



November 2011

ESG Focus: Post-Fukushima – the nuclear reaction

The broad range of responses from the world's major economies

On 11 March 2011, a 9.1 magnitude earthquake occurred off the coast of Japan. The accompanying tsunami devastated a stretch of coastline. Approximately 25,000 lives were lost and major damage occurred to homes and properties. The Fukushima nuclear power plant, operated by Tokyo Electric Power, was damaged by the tsunami. Initially, many feared a disaster of Chernobyl-like proportions, with severe implications for the surrounding area and its inhabitants compounding the direct effects of the earthquake and tsunami. A worldwide nuclear disaster did not occur and radiation leaking from the site is estimated to be around 10% of that from the Chernobyl reactor in 1986. The reactors operating at the time the tsunami struck were successfully shut down and containment structures around the cores were effective in preventing greater leakage. More recently, however, and of increasing concern, are localised pockets of contamination. Relatively high caesium levels have been detected across sizeable areas of agricultural land at levels which were considered dangerous after Chernobyl. The Japanese food industry, already tainted by mislabelling precedents, may find itself at the centre of a panic should any health-related incidents occur as a result of contamination.

The Fukushima nuclear crisis is not over. Permanent cooling systems must be established, radioactive pools of water lie untouched in various places within the plant, physical damage to walls and other structures need repair and, once all this is done, any melted radioactive fuel must be decommissioned or entombed. Tokyo Electric Power has so far paid out US\$1.6bn in provisional compensation to evacuees. However, some analysts believe the total compensation bill could reach as high as US\$130bn, which would require state support. Japan's government announced an official 30km restriction zone around the plant, but now states it needs to clear contaminated soil over a much larger area. Perceived governance failures are being addressed, with heads rolling, including Prime Minister Naoto Kan, and a new Nuclear Safety Agency announced. Mr Kan had said that he wanted to move to a nuclear free-Japan. However, there has been no decision as yet to end nuclear power in

Japan. Although the direction under Mr Kan's successor, Yoshihiko Noda, is not yet clear, a majority of commentators do not anticipate a nuclear-free future for the country.

Fukushima, climate change and the global nuclear industry

Drivers for nuclear energy are manifold. Soaring energy demand is accompanied by high oil prices. A mostly immature renewables industry offers localised opportunities but faces major challenges in substantially plugging the gap. Meanwhile, the economics of climate change and carbon reduction bring significant new costs to fossil fuels. In the 2009 report, "Nuclear power: a climate change solution?", Newton wrote about the merits of nuclear power as a low-carbon energy source, while noting that another incident like Chernobyl or Three Mile Island could threaten the viability of nuclear energy. The report also described the challenges which continue to face renewable energies, such as solar, wind and hydro.

There are great variances in the public's acceptance of nuclear energy. Earlier this year, in the immediate aftermath of Fukushima, Newton wrote that a more cautious approach to nuclear is likely to be adopted by countries around the world, and that some countries around the world may cancel their plans altogether.¹ Understanding the evolving regulatory landscape around nuclear energy is key for those investing in the sector. This includes builders of nuclear power stations, miners and processors of uranium, and companies dealing with nuclear waste and plant decommissioning. Nuclear regulation is also critical for all other sectors involved in producing energy, including utility companies, energy efficiency companies and providers of other sources of energy, both hydrocarbon and renewable. This is linked to several of Newton's investment themes, particularly *energy economy*, *earth matters* and *Chinese influence*. Newton has now explored the huge disparity in responses to Fukushima from the G8 and from the other countries with a large number of nuclear reactors.

1. Newton ESG Themes, Q1 2011.

The table on page 3 shows the number of reactors in operation for each of the major nuclear nations discussed in this report. In the right-hand column it also outlines the pledges of each country to the Copenhagen Accord agreed at the 2009 United Nations Framework Convention on Climate Changes (UNFCCC), Conference of Parties 15. The achievement of the pledged targets partially depends on current nuclear energy production and on the development of future capacity as outlined in the middle columns, which shows the number of reactors under construction, planned and proposed.

