the financial crisis and a reduced demand for power in Europe.

The move will enable it to move forward with key projects, benefit shareholders as well as generate cost savings, said Iberdrola, which has also brought Qatar Holding on board as a shareholder. It has offered to exchange each Iberdrola Renovables share for 0.5045 Iberdrola Group shares.

"With the merger, Iberdrola will be able to promote projects that would have been more difficult for Iberdrola Renovables due to balance sheet, financial and manpower limitations," said Iberdrola in a statement.

An ill wind: Iberdrola's move to de-list its renewable energy subsidiary has angered investors

In March Iberdrola announced that Qatar Holding, the direct investment arm of the Qatar Investment Authority would purchase 6 per cent of its shares for €2.02 billion.

Iberdrola said that the deal would allow it to limit borrowing and reduce the risk of having its credit rating cut.

BP in deal to unlock Indian resources

BP has followed up its $16 billion share swap with Russian firm Rosneft with a $7.2 billion move into India.

The UK-based oil giant has signed a deal with Reliance Industries to take 30 per cent stakes in 23 oil and gas production sharing contracts that Reliance operates in India and to form a 50:50 joint venture between the two companies for the sourcing and marketing of gas in India.

The joint venture will also endeavour to accelerate the creation of infrastructure for receiving, transporting and marketing of natural gas in India.

"We are delighted to partner with BP, one of the largest energy majors and one of the finest deep water exploration companies in the world," said Mukesh Ambani, Chairman and Managing Director of Reliance Industries. "This partnership combines the skills of both companies and will be focused on finding more hydrocarbons in the deep water blocks of India and significantly contribute to India's energy security."

The deal is the biggest foreign investment in Indian energy and among the largest in any sector. The 23 oil and gas blocks together cover approximately 270 000 km^2.

"This partnership meets BP's strategy of forming alliances with strong national partners, taking material positions in significant hydrocarbon basins and increasing our exposure to growing energy markets," said Mr. Carl-Henric Svanberg, Chairman of BP.

BP will pay Reliance $7.2 billion for its stakes in the production sharing contracts, and will also make performance-related payments of up to $1.8 billion. These payments and combined investments could amount to $20 billion, says BP.

"India is one of the fastest growing economies in the world. By allying ourselves with Reliance, we will access the most prolific gas basin in India and secure a place in the fast growing Indian gas markets, creating a genuinely distinctive BP position," said Bob Dudley, BP Group's CEO.

According to BP's *Energy Outlook 2030*, gas is expected to be the fastest growing fossil fuel in India, with demand growing at a rate of nearly five per cent a year between 2010 and 2030. India's gas consumption was 5.0 bcf/d in 2009 and is estimated to have been 6.1 bcf/d in 2010. Total Indian gas consumption is projected to grow to 12.5 bcf/d in 2025, and exceed 15 bcf/d in 2030.

Areva signs up R-R as industrial partner

Rolls-Royce is set to take part in Areva's push to build EPR nuclear reactor technology around the world after signing an agreement with the French firm.

The deal will make Rolls-Royce a strategic partner to Areva, supplying key components for new reactors in the UK as well as for other projects for which Areva is tendering around the world.

Areva's EPR technology is to be used by EDF and its partner Centrica, which are planning the construction of up to four new reactors in the UK. The French firm is also competing to supply a further four reactors planned for the UK by a consortium of E.On and RWE, and is also in talks with NuGen, a joint venture of GDF Suez, Iberdrola and Scottish and Southern Energy, which is planning new build projects in the UK.

The deal between Areva and Rolls-Royce came in mid-March, a few days after Westinghouse and Endesa signed an agreement covering Westinghouse's AP1000 nuclear energy technology.

That agreement is aimed at providing Endesa with more information on the AP1000 design and performance, and with a view to potentially selecting the technology for future new nuclear projects to be built in Spain and South America.

Westinghouse announced that the agreement allows the transfer to Endesa of select proprietary Westinghouse information on the AP1000 design, its manufacture and construction. Endesa personnel will also work alongside Westinghouse in areas such as engineering, licensing, plant construction support and simulator training.

"This agreement is… reflective of the ever-increasing interest in the AP1000 by potential customers throughout Europe," said Westinghouse's President of Operations Ric Perez.

Tenders, Bids & Contracts

Americas

ABB to supply wind farm substations

Wind turbine firm Suzlon has placed orders with ABB for substation solutions to serve wind farms installed in the states of Ceará and Rio Grande do Norte, Brazil.

ABB will design, supply and install two 230 kV main substations and 104 unitary 36 kV compact secondary substations. Key equipment to be supplied with this $19 million order includes low-loss distribution transformers and a range of medium voltage switchgear.

Each wind turbine will be fitted with a fully automated unitary substation enabling real-time tracking and operation from a monitoring centre in Fortaleza, and maximising availability of the wind farms.

Gradient signs geothermal EPC

Geothermal energy project developer Gradient Resources has executed an engineering, procurement and construction (EPC) contract with Benham Constructors for the delivery of a new 60 MW modular binary cycle power plant at its Patua project in northern Nevada.

The Patua site is Gradient's first geothermal project. Physical construction of the first 60 MW phase of the power plant will begin in the second quarter of 2011 and the anticipated date for commercial operations is the 3rd quarter of 2012.

Benham Constructors is a subsidiary of Science Applications International Corporation.

Siemens awarded I&C contracts

Siemens Energy's Instrumentation, Controls & Electrical (IC&E) business unit has signed two new contracts in the USA for its innovative plant-wide distributed control systems.

Siemens is to upgrade the existing control systems of five Oglethorpe Power Corporation (OPC) power plants with its T3000 (SPPA-T3000) system, and has also signed a contract to install and test its SPPA-E3000 electrical system at four new power houses of American Municipal Power's (AMP) Ohio River hydropower project.

The OPC order consists of providing SPPA-T3000 control upgrades for the Chattahoochee combined cycle energy facility, in addition to its Smarr, Hawk Road, Sewell Creek and Talbot County simple cycle energy facilities located in the state of Georgia. The upgrades will take place between March 2011 and March 2014.

The Ohio River project consists of four new powerhouses with a total of 11 bulb-type turbines. Siemens' scope of supply is to provide the integrated SPPA-E3000 electrical system, which will provide the electrical controls, as well as synchronisation, coordination and protection for all of the 11 bulb turbines.

OPG selects Voith for Decew Falls refurb

Ontario Power Generation has awarded Voith Hydro Canada a contract to supply key parts for the refurbishment of the Decew Falls I hydropower project in Canada.

Under the contract, Voith will supply the turbine runner, shaft, and wicket gates of Unit 8 at the plant. The overhaul will be complete in early 2012.

Decew Falls I has been supplying power to the grid for more than a century.

NorthWestern Energy orders Beacon flywheel

Beacon Power Corporation has signed a lease agreement with NorthWestern Energy for a 1 MW Beacon Smart Energy Matrix flywheel energy storage system.

The system will be installed by Beacon Power and operated in conjunction with Mill Creek Generating Station (MCGS), a gas-fired regulating reserve plant recently commissioned in Montana and owned by NorthWestern Energy. The system is expected to be operational by the end of 2011.

Asia Pacific

Reliance chooses B&V for Samalkot design

Reliance Power has selected Black & Veatch (B&V) to design its $2 billion Samalkot power plant, which when completed will be the largest facility of its kind in India.

The 3 x 833 MW combined cycle power plant will provide much needed additional generation to India's southern grid. It will be fuelled with natural gas.

Initial construction work has commenced and the new plant is planned to start generating power early in 2012.

Emerson wins Sanmen, Haiyang contracts

Westinghouse Electric Company has awarded Emerson Process Management contracts totalling approximately $17 million to supply its Ovation expert control technology at four new Westinghouse AP1000 nuclear reactors in China.

The Ovation systems will be installed at the Sanmen Nuclear Power Plant in Zhejiang Province and at the Haiyang Nuclear Power Plant in Shandong Province. Each plant has two 1000 MW reactors under construction, with more units planned.

The Ovation technology will control power generation processes, provide an interface to operations and maintenance systems, and collect and distribute plant-wide information for process and power generation management.

Honeywell wins China smart grid project

Honeywell has been selected to develop and implement China's first smart grid pilot project and feasibility study for managing energy use in commercial buildings.

The pilot will centre on Honeywell's smart grid technology and expertise, including automated demand response, advanced energy management and submetering. It is part of a grant agreement between the US Trade and Development Agency (USTDA) and State Grid Electric Power Research Institute (SGEPRI), sponsor of the project and a subsidiary of State Grid Corp. of China.

China reports HVDC success

Alstom Grid and its Chinese partner China Electric Power Research Institute (CEPRI) have reported that Pole 2 of State Grid Corporation of China's (SGCC) Ningdong-Shandong 660 kV HVDC connection has been inaugurated and fully tested at full 4000 MW power in bipole mode.

The Ningdong-Shandong HVDC connection is the first 660 kV HVDC link in the world and transmits power over 1335 km from the Yinchuandong converter station in centre-North China to the Tsingdao converter station on the eastern coast. The link is equipped with Alstom's new higher rated valve design and thyristor valves that are the most powerful ever put into operation worldwide for an HVDC scheme.

Contact awards Te Mihi EPC

New Zealand's Contact Energy has awarded the engineering, procurement and construction (EPC) contract for the construction of the 166 MW Te Mihi geothermal project to a consortium consisting of McConnell Dowell, SNC Lavalin and Parsons Brinkerhoff.

Under the contract, the firms will build two new geothermal power units of 83 MW each near the Wairakei geothermal power station, northwest of Taupo, NZ. Once completed, approximately 45 MW of the existing Wairakei geothermal station will be decommissioned, resulting in a net increase from the combined Te Mihi and Wairakei stations of 114 MW.

Europe

Alstom in PMG collaboration

Alstom is to collaborate with power conversion specialist Converteam to develop and test the world's largest direct drive permanent magnet generator (PMG) for a wind turbine.

The two companies are planning to equip Alstom's two 6 MW offshore wind turbine prototypes that will be installed onshore and offshore in Europe during winter 2011 and in 2012 with Converteam's Advanced High Density (AHD) PMGs. The use of this technology is expected to improve reliability, reduce maintenance costs and boost efficiency.

Converteam delivered their first permanent magnet generators for 5 MW wind turbines in 2004, and their first high power (rated 3.7 MW) direct drive PMG has been in operation since 2008.

Vestas signs service renewal in Portugal

Vestas has signed a service renewal contract for the Candeeiros I, Candeeiros II and Pampilhosa wind power plants in Portugal.

The wind farms are owned by Iberwind and consist of a total of 75 of Vestas' V90-3.0MW wind turbines. The service renewal contract includes the Active Output Management package 'AOM 4000' for a seven-year period.

Vestas has also received from Iberwind an order for the Lagoa Funda wind power plant, the very first repowering project in Portugal. The contract comprises a full engineering procurement and construction (EPC) contract for six of the V90-2.0 MW units, a 15-year service agreement and a VestasOnline Business scada system as well as a condition monitoring system solution.

EnviTec Biogas to build three plants in Spain

EnviTec Biogas AG has signed a contract with Desarrollos Industriales Alternativos Daldur (Daldur) for the construction of three biogas plants in Spain.

Under the contract EnviTec will build three biogas plants in the autonomous region of Castilla y Leon, each with a capacity of 500 kW. The deal marks the German firm's entry into the Spanish market and pushes its international expansion strategy forward.

The three new plants will run primarily on liquid manure, energy crops and grape marc. Other biogenous residues may be used as well, as the Spanish law grants biogas plant operators relatively high flexibility.

Alstom Grid system goes live in Italy

Alstom Grid has delivered in record time the first phase of the day-ahead and intra-day market applications of its Smart Dispatch Market Management solution to Terna S.P.A., the Italian Transmission System Operator (TSO). These applications went live on January 1, 2011 after being configured for the new Italian energy market rules.

The Smart Dispatch system has a flexible framework allowing Terna to quickly comply and adapt to changes in local electricity regulations. In addition, the solution includes Smart Grid-ready applications to optimally and reliably manage large electricity networks and bring energy market efficiency benefits to end customers.

A second phase will be implemented in 2011 in order to allow additional developments on the system.

Turkey orders world's largest gas engines

Wärtsilä has received an order to supply seven of its 18V50SG natural gas fuelled engines for a new power plant in Turkey.

The order was placed by independent power producer Odas Elektrik Uretim, which is building the project at Urfa, southeastern Turkey. The plant is scheduled for completion in the autumn of 2011, and will supply power to the national grid.

The Wärtsilä 18V50SG spark-ignited gas engine is the largest gas powered combustion engine generating set in the world.

International

MW Power powers pellet factory

The Metso-Wärtsilä joint venture MW Power is to supply SIA Graanul Invest with a biomass power plant for combined heat and power production (CHP) in the municipality of Launkalne in Latvia.

The biomass power plant will utilise bubbling fluidised bed (BFB) technology and with a combination of forest residues such bark and wood chips or milled peat as the main fuels. The plant will produce 15 MW of heat and 6.4 MW of electricity, which will be partly utilised in the customer's own pellet factory.

Most of the produced electricity will be fed into the national grid.

SIA Graanul Invest is the Latvian-based subsidiary of AS Graanul Invest, which is a private capital firm dealing with bioenergy and renewable energy production.

TGK-9 selects GE 6FA technology

Russian power generation company TGK-9, an affiliate of Integrated Energy Systems (IES), has selected advanced gas turbine technology from GE for a combined cycle plant in Berezniki, an industrial city in Russia's Urals Federal District.

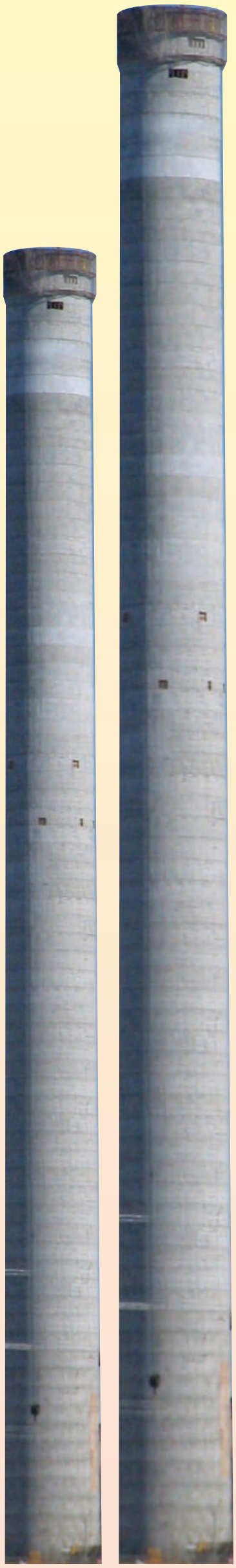
GE will supply two Frame 6FA gas turbines and associated generators plus technical assistance, on-site training and performance testing for the 220 MW project. Electricity will be distributed under an agreement between the Russian Ministry of Energy and IES, Russia's largest private power supply and gas distribution company.