Currently, according to the International Atomic Energy Agency, there are a total of 440 commercial reactors in operation in 30 countries, 62 under construction, 154 in the planning stage and 342 proposed. The figures relating to those in the planning and proposed stages, however, may change as governments tackle the questions posed by the Fukushima incident are addressed in different ways according to different pressures faced.

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SRI Officer

The response from Governments in major nuclear energy producing nations

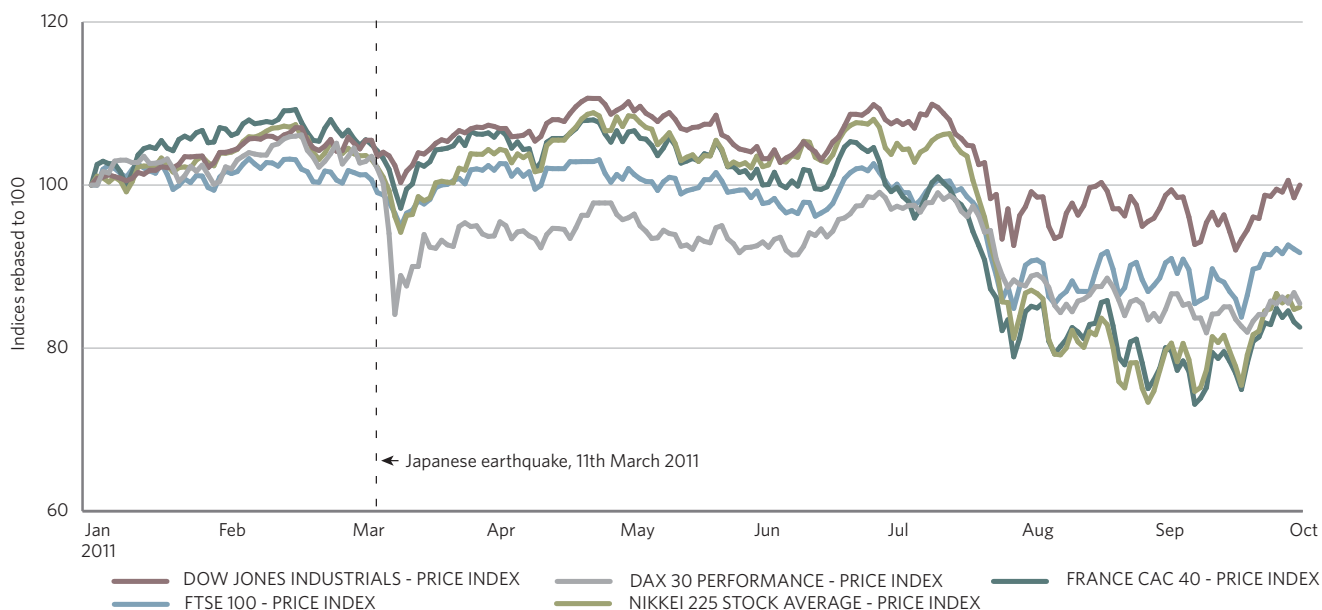
Japan

The immediate effect of the Fukushima event on major international stock markets can be seen in the chart below. The impact on the Nikkei 225, Japan's principle index, was pronounced, as shown by the light green line. The sharp fall of around 15% in a day reflected fears that the disaster might turn out to be even worse than it actually has been for the country, so far.

The Nikkei's bounce, and subsequent approximate reversion to correlation with other markets, to a great extent reflected the perceived success of the Japanese in managing the nuclear element of the crisis at Fukushima, which was the big unknown factor.

It is common to talk of a post-Fukushima stage having now been reached. However, from both a technical and regulatory standpoint, Japan's own response is still not complete. Tests are being carried out focusing on the ability of plants to withstand various worse-case scenarios. The country intended, before the earthquake and tsunami struck, to double the energy self-sufficiency ratio to about 36%, to reduce the zero-emission power source ratio to 70% and to achieve these by doubling nuclear generation to around 50% of energy generation. If regulations tighten safety requirements considerably, might these impose costs so onerous that they price nuclear out of the market, at least in the medium term?