Alstom to retrofit Belchatow generators

Alstom has signed a contract with the operator of Belchatow, Europe's largest coal-fired power plant, to retrofit six generators at the power plant's units 7 to 12.

Alstom's generator retrofit will enable each unit's power output to be increased by over 20 MW bringing each unit's power output to 390 MW, as well as extend the lifetime of the units by 25 years. The total output increase of the project will be more than 120 MW.

Belchatow's owner, PGE Gornictwo i Energetyka Konwencjonalna S.A., began modernising the plant in 1997.



Moving into the smart grid era

Events in Japan and the ongoing turmoil in North African and Arabic countries are putting the spotlight on renewables and distributed generation. According to KEMA, the era of smart grids might therefore be closer than we think.
Frits Verheij

The earthquake and tsunami in Japan and ongoing turmoil in North African and Arabic countries has intensified the discussion about our energy markets. What should our power generation mix look like? And how can we reduce our dependency on energy imports?

To an important degree, renewable energy and distributed generation seem to answer both questions. Nevertheless, the incorporation of large volumes of intermittent renewable sources of energy will significantly increase fluctuations in supply. Consumers becoming producers of distributed generation (prosumers) will also affect power flows, requiring new market mechanisms – the era of smart grids is closer than many might think.

We are on the brink of an energy transition. Intelligent grids will attract new players, while forcing existing players to redefine their roles. New fields of expertise and new technologies are emerging, so regulations will need to be adjusted to enable this transition. Everyone involved in this "new world of energy" will clearly need to work together in different, maybe even in radically different ways.

At the energy summit in Brussels in February, the EU set a target of creating a fully integrated, internal energy market by 2014. Commissioner for Energy, Günther Oettinger said: "By 2014, power and gas should be transported as easily throughout Europe as goods and services." As part of this plan, the Commission is encouraging Member States to adopt technical standards for smart grids and smart meters by the end of 2012.

Smarter grids are a key part of this bigger picture. There are both push and pull factors. The grid of the future will need to handle complex energy flows with intermittent supply and demand. Utilities are pushing for innovation, consumers are becoming more active in matching demand to supply, and smart grids could save up to 10 per cent of energy use in Europe.

Local power generation based on renewable energy like solar-PV causes supply that varies throughout the day. Near future demand will also fluctuate due to electric vehicles charging and increasing use of heat pumps and other electrical appliances. Maintaining a balance between supply and demand and smoothing out peaks and shifting loads will be a big challenge.

The solution is demand response or demand side management. If supply no longer follows demand, then demand will have to follow supply. There must also be a clear price advantage so that consumers can use electricity when it is least expensive (i.e. a real-time link with the trade market). There will also be a need for extremely clever technologies: in other words, the energy infrastructure must be truly intelligent.

A successful smart grid is a network of intelligent devices interconnected via a robust communications structure enabling the use of (new) services. Getting this right is crucial to avoiding problems where they are most likely to occur: at the interfaces. The benefits of smart grids depend on ensuring interoperability across the full spectrum of smart devices on both sides of the meter. There are considerable interoperability challenges. Most utilities have a reliability mandate from their regulator. Normally all elements in a smart grid have passed tests. However, these are usually interdependent and have probably not been tested for interaction with other elements.

The potential for smart grids is not restricted to electricity. There are also promising technologies for increasing the reliability and sustainability of water and gas networks, especially when utility systems are linked together. Innovations in smart gas grids include coupling gas and electric infrastructures, optimising gas quality, and optimising grid operation and asset management. Glendale Water & Power in California is rolling out 33 000 water meters – and simultaneously 100 000 electric meters – in its service area.

However, the smart grid may well be one of the most disruptive technologies this century. Utilities must look beyond changes in technology. Business transformation starts with a strategic vision: "Where do we want to be in the long term?" Gaining support from stakeholders is crucial. To do this, utilities must assess stakeholders' needs and determine for each: "What's in it for me?"

The deployment of advanced metering infrastructure (AMI) will have a profound impact on utilities and this, together with smart distribution, will require new standards. The challenge is to improve risk management, while defining quantifiable metrics that can measure progress. A key component is managing data: getting it to the right systems and people in the right format, at the right time. AMI deployment also will have an impact on jobs and organisational structures. Each organisation involved will need to develop a transition plan.


Frits Verheij: We are on the brink of an energy transition

A common issue that utilities face is determining who owns and manages the AMI network.

A governance model completes the transformation, aligning programmes with business operations and defining schedules. Creating a roadmap for AMI project deployment helps utilities ensure successful implementation, while safeguarding their smart grid investments.

The pace of innovation reflects an urgent need to make energy systems more sustainable, at the same time keeping these systems reliable and affordable. New market entrants range from small regional start-ups to large multinational companies. They include electricity, gas, and water utilities, smart grid technology vendors, financial service providers and investors, consumer product manufacturers, universities, governments and non-profit organisations.

Global giants such as Google and Microsoft are also getting involved. Google's activities range from web-based consumer services such as Power Meter, to their subsidiary Google Energy's direct investment in wind energy projects such as the Atlantic Wind Connection. Microsoft has similar initiatives.

White-goods manufacturer Whirlpool has joined forces with smart grid software company Tendril. Their partnership promises communication and interoperability between smart appliances and energy providers. Similarly, competitors GE Appliances & Lighting and Miele have established smart grid pilots with Louisville Gas & Electric and German utility RWE, respectively. Several manufacturers are developing hybrid heat pumps that are electricity-driven for base load and gas-driven for periods of peak demand.

There are also partnerships and innovations on the supply side. For example, automobile manufacturer Volkswagen and German utility LichtBlick are cooperating to develop gas-fired combined heat and power (CHP) plants at customer sites. New firms such as MTT, Enatec, Microgen and Korean KD Navien are developing similar innovations in micro-turbine and Stirling engine technology in Europe and Asia.

Connecting suppliers and consumers are a host of communication companies such as Sprint, AT&T, Deutsche Telekom, T-Mobile and KPN. New hardware manufacturers such as Tropos Networks and incumbents such as Cisco and Alcatel-Lucent are building communications networks and components specifically for smart grid applications.

Driving this boom is new money. Venture capital investments increased significantly in 2010. According to Bloomberg's *2010 New Energy Finance* league tables, venture capital investment in clean energy increased 71 per cent from 2009 to 2010. The same study showed that roughly half of the $4.6 billion that venture capitalists raised was invested in smart grid companies.

In terms of managing risks, lessons can be learned from the US. Utilities and technology manufacturers will share the responsibility for risks related to performance. To help manage these risks, KEMA and Duke Energy collaborated to create the Smart Grid Interoperability Lab (SGIL) in the US. This lab provides a live, operational smart grid environment for testing and simulating the compliance of products and services with existing and new standards, as they evolve.