MAJOR INDICES - REACTION TO JAPANESE EARTHQUAKE



Source: Thomson Reuters Datastream

REACTORS AT THE WORLD'S LEADING NUCLEAR ENERGY PRODUCERS

Country	Operating	Nuclear electricity generation 2010	Under construction	Planned	Proposed	Copenhagen Accord Pledges
Japan	51	29.2%	2	10	5	25% below 1990 levels by 2020.
USA	104	19.6%	1	6	28	"In the range of" 17% below 2005 levels by 2020. Pending legislation would entail a 30% reduction in 2025, 42% in 2030, and a goal to reduce emissions 83% by 2050.
Canada	18	15.1%	2	3	3	17% below 2005 levels by 2020, to be aligned with the final economy-wide emissions target of the United States in enacted legislation.
France	58	74.1%	1	1	1	Against 1990 levels by 2020: 20% is unilateral; 30% is conditional, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately.
UK	18	15.7%	0	4	9	Against 1990 levels by 2020: 20% is unilateral; 30% is conditional, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately.
Germany	17	28.4%	0	0	0	Against 1990 levels by 2020: 20% is unilateral; 30% is conditional, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately.
China	14	1.8%	26	52	120	"Endeavour to" lower its carbon dioxide emissions per unit of GDP by 40-45% by 2020 compared to the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020, increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic metres by 2020 from the 2005 levels.
South Korea	21	32.2%	5	6	0	30% reduction from BAU by 2020.
India	20	2.9%	6	17	40	"Endeavour" to reduce the emissions intensity of its GDP by 20-25% by 2020 in comparison to the 2005 level. N.B. agricultural emissions excluded.
Russia	32	17.1%	10	14	30	15-25% below 1990 levels by 2020, depending on appropriate accounting of the potential of Russia's forestry as carbon mitigator.
Ukraine	15	48.1%	0	2	20	20% reduction from 1990 levels.

Sources: World Nuclear Association, <http://www.world-nuclear.org/info/reactors.html>. STATUS OF GLOBAL MITIGATION ACTION, Current targets and policies in key countries, www.climatechange.gov.au

Japan consumes 4.2% of global primary energy, and it is the largest importer of liquefied natural gas and coal and the second largest net importer of oil.² Without hydrocarbon reserves of its own to feed this demand, and with inadequate renewables, it imports the vast majority of its energy requirement. With soaring oil costs and with China's growth continuing to place increasing strains on the global energy supply, Japan will be in a much more competitive energy market. If nuclear is stalled, reduced or phased out, it will need to invest heavily in alternatives, such as gas-fired generation, clean coal, hydropower, solar photovoltaics and windpower.

United States

Commentators have pointed to a calm and measured reaction to Fukushima in the US, with none of the public backlash seen in some European states. The Nuclear Regulatory Commission (NRC) released its 90-day review of US reactor safety in July 2011. The remaining three months of the review focussed on meetings with the nuclear industry leading to a more thorough six-month review, released in October 2011. Actions recommended include:

- Frequent updates to seismic studies of existing facilities.
- Added safety measures, including pathways for pump trucks to supply cooling water, guaranteed instrumentation, seismic protection of cooling equipment, flooding protection and backup power for use in emergencies.
- Extension of blackout rules – some plants only have provisions for four hours of power in the event of a blackout and the NRC is now calling for up to 72 hours provision.
- Strengthening emergency preparedness among staff and better codifying guidelines for responding to severe incidents.

There were concerns in the industry that the review might call for sweeping reforms, with cost implications proving onerous for smaller reactors in particular. In the event, recommended actions are widely considered to be realistic and unlikely to affect competitiveness. Any further negotiations may centre on timing, with Republican politicians urging the NRC to adopt a wait-and-see policy with regard to the outcomes of the Japanese investigation.

The US nuclear industry is several decades old. Currently, there are 104 reactors in the country producing energy. To some extent, the terrorist attacks on Washington DC and New York City on September 11, 2001 were a catalyst for a review of these reactors. Concerns that future attacks might focus on energy reactors led to a number of operational and safety-related changes which pre-empted the current NRC reaction to Fukushima. There are three current instances of host states attempting to close nuclear plants, although none as a result of Fukushima.