Smart devices and advanced automation throughout the grid are often connected through servers, which receive and manage bi-directional data flows. Many smart devices and advanced automation components operate using different protocols, again requiring new standards, which are currently being developed by organisations such as the US National Institute of Standards and Technology (NIST), by IEEE, and by IEC in Europe.

A combination of compelling smart grid consumer products, collaborative utility/vendor partnerships, and a willing investment community will continue to spawn new smart grid companies and innovations. The challenge will be to integrate these new ideas without compromising energy service reliability.

Frits Verheij is Director of Smart Energy at KEMA

Smart grid pilot programmes

Energy is increasingly being generated locally and sustainably and consumers can now influence their own energy supply. The question is: how do you create a system that is both feasible and attractive for all of those involved? KEMA is leading the European project called GROW-DERS (which stands for Grid Reliability and Operability with Distributed Generation using Flexible Storage), which is attempting to answer this question.

The aim is to demonstrate the technical and economic potential of existing electricity storage technologies and new developments in power electronics. On four sites, three different storage systems (plus a combination) are evaluated with a technical-economic assessment tool that includes intelligent prediction software.

Transportable storage provides a flexible asset for network management, making it possible to defer investments in expensive switchgear, avoid stranded assets, and enable European industry to lead in the operation of distribution grids with large-scale penetration of distributed energy resources based on storage systems.

An interesting approach is being taken by the Smart Energy Collective in the Netherlands, led by KEMA. A total of 30 companies – ranging from grid operators, energy and service providers, ICT consultancies, manufacturers of new technologies to companies in the building industry and financial services – have joined forces to develop several large-scale smart grid pilot projects.

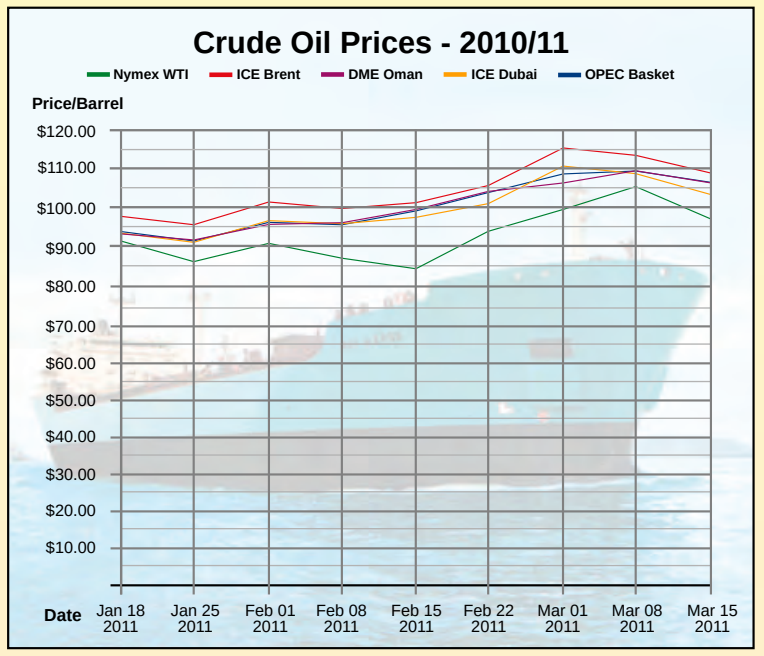
Also in the Netherlands, a Power-Matching City project has already been in operation for more than one year in Hoogkerk near Groningen. In the city of Meppel, a smart grid will maintain a constant neighborhood-level balance between supply and demand for locally generated renewable energy.

In Brazil, Cemig, one of the largest electricity distribution companies in the world is launching a smart grid pilot project called 'Cities of the future', which will include advanced metering, distribution and substation automation.

Germany is executing a programme under which pilot projects in six test regions develop and test key technologies and business models for an "energy internet". South Korea has launched a big programme on Jeju Island, and even Japan has defined four large-scale pilot projects on Smart Community. There are a tsunami of initiatives all over the world.

Oil

Rising prices threaten fragile economy



Libyan production to be off line for some time
Demand for crude oil continues to rise

David Gregory

Unrelenting unrest and growing violence in the Middle East continues to push the price of crude oil higher. While the earthquake and tsunami in early March has had its impact on the international crude oil market, events in the Arab world are keeping the situation on edge, forcing prices ever higher and generating fear that they could dash the still fragile economic recovery.

The price of a barrel of West Texas Intermediate (WTI) rose by $20/b during the course of a month. In mid-February, the price of a barrel of WTI was selling in the mid-$80/b range and by mid-March it was priced at around $105/b. In mid-March Brent crude was selling at $116/b.

The Arab Revolution has spread from Tunisia, to Egypt, to Bahrain, Libya, Yemen, Oman and Syria and each new incident registers with crude oil traders.

Libya, a member of Opec and a producer of some 1.6 million b/d, has so far had the greatest impact on crude prices. Practically all of its production is now shut down and foreign companies with large operations and investments in the country are wondering what will become of their assets and when they will be able to return to Libya to resume work. Most analysts expect Libyan production to be off line for some time to come – regardless of the outcome. Furthermore, should Libyan leader Moammar Qadhafi prevail in the civil war that now involves NATO forces, foreign oil firms fear their assets will be nationalised by his regime in retaliation against Western countries for siding with the rebels.

Increasing pressure on Yemeni President Ali Abdullah Saleh by an ever-growing number of demonstrators could impact that country's small crude production industry as well as its 6.7 million tons/year LNG plant.

Meanwhile, demand for crude oil continues to rise despite rising prices, an indication that perhaps the world is moving out of recession and into better economic circumstances.

However, according to the London-based Centre for Global Energy Studies (CGES), growing world demand for oil and the removal of Libyan production from the market warrants an increase in production from Opec. The consultancy said in its latest *Monthly Oil Report*, released on March 21, that Opec needs to send "a clear unambiguous signal" that the lost output from Libya will be replaced soon.

"The oil market has been tightening since the middle of 2010, but Opec has done little to try to prevent a repeat of the damaging surge in oil prices in 2008, which was followed by an abrupt collapse in global oil demand, and with it, Opec oil production and revenues," the CGES said in its report. "Instead, Opec has continued to claim that the world is well supplied with oil, stocks are high and prices are being driven by factors other than market fundamentals."

The CGES said oil demand growth has remained remarkably robust in the current quarter, growing at 2.7 per cent year-on-year. It added that Opec production in February averaged 29.85 million b/d and in mid-March averaged 29 million b/d. The consultancy said its supply/demand balance shows that the world will need 30.3 million b/d of Opec crude in the second quarter of 2011, "just to keep quarterly oil prices at around $110/b."

For its part, Opec said in the March issue of its *Monthly Oil Market Report (MOMR)* that it "continues to closely monitor oil market developments and stands ready to act, as deemed necessary, to support market stability." In the *MOMR*, Opec forecast that world demand during the second quarter of 2011 would average 86.77 million b/d, with demand for Opec crude averaging 28.88 million b/d. For the full year of 2011, Opec forecast that world demand would average 87.83 million b/d and that demand for Opec crude would average 29.79 million b/d.

Meanwhile, the International Energy Agency (IEA) said in its *Oil Market Report* of 15 March that political unrest in the Middle East and North Africa "has injected volatility into futures markets, with prices gyrating by an average $3/b daily."