The abundance of available gas means that a true nuclear renaissance is probably unlikely in the shorter term. However, beyond energy market dynamics, there do not appear to be any emerging barriers to US nuclear new-build.

Canada

Canada's regulatory response has been as measured as its neighbours to the south. The Canadian Nuclear Safety Commission (CNSC) released a statement in the aftermath of the Japanese tsunami stating that it had confidence in "the safety of Canada's fleet of nuclear reactors regarding seismic activity." It went on 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... and can manage potential consequences so that workers, the public and the environment are protected."

Despite the calm response in Canada, on April 20, 2011 a review of the events at Fukushima was commissioned. This review is evaluating operational, technical and regulatory implications for Canada's 20 nuclear power plants, and licences will be considered in light of safety. Operators were ordered to re-examine defences against external hazards and severe accidents, and emergency preparedness. The mandate asks for identification of high-level lessons learned and recommendations for short-term and long-term measures to address shortcomings. Routine testing for radiation of food imported from Japan took place for approximately three months, while fish caught off the coast of British Columbia, which faces Japan across the Pacific, are also tested.

There has been no sense of panic amongst the public or regulators and, in the absence of anything major coming out of the review process, Canada's nuclear programme is expected to continue largely unaltered.

France

With 58 operating reactors generating over 80% of energy requirements, France is the world's most nuclear-dependent economy. Therefore, industry-wide changes have a relatively larger cost. For this reason alone and, unsurprisingly, it is business as usual for the French. New safety measures may bring additional costs, depending on the outcome of stress tests which look at floods, earthquakes, power loss, heat sinks and accident management. Four days after Fukushima, following a hastily convened meeting of nuclear experts in Brussels, European Union (EU) Energy Commissioner, Guenther Oettinger, called for stress tests of reactors in EU countries and neighbouring jurisdictions. France has gone beyond the EU's tests by looking at non-nuclear parts of civil engineering at nuclear plants and testing on a basis of 60 years' productive life, instead of the recommended 40 years, thereby requiring more robust systems.

French reactors are granted ten year licences based on safety. The new licence for the Fessenheim power plant has been given in theory, but is awaiting final approval pending the country's stress tests. Fessenheim is situated less than one mile from the German border. Given Germany's decision to ban all nuclear power within its borders, some industry insiders have speculated that its operator, EDF, might face political pressure to close one of the two reactors at the site, particularly if capital expenditure requirements resulting from the stress tests are especially high. Although closure is probably the less likely outcome, the final decision on Fessenheim is eagerly anticipated as a barometer for French positioning on existing and new nuclear reactors.

The safety of France's nuclear production is very important for a country which will export so significantly to neighbouring countries which have chosen a nuclear-free future: Germany, Switzerland and Italy. Therefore, despite a lessening of enthusiasm for nuclear from the extreme left and right wing parties, a further €1 billion has recently been put into nuclear research and, with the recent moratorium on hydraulic fracturing for shale gas effectively blocking a potential source of energy diversification, nuclear power is necessary and commitment, it seems, is robust.

UK

The UK's Office for Nuclear Regulation called for a review of the nuclear energy sector. An interim report was produced in May 2011. This contained recommendations relevant to regulators and to industry. It looked at additional risks posed by having several reactors on one site and contained recommendations that plant operators should review ventilation, electrical backup systems, storage of spent fuel rods and flood protection. The report did not call for a pause in current nuclear operations. The final report was released in October 2011 and, beyond expanding on the recommendations of the interim report, including what relating to emergency response and learning lessons from the Japanese experience, gave an effective all-clear. The report's author, Dr Mike Weightman, said in an interview, "I remain confident that nuclear facilities in the UK are continuing to be safe to operate and I remain confident in the robustness of the nuclear safety regime".

New-build remains at the centre of the nuclear debate in the UK. The UK is now a net importer of oil and gas and, while other alternatives are being built, notably wind, these only meet a small percentage of overall energy requirements. Therefore, nuclear expansion has been pencilled in as the major sector for growth of energy production. This situation has not changed with the events in Japan. In July, Parliament overwhelmingly voted for the development of eight new proposed sites.