The IEA said growth in global oil demand remained unchanged at 2.9 million b/d for 2010 and 1.4 million b/d in 2011. But it added that high oil prices "entail significant downside risks to this year's outlook". It put crude oil demand at 87.9 million b/d for 2010 and 89.4 million b/d for 2011.

Gas

Japan nuclear shutdown impacts gas market

With gas shipments being diverted to Japan, Europe is likely to be facing higher gas prices.

Mark Goetz

Japan's demand for natural gas in the form of LNG is set to rise as the country struggles to cope with power shortages brought about by the March 11th earthquake and tsunami.

The earthquake and tsunami severely damaged the nuclear reactors at Fukushima Daiichi causing the country to lose around 8 per cent of its total electricity generation capacity, the consultancy IHS CERA reported. Although rolling blackouts have been put into effect, fortunately most of Japan's gas-fired generating capacity remains intact.

By mid-March, Toyko Electric Power Company (Tepco), which owns the Fukushima Daiichi nuclear facility, had arranged a number spot LNG purchases and swaps with other buyers in order to cover its power generation demands for April. Additional supplies of LNG are expected to come from Korea Gas (Kogas), a major LNG importer, and from Russia's Sakhalin II LNG project. Potential suppliers are expected to be Abu Dhabi's Adgas, Qatargas, Brunei LNG, Malaysia's Petronas, Indonesia and Australia.

Japan is already the world's largest importer of LNG and its rising demand for LNG in the wake of the nuclear power shutdown is expected to result in a tightening of the LNG market, although it remains to be seen by how much. In mid-March the price of LNG in the Northeast Asia spot market rose by more than $1.00 to $11.40 per million Btu. The jump in demand by Japan also resulted in a slight increase for LNG cargoes in Southwest Europe.

LNG producers such as Qatar have seen many months of disappointing prices on the spot market, largely due to the 2008 economic downturn, but also because of the advent of shale gas in the US, where demand for foreign deliveries has seriously declined.

Speaking at the Gastech conference in Amsterdam last month, the CEO of Qatargas, Shaikh Khalid Al-Thani, said Europe would have to pay more for its spot LNG supplies or face those shipments being directed to better paying markets in the Far East and Japan.

Shaikh Al-Thani said the shift towards natural gas as a result of the nuclear crisis in Japan would reduce Europe's ability to secure spot LNG cargoes. "More Qatargas supplies have been directed to Japan," he said, adding: "If Europe does not change its policy towards prices and becomes more competitive, then most of its supply will go towards Japan."

De La Rey Venter, global head of Royal Dutch Shell's LNG division, told the Gastech gathering on March 22 that Shell had made eight extra shipments of LNG during the previous week. He said no one knows how much additional LNG shipments Japan would need this year.

Meanwhile, Russia has offered to deliver more gas to Europe by pipeline in order to allow its Europe-bound LNG cargoes to be diverted to Japan. The CEO of Russian gas monopoly Gazprom, Alexei Miller, told RIA Novosti that his company "could supply an additional 50-70 million m^3 of gas [to Europe]. Therefore we will be able to compensate for the LNG with additional natural gas volumes." The company is planning to boost its LNG supplies to Japan by 100 000 tons this month (April) and next month.

But it remains to be seen if Russia's European customers are interested. Russia's pipeline gas is linked to the price of oil, the price of which is currently between $105-115/b. The European market is expected to focus on the LNG spot market for as long as it can.

The nuclear crisis in Japan has caused increased alarm internationally among those countries that use nuclear power.

A statement issued by the World Bank said that if countries turn away from nuclear energy their decisions could result in longer-term demand for fossil fuels.

Should they begin to turn away from nuclear power, natural gas would be the likely alternative, bearing in mind that a clean source of fuel would be sought. However, demand for coal and crude oil could rise above forecast as well, not the best of news for a world attempting to cope with high greenhouse gas emissions – as well as earthquakes and tsunamis.

Making the case for energy storage

Managing a grid that includes an increasing amount of intermittent renewable energy sources is a major challenge for energy utilities. *TEI Times* hears why France-based company, Saft, believes energy storage, and in particular lithium-ion batteries, is the answer.

Renewable energy sources such as wind and solar are playing an increasingly significant role in the global power generation mix. However, their variable nature presents a major challenge for power grids that need to match generation with demand.

The ability to store energy when it is windy or sunny, so that it can be fed back into the grid when it is needed, is therefore seen as a vital technology.

There are a number of technology options for energy storage, each operating in different power capacity ranges and offering varying discharge times at rated power.

Pumped storage hydro is by far the most widely used method for energy storage. With power ratings in the tens of megawatt to gigawatt range and long discharge times, there is around 130 GW of pumped storage capacity currently installed worldwide. Although a mature technology, its application, however, is limited by geography.

Compressed air energy storage (CAES) is another large-scale energy storage technology that has been investigated over the years but, like pumped hydro, it is also location specific since it depends on the availability of the large salt caverns needed to store the compressed air. Progress with CAES has been slow and to date there are only a couple of installations worldwide. Further, such projects can take around 15 years to build.

Another option is to use utility scale batteries. Francois Bouchon, Director of the Energy Storage Business Unit at French battery manufacturer, Saft said: "They have capacities in the kilowatts to tens of megawatts range, and can discharge over a period of minutes to 2-3 hours."

Currently batteries based on sodium sulphur are the most common for utility scale energy storage, with some 300 MW of storage capacity installed worldwide, with 50 per cent of these being in Japan. Meanwhile, the world's most powerful battery installation in operation today is a 46 MW nickel cadmium unit installed at Fairbanks in Alaska to provide spinning reserves in an island grid.

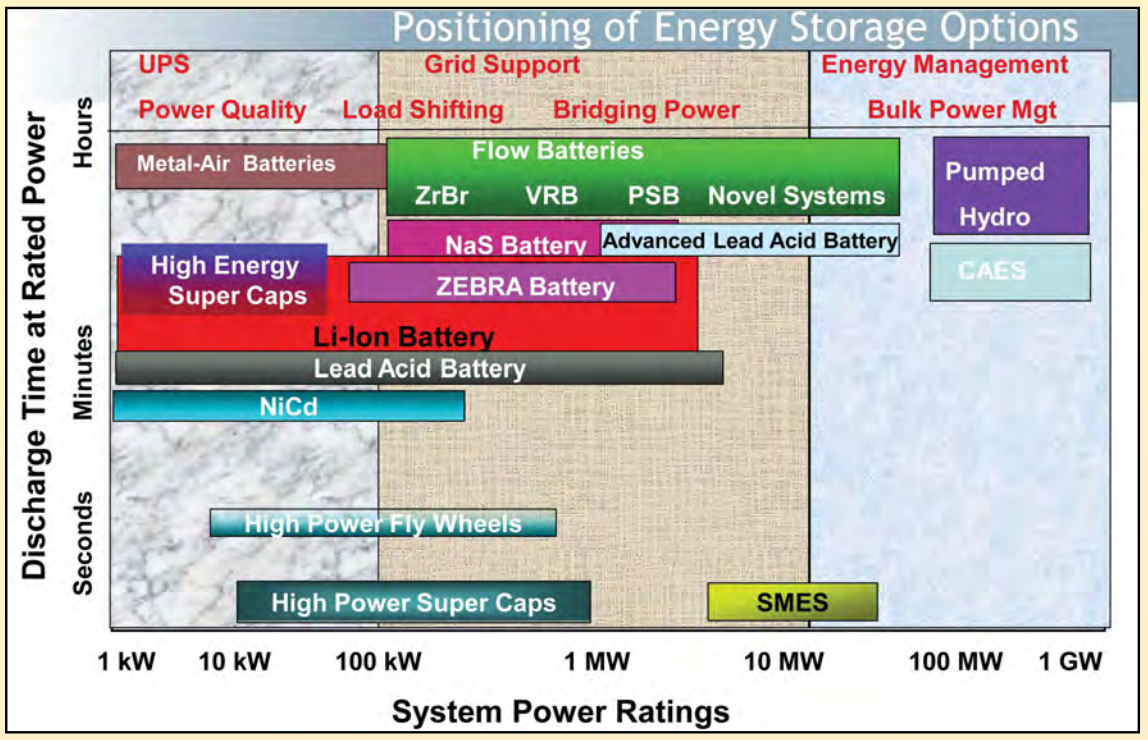
However, according to, Saft, there is a growing interest in lithium-ion batteries. "Lithium-ion batteries are very flexible. With sodium sulphur batteries the power-to-energy ratio is 1:7; this means you have to install 7 MWh to deliver 1 MW of power. This ratio is fixed. But with Lithium-ion batteries you can play with the power-to-energy ratio. Depending on the thickness of the electrode, etc, you can have a ratio of 1:4 or 4:1, for example, depending on your needs."