The roll out of the UK's new nuclear power will be carried out by EDF, buyers in 2009 of British Energy, the former operator of UK nuclear power. Centrica, who now own 20% of the former British Energy assets, are likely to be involved in the first phase of the new-build programme, while a second phase may involve other utilities companies. A final decision on the timing and extent of the new-build is required in late 2012. With an all-clear from the review process now received, clearance for the proposed reactor designs from Areva and Westinghouse can be given and planning permission for the plants secured. Experts have estimated that the delay caused by the review process is likely to have been about six months.

In the British Science Association poll of September 2011, 41% of respondents said the benefits of nuclear energy outweighed the risks, up from 38% in 2010. Fukushima does not appear to have dampened enthusiasm for nuclear power amongst regulators or the public. The industry therefore looks set to grow significantly within the UK's energy mix.

Germany

Germany has made the most dramatic post-Fukushima decision. In May, the government decided to decommission all of its existing nuclear power stations between 2013 and 2022. The move contravened a decision made in Autumn 2010 to prolong the lives of existing nuclear plants. Germany carried out its own stress tests, which were much more stringent than the EU tests, and on the basis of these, their reactors failed.

Ending nuclear energy may have been a politically astute move from Chancellor Angela Merkel, neutralising criticism from the green and SPD parties, and avoiding a long fight with an anti-nuclear public majority. In terms of industrial strategy, this decision also may prove to have been a good one for the country. Germany has relatively little industry involved in building nuclear power infrastructure. However, it is the global leader in some renewable alternative energy technologies, notably solar. With China closing the gap in this area, banning nuclear effectively gave a huge boost to research, development and production of renewable energy sources. The decision of near neighbours Italy (see below) and Switzerland to block any nuclear power stations within their boundaries gave a further *de facto* boost to German alternatives, given the future need of all three countries to diversify away from dependence on French electricity.

As the new dominant source of demand and supply for renewable energy, Germany has a unique opportunity to test the large-scale viability of renewables, and the world will watch eagerly and see whether they can succeed. Should it fail, keeping to climate change targets may become an impossibility in Western Europe.

Italy

Throughout the last 50 years, Italy has oscillated in terms of whether to develop nuclear energy. In June of this year, less than three months after the tsunami hit Japan's reactors, the Italian electorate voted overwhelmingly to block any new atomic power in the country via a referendum.

Italy's industrial growth of the second half of the 20th century was built, to a notable extent, on the oil and gas which ENI sourced across the Mediterranean in Libya. The ongoing civil war in Libya has led to insecurity and soaring costs of this supply. LNG plants are being built in the south of the country, but they are several years from production. Despite medium-term energy security, given the combination of these factors, Italy is likely to become more dependent on imported French nuclear energy.

China

China's energy use, dominated by hydrocarbons, particularly coal, more than doubled in the first decade of the century, driven by rapid economic growth and urbanisation. Electricity demand is forecast to continue to soar, and the government is planning a substantial increase in new nuclear power capacity to add to its fleet and supplement coal and hydro. China is building power plants using different overseas suppliers of reactors, as it does not wish to be dependent on a single supplier and technology. With a low cost of installation relative to the developed world and a lower rate of return required, given that investment is state-backed, there would appear to be little standing in the way of nuclear new-build.

Concerns have been voiced at the ability of China to keep up with the new-build, in terms of safety and regulation. A report from the State Council Research Office released before Fukushima, pointed to such safety shortfalls. The report pointed also to low quality equipment being used, a shortage of manpower and the choice of old style technologies as serious problems facing the expansion plans. After the crisis in Japan, these views gained more credence and projects under construction were halted. In addition, there was a moratorium on new approvals. The construction ban has now been lifted but new projects are still banned for now.

The Government has said it will opt for newer nuclear energy technologies than had originally been the case, which will bring higher costs. However, the issues of manpower and safety remain. A recent high-profile bridge collapse gave a taste of the level of public outcry that state-backed civil engineering failures can bring. This may bring into question the government's appetite, let alone its capability, to achieve the rapid pace of the expansion planned.