The value of battery-based energy storage systems, whether Li-ion or otherwise, is clear. They can have numerous applications right across the grid value chain – from generation, transmission and distribution down to consumption.

In terms of generation, energy storage systems can smooth intermittent generation by providing capacity firming, thus making renewable energy a predictable component of the grid operator's electricity mix.

The stabilisation of wind farms and solar arrays involves significant daily energy flows, high output and very dynamic charge/discharge behaviour at variable depth-of-discharge. Saft says Li-ion technology offers the ideal combination of energy and power output for this type of application and has proved its suitability for such demanding cycling conditions.

Michael Lippert Marketing and Business Development Manager of the Energy Storage Business Unit said: "Li-ion batteries have a long calendar life and cycle life, even at high temperatures. Although lifetime will depend on the amount and depth of discharges over its lifetime, our benchmark reference predicts they can last for 20 years with a 60 per cent daily discharge."



There are a number of technology options for energy storage, each operating in different power capacity ranges. Source: EPRI and Saft

The growing penetration of intermittent renewable energy sources is a significant new source of instability in power networks – networks that are already stressed as a result of increasing power demands, (especially in peak periods), power flow fluctuations and other disturbances.

High-power energy storage can provide dynamic, rapid support that enables electricity utilities to manage the introduction of intermittent renewable resources. They can also provide ancillary services such as power frequency regulation that improve the stability, reliability and the capacity of power networks.

The use of dynamic energy storage systems operating in combination with fast-acting grid interface electronics can provide an alternative to the traditional approach to grid frequency regulation based on maintaining a margin of spinning reserve. Saft has teamed up with ABB to develop the first commercially available dynamic energy storage solution for grid applications. The first pilot system being installed in Martham, Norfolk, in the UK, is scheduled to begin operating this year. It is designed to provide the optimum mix of active and reactive power for support.

There are many cases where distribution networks are becoming heavily stressed and operating close to their peak capacity, especially where new renewable generation has been added in the local area. This can make it necessary to consider the construction of new substations and/or reconfiguration of distribution feeders.

The introduction of energy storage at strategic points in the distribution network can enable operators to relieve these capacity constraints by implementing peak shaving. This allows utilities to defer or even eliminate the need for major capital investments in network upgrades.

Lippert noted: "Li-ion modules are designed for connection to the grid at transmission as well as sub-transmission and distribution levels, and system ratings of up to 50 MW for up to 60 minutes are possible."

According to Saft, its Li-ion energy storage systems can represent a significantly more cost-effective and immediate approach to adding capacity to a network, with payback in as little as two to three years. In addition, in markets like the US they can provide extra revenue streams by offering the capability for ancillary services such as dynamic voltage support and blackstart capability.

Battery-based energy storage can also play a role at the consumption level. The vast majority of PV installations for homes and businesses in the developed world have a permanent grid connection through which they inject all the electricity they produce into the local network, to be sold to the utility. However, they still have to import electricity from the network to satisfy their local needs. Energy storage can enable these households to become energy autonomous, producing and consuming their own electricity.

> With all the factories coming on line the cost will reduce by about 30 per cent over the next 3-4 years. We are confident that the cost will be halved by 2020

Effective energy storage can also 'time-shift' power generated during peak production times – during the middle of the day for solar energy – to the peak demand times, mainly during the evening. This both maximises local consumption and enhances the value of the PV system as only surplus energy is fed back into the grid. For industrial consumers, energy storage could be a cost-effective approach to peak demand reduction (peak shaving) as an alternative to using diesel generators, says Saft.

The numerous potential applications for battery-based storage has given companies like Saft the confidence to make significant investments in preparing for the boom they believe is coming.

Saft is building a plant in Jacksonville, USA, which it says will be starting high volume production of Li-ion cells by the third quarter of this year. Bouchon added: "By 2014/15 the production capacity will be 350 MWh. This is roughly 1 GW a year."

Although it is still early days, according to the company the energy storage market is "potentially huge". Bouchon said: "To be very honest, no one knows [the size of the market] because it is still shaping up. But we could be talking about a market of around €20 billion by 2020 for all storage technologies combined. In Germany there is 60 GW of renewables, which utilities have to do something about. They can build transmission lines and substations but these are massive investments." Bouchon says energy storage is an alternative, and in markets like Germany and Spain "is a must".

The company is installing its first Li-ion container for a utility scale generation system at the Tudela solar project in Spain. This 1 MW, 560 kWh system will be delivered to the plant owned by solar developer, Acciona, by the second half of this year.

Nevertheless, challenges remain. As the technology is not yet proven, it will be difficult to persuade power companies to invest but this will change as the technology matures and more experience is gained.

From a manufacturer's aspect, there is a need to improve battery life under difficult conditions. Lippert added: "Obtaining symmetrical power capability in charge and discharge is a challenge. Batteries are designed for high rates of discharge; having the same rate of discharge and charge has been a difficulty in this industry."

While technical difficulties will no doubt be overcome, favourable market conditions will still have to be created. As Bouchon noted: "One issue is regulation; for example, who will own the storage device? Standards that, for example, cover how to specify an energy device need to be developed. It's important to have the smart metering infrastructure and information systems in place. There needs to be the right pricing for storage so that utilities can make a business case."

The business case will obviously be affected by the cost of the systems. Although Li-ion batteries have been around for 15 years, large-scale batteries is a new area and therefore still expensive. Today costs are about €1 million/MWh but Saft believes this will come down.

Bouchon summed up: "With all the factories coming on line, the cost will reduce by about 30 per cent over the next 3-4 years. We are confident that the cost will be halved by 2020."

CCS pilot at El Bierzo takes shape

First firing of the circulating fluidised bed boiler at the El Bierzo CCS Technological Development Centre is fast approaching. Scheduled for June, it will represent a major milestone in this EU-funded project, which is the first-of-its kind. **Junior Isles**

Cubillos de Sil may be just a small village in the northwest of Spain but construction of a project in the village – traditionally known for agriculture, wine and coal mining – will soon put it on the power industry map.