South Korea

South Korea has 21 nuclear plants in operation, with more planned and under construction, aiming to take nuclear electricity from 31% to 48.5% of the country's total energy demand by 2024. A safety inspection was ordered shortly after Fukushima. Some safety walls are being raised to prevent flooding, should water levels rise as high as those seen during the tsunami that hit Fukushima. The government has made US\$1 billion available for any safety-led modifications required. However, the government has also made it clear that nuclear expansion plans would continue as intended.

An opinion poll showed virtually no change on a national level in terms of support for nuclear power in the country. However, a re-taken referendum, local to a planned new plant, found that the consensus was marginally against the plant. This may suggest that, in the future, new sites may face greater discontent and that it may be necessary to increase capacity through new reactors at existing plants.

The government and KEPCO, the majority state-owned electricity monopoly, intend to export 80 reactors by 2030, bringing in hundreds of billions in revenue for the country. A significant contract has already been won to provide the United Arab Emirates with reactors, beating off competition from more seasoned players. Given this plan, and increasing competition for energy in the region from Japan, China, Taiwan, Vietnam and other countries experiencing economic development which is outpacing new energy production, South Korea's commitment to nuclear comes as no surprise. The bigger question for the country may not be what happens domestically, but how international demand shapes the nuclear export market.

India

Post-Fukushima, no operating nuclear reactors were stopped in India. The Indian government called for a safety review of nuclear power projects in India. However, there were no significant changes required as a result.

India recently signed a deal with the US, which effectively enables supply of equipment for the Indian nuclear industry by foreign companies. The government is also attempting to introduce a limited liability statute for equipment suppliers in the case of nuclear accidents

The country's nuclear expansion programme continues and the government is in the process of identifying optimum locations for five nuclear power plants to be built in collaboration with foreign equipment suppliers. Local opposition against nuclear power projects has increased, with large protests in Maharashtra State, where a large new station is planned. In addition, the Environment Minister, since replaced, stated after Fukushima that planning permission granted for multiple-reactor plants should now be

reconsidered. However, the government has maintained that nuclear power is an essential part of the energy mix going forward. Any additional safety measures may increase costs and extend timelines, but with rapid industrialisation and urbanisation, and a fast growing population faced with poor existing domestic energy production capabilities, there appears little doubt that nuclear plants currently in the planning phase will indeed be built at some stage.

Russia

Russia chose not to participate in EU stress tests and carried out its own. There is only one nuclear operator in the country, the state-owned Rosatom, meaning that there is limited disclosure. However, at a recent nuclear expo, it was announced that no problems have been detected with the country's fleet of reactors. It was suggested that some new safety measures were desirable, surrounding backup power and spent fuel, but that these were fairly minor and would neither require major capital expenditure nor cause delays to planned construction.

The country has a complex energy policy imperative. More reactors built at home means more electricity is derived from nuclear, leaving extra gas for export, a major earner for the country. Meanwhile, as the biggest exporter of reactors with an order book including China, India, Bangladesh, Lithuania and Belarus, building new plants at home also further proves the efficiency and safety of the Russian technology and encourages other countries to use it.

There are no official changes to plans for new reactors, either domestically or for those which Rosatom is due to build for other countries. Possibly the most controversial of the new-build plants planned is that in Kaliningrad, the small isolated part of mainland Russia which borders north-east Germany. Given Germany's decision to phase out nuclear, they will be keen that all reactors built close to them meet the highest safety standards, as is the case with EDF's Fessenheim plant in France. The Kaliningrad plant is intended to sell power into Germany and no delays have been announced since Fukushima. Russia has been publicising the safety of its new technology reactors. In addition, Rosatom has offered to help Germany decommission its fleet, positioning itself as a nuclear life cycle services firm to compete with Western corporates offering a similar service.

Ukraine

With 48% of electricity currently coming from nuclear, Ukraine remains one of the world's largest nuclear energy producers. As the host of the Chernobyl disaster, this may come as a surprise. However, with a very large increase in electricity requirements being required to support the country's relatively rapid economic growth, the country is planning new reactors. The Prime Minister reaffirmed Ukraine's commitment to nuclear a few weeks after Fukushima.