Cubillos de Sil is the location of a pilot project that will be the forerunner to a first-of-a-kind project that will demonstrate carbon capture and storage (CCS) of emissions from a circulating fluidised bed (CFB) boiler at commercial scale.

Known as the OXYCFB300 Compostilla Project, the initial phase of a future commercial demonstration is one of the six CCS demonstration projects that have so far received funding under the European Energy Programme for Recovery (EEPR). The investment decision on the construction phase will be evaluated by 2012, once all the studies, tests, and feasibility, funding, regulatory and permitting issues have been completed.

The future project, which is currently under development by a consortium formed by Endesa, Ciuden and Foster Wheeler, is aimed at demonstrating all three portions of the CCS chain, i.e. CO_2 capture, transport and storage.

Most notably, the project will be based on an approximately 330 MWe CFB supercritical oxy-combustion power plant. Carbon dioxide captured from the plant will be transported and stored in an on-shore deep geological structure. Preliminary studies predict that about five million tons of CO_2 could be stored during the first five years of operation.

The project is being undertaken in several phases. The first phase, which will run from 2009 until the middle of 2012, will see the construction of three Technological Development Centres (TDCs) developed by Ciuden (Fundación Ciudad de la Energia), a public institution that will demonstrate each part of the chain at pilot scale. These activities will provide experience and technical support for the demo plant.

The TDC for carbon capture features a 30 MWth oxy-combustion CFB, which uses exactly the same technology to be incorporated by the commercial scale demo plant. Carbon dioxide captured from the pilot will be transported to the storage TDC in Hontomin (Burgos, Spain). The storage facility is currently in the phase of detailed geological characterisation.

Phase 1 also covers the survey and geological characterisation of a safe and suitable geological CO_2 storage for the entire demo plant lifetime, the development of the project FEED (front-end engineering design) including the plant, the pipeline and the injection infrastructure, the permitting process, and all the associated engineering studies required to guarantee the success of the demo plant construction.

According to the consortium, the TDC phase will address several key areas: Oxy-CFB performance, scale up and further optimisation; feasibility of the CO_2 transport pipeline; suitable CO_2 storage sites and CCS value chain integration. The consortium says it will also help address issues surrounding public perception of CCS.

Ciuden is responsible for constructing the TDC for CO_2 capture, the largest ever in the world for oxy-combustion development. The centre incorporates a closed-loop test rig for CO_2 transport.

Construction of the TDC for the capture portion is divided into several main packages: coal preparation unit; PC boiler, CFB boiler, flue gas treatment train, oxidant preparation unit, flue gas recirculation and mixing, distributed control system, compression and purification unit (CPU) and technical buildings.

The TDC for CO_2 capture is 90 per cent complete

So far, the TDC phase is progressing well; the TDC for CO_2 capture is 90 per cent complete and is expected to start operation this July with first gas firing of the CFB. First firing on coal will follow two months later in early September. The contract for the CPU was awarded in December 2010, and the CPU is expected to start testing during the first half of 2012.

Commenting on the test programme, the consortium said: "Optimisation of operating modes, dynamic performance and control strategies will be performed. We will be looking for the most efficient procedures for safe and reliable operation, load following capabilities, shut-down/starting-up routines and performance of the integrated TDC."

The consortium added: "First CFB tests are programmed to be completed by the end of 2011 and the operating modes and control strategies will be completed in the first half of 2012."

The CFB is expected to generate gas for the purification unit with a dried gas composition of more than 95 per cent CO_2. The CPU unit is designed to capture up to 90 per cent of the CO_2 in the inlet stream.

If all the test targets are met and the unit operates as expected, the next phase will be a scale-up to demonstration size – a crucial step prior to commercial deployment. The main target of the OXYCFB300 Compostilla Project is to validate a flexible and competitive CCS technology at industrial level that will allow the renovation of the existing fossil thermal plants from 2020 onwards, using a wide range of domestic coals as well as imported fuels (coal, pet-coke) and biomass.

According to the consortium, scale-up to the larger size will require careful consideration in several areas. One of the major areas will be the ability of such a plant to meet the requirements of today's grids.

The consortium noted: "Large utility boilers are typically designed to give maximum efficiency at nominal load (MCR) conditions. Grid control requirements may, however, require them to operate for extended periods at partial loads, raising a question about how the efficiency requirements can be met at partial load operation, too. The load following capability and efficiency of large rotating machines (compressors) in the ASU and CPU systems in particular, require attention. Prediction of dynamic behaviour of the integrated systems (ASU, boiler/turbine/generator and CPU) is also a challenge, and extensive modelling will be utilised in the development of a viable control concept for the plant."

Foster Wheeler will be responsible for developing and eventually supplying the boiler island featuring its Flexi-Burn CFB, which will be capable of operating in either carbon capture or conventional air mode without requiring mechanical modifications of the plant's equipment. From July 2009 to July 2010, the Foster Wheeler project team started preparing an engineering and project plan.

Small-scale pilot tests for fuels and limestone preliminary characterisation have been carried out at the CANMET Energy Technology Centre-Ottawa in Canada. Foster Wheeler has also been supplied with the basic process parameters and coal basis needed to start the boiler design. The results and conclusions from Ciuden's capture TDC tests will be taken into account in the final stage of the FEED design.

Several FEED activities are running in parallel with the boiler engineering. Budgetary bids and detailed technical proposals for ASU and CPU supplies have been requested. Work related to the integration of the commercial ASU and CPU features with the boiler static and dynamic requirements have been carried out.

Several contacts have been solicited with companies capable of developing dynamic and CFD simulation studies. These studies will reinforce FEED engineering design, system integration, control dynamics and troubleshooting in both transient and steady states.

The first steps for design criteria related to the power train, mechanical and electrical specifications and plant layout have also been taken. Alternative studies for power evacuation have been performed and several options have been assessed regarding the water intake, looking for synergies with the existing water intake (pumps, conducts and filters).

Contact with potential main equipment suppliers is also under way. The consortium said: "Several contacts with turbine island suppliers have been made in order to identify technical and commercial availability of this equipment. Preliminary RFQ specifications are already finished. First contacts with cooling tower suppliers have also been made."

Geotechnical and topographic site works are being carried out at the envisaged location of the capture demonstration plant. There have been meetings to discuss specific technical questions related mainly to the height of the cooling tower and the emission of the flue gas not captured.

It is widely acknowledged that demonstrating the entire chain of a CCS project, not just the capture portion, will be necessary if there is to be any guarantee of success. This has been a central point from the outset.

A basic feature of Ciudens's approach is the integration of the elements of the value chain.

The capture TDC includes, in addition to capture installations, a closed-loop test rig for CO_2 transport. The storage TDC is in a different location, 300 km away but could use CO_2 produced at the capture TDC.

Less than 100 000 tonnes of CO_2 will be injected into a 1500 m deep dome-like saline formation at the storage TDC over a period of five years. A fourth installation is planned. The project, called PISCO2 (Plant for CO_2 Injection in Soils), aims to test the effects of CO_2 on different soil ecosystems by the controlled injection of small quantities of CO_2 in the first layers. The results will establish CO_2 mobility, bio-monitoring and control criteria.

The transport and storage elements of Phase 1 are nearing completion. The closed-loop testing facility assembly is scheduled to start early 2012.

"The 3D seismic campaign for the detailed characterisation of the deep geological structure took place during the summer of 2010 and the first images of the underground structure are being obtained. Several research groups are working on the field to obtain data for the site characterisation and baseline establishment. After the site selection and characterisation stages developed from 2007 to the first half of 2011, the drilling of an injection and two monitoring wells is planned to start at the end of 2011. The TDC will be completely operative in 2013," said the consortium.

Meanwhile, studies for the CO_2 pipeline are in progress. The main activities are focused on the conceptual and basic design.

While the roadmap for developing the technology is clear, it is too early to predict the final cost of the 330 MWe demonstration project.

The consortium concluded: "The total cost for the TDCs is approximately €150 million, jointly funded by the European Commission and the Spanish Government. [However] until mid-2012 and according to the EEPR Project programme schedule, we have no plans to anticipate costs of the 330 MW demo plant."

Junior Isles

Standing on shaky ground

In one fell swoop of nature's most destructive forces, the nuclear power industry's image, painstakingly rebuilt over the last 25 years, fell apart like a house of cards.

The huge earthquake and subsequent tsunami that caused serious damage to Japan's Fukushima Daiichi nuclear power plant has dealt a blow to the industry, from which it will take an extremely long time to recover.

As Japanese operators at the crippled plant risked their lives to bring the situation under control, the ramifications of the incident spread like a domino effect around the world. Several countries that had plans for nuclear build-up in the near to mid-term have either abandoned or put those plans on ice.

In Japan itself, Tepco notified local authorities that it will indefinitely shelve the Higashidori nuclear power plant project in Aomori prefecture. Germany halted operation on seven of its older stations and is considering reversing its decision to extend the lifetime of its nuclear fleet. The UK has asked for a report on nuclear safety by mid-May, while Switzerland suspended the approvals process for two new nuclear power stations at three sites, so safety standards can be revisited. Even China, which is building 27 of the 62 reactors currently under construction worldwide, has decided to freeze construction of its nuclear plants pending a safety review.

While the international community should avoid a knee-jerk reaction to the incident, a pause for thought is prudent. If there are lessons to be learnt, the time should be taken to learn them.

Luis Echávarri, Director-General of the Organisation for Economic Co-operation and Development Nuclear Energy Agency (NEA) said: "It's probable that reactors under construction will continue but an evaluation of the situation has to be done… countries will wait and grasp lessons learned and how it impacts safety."

The earthquake and tsunami may have been a special situation but Echávarri said the methodology used for taking into account seismic events has to be re-evaluated. "It is clear that the event in Japan has demonstrated that the analysis was not conservative enough. The [strength of] earthquake was higher than it was supposed to be. It also seems the analysis of the size of [possible] tsunamis was not realistic."

While such events are rare, it is clear that analyses of potential external events need to be revised. In Europe for example, there may be little chance of a tsunami but there should perhaps be greater consideration to the possibility of flooding.

The systems used for providing emergency power, which failed at Fukushima causing failure of the cooling system, have to be a key focal point. Plant owners and regulatory authorities will need to look at the location and protection of emergency generators and batteries, and consider whether their needs to be another way of providing electricity in emergencies. The circumstances under which explosions are caused by hydrogen also need to be examined. This was a major cause of equipment damage in reactors 1 and 2 at Fukushima.

Echávarri commented: "The responsibility today is not to launch new projects without clarifying these things."

> While every country has a right to pursue its own energy path… perhaps the time has come for international oversight on the siting of nuclear plants

Although the circumstances were unprecedented, the question remains: could it happen with the third generation reactors currently under construction in some countries, which will form the backbone of the planned wave of projects?

It is a difficult question to answer and perhaps all that can be said with any certainty is that "the safety of third generation reactors is much higher", as an Areva spokesperson commented.

Westinghouse and GE Hitachi third generation reactors feature 'passive' safety systems designed to operate even in the event of a power failure to the coolant systems. Meanwhile, in addition to a double containment shell, Areva's EPR also has a core melt catcher so that fuel does not escape the reactor vessel if there is a meltdown.

Yet it is impossible to 'design-out' every potential scenario and there will always a degree of risk regardless of the technology. After Chernobyl, it was said: "this could never happen again". This is still true. Chernobyl did not happen again but Fukushima did. People did not expect that what happened in Japan could happen.

Michael Kruse, Principal, Energy and Utilities Practice at global management consultancy, Arthur D. Little, said: "There is always a probability that unexpected events can happen that were not considered in the design. The question is how high is the probability and how much damage will be caused in the long-run?"

More than 400 reactors operate worldwide and about 90 of these are in areas of significant seismic activity. These plants should certainly be put under the microscope.

The US has reaffirmed its support for nuclear but at the same time is likely to review the location of its nuclear plants. Steven Chu, the US energy secretary said: "Where we site reactors going forward will be different than where we might have sited them in the past." He said regulators would take a closer look at the location of existing and any new plants.

While every country has a right to pursue its own energy path, with the likes of Indonesia still pushing ahead with plans for its first nuclear plant, perhaps the time has come for international oversight on the siting of nuclear plants.

Kruse commented: "Electricity markets need to be considered from a global or regional perspective so that markets are much more integrated. It requires trust and may mean that some countries may not be able to build nuclear plants due to a lack of infrastructure or high seismic activity. [But] It will drive more collaboration in international energy markets if countries share a common electricity generation portfolio. We also need more international harmonisation on safety standards."

The idea of greater international collaboration and oversight in the nuclear power industry is perhaps not as far-fetched as it might initially sound.

There is an international initiative for developing a fourth generation nuclear power plant. The international nuclear community is also working together on fusion. "It may be that commercial companies give up their technologies for the benefit of global safety. If one country has a problem with a nuclear power plant, the world suffers. This indicates that nuclear is something a country cannot do alone. It needs to consider the global context," said Kruse.

There is also the Nuclear Non-Proliferation Treaty governing the spread of nuclear weapons. It may be contentious, but having a global agreement that covers the siting of nuclear plants based on geology and potential seismic activity should not be out of the question.

Statistics show that in reality nuclear is safe. Unfortunately, perception is often the reality. Whether risks are real or not, the perception of risks is what ultimately counts.

For the most part, countries with plans for new nuclear plants have declared they plan to press ahead with their programmes albeit pending a review of the nuclear safety systems.

But the events in Japan are likely to have shifted public perception of nuclear energy. Italy is hoping to end a 25-year moratorium on nuclear power. Following Fukushima, the Italian referendum on allowing new nuclear (scheduled for June) is likely to be defeated, unless it is delayed.

The long-term impact of Fukushima will depend on the final result of the accident – how much radiation has been released and how it will affect the operators and the public.

What is certain, however, is that the perception of risk has changed. It will be harder and more expensive to obtain financing for nuclear projects. Safety requirements will also probably increase significantly, which will have a negative impact on the overall business case for nuclear.

Regardless of what countries decide, the immediate impact is that the increased cost is likely to push the price of nuclear higher than most markets can bear. Like the fuel rods at Fukushima, the scattered cards that once made up the nuclear house may remain too hot to handle for some time to come – at least until the price of fossil fuels or the effects of global warming become unbearable.