There is no current safety review underway – Ukraine's reactors were tested by the International Atomic Energy Agency and the EU between 2009 and 2011. This review was mostly favourable and recommendations are being implemented. There has been no major public reaction to the nuclear industry post-Fukushima and it appears that the country feels that Chernobyl's lessons have been learned and it can move ahead with nuclear expansion plans.

The EU and moves towards harmonisation

14 of the 27 EU member states currently produce nuclear power. The European Commission has argued for common safety standards across the EU. However, given the very different technical approaches to parts of the process, including cooling and pressurisation, harmonisation can be very complex. There is, therefore, a strong argument for the maintenance of local regulators who know the technology, have conducted the research and developed the processes while understanding the history of any issues and risks. In addition, any centralisation of nuclear regulation could lead to extra bureaucracy and possible lack of responsibility. External peer reviews are more likely to provide a harmonisation tool, and some countries have been asking for the International Atomic Energy Agency to provide such a role, acting as inspector and whistleblower.

Global expansion of nuclear power remains inevitable

The arguments supporting the rollout of a nuclear energy industry in the 1960s and 70s – energy costs, shortages and security – have only become stronger. Now with political instability in oil-rich regions and global warming adding to the equation, and with the prohibitive cost of other alternatives, the case for nuclear appears stronger. Globally, approximately 154 reactors are at the planning stage. About 140 of these, in addition to the majority of those proposed, are in Asia.

Continued uncertainty over global emissions regulations does not provide a clear, quantifiable incentive structure. Energy producers in all sectors will watch the 17th UNFCCC in Durban later this year given the end of the first commitment period to the Kyoto Protocol at end-2012. However, as carbon costs become greater and more widespread, most countries building nuclear power plants see it as a key measure in mitigating emissions, given the relatively low emissions per unit of power generated through nuclear. Countries who reduce or phase out nuclear and fail to plug the gap with other alternatives will be increasingly dependent on coal, oil and gas and therefore will have difficulties meeting carbon targets. The map overleaf shows that, of the countries covered in this report, companies in the US and Canada are considered to be at extreme risk from future carbon regulation and public pressure, while all the other countries continuing with nuclear programmes are high risk, as are those electing to pursue a nuclear free future, such as

The disparity of responses to Fukushima

The CO₂ Emissions from Energy Index

evaluates the risk to business operating in countries which may be subject to future international regulation of CO₂ emissions or pressure from public interest groups.



France

58 operating reactors, three in construction, planned or proposed.

World's most nuclear-dependent economy. New safety measures may bring additional costs. Out with increasing exports to nuclear-free Germany, Switzerland and Italy. Nuclear power commitment is robust.



UK

18 operating reactors, 13 in construction, planned or proposed. Final findings of review due soon and no major steps expected. In July, the Houses of Parliament overwhelmingly voted for eight new sites.



Canada

18 operating reactors, eight in construction, planned or proposed.

Review of industry and food imports tested, but business as usual.



USA

104 operating reactors, 35 in construction, planned or proposed.

New safety and process measures required, but the industry is proceeding much as previously planned.



India

20 operating reactors, 63 in construction, planned or proposed.

Safety review did not result in significant changes. Long term severe energy scarcity means nuclear expansion programme continues despite some protests.





Germany

17 operating reactors. Government ordered total phase out of nuclear energy on home soil over next decade.



Italy

No reactors in operation, construction, planned or proposed. June referendum overwhelmingly blocked any atomic power in the country.



Russia

32 operating reactors, 54 in construction, planned or proposed. Carried out industry review, minor improvements required, but no delays to planned construction.



Ukraine

15 operating reactors, 22 in construction, planned or proposed. Reactors tested between 2009 and 2011, review was mostly favourable and recommendations are being implemented. Moving ahead with nuclear expansion plans.



- Extreme (0.0-2.5)
- High (>2.5-5.0)
- Medium (>5.0-7.5)
- Low (>7.5-10.0)
- No data



China

14 operating reactors, 198 in construction, planned or proposed. Some concerns over safety and choice of older-style technology led to plants under construction being temporarily halted. Multiple recent civil engineering failures may slow the pace of expansion plans.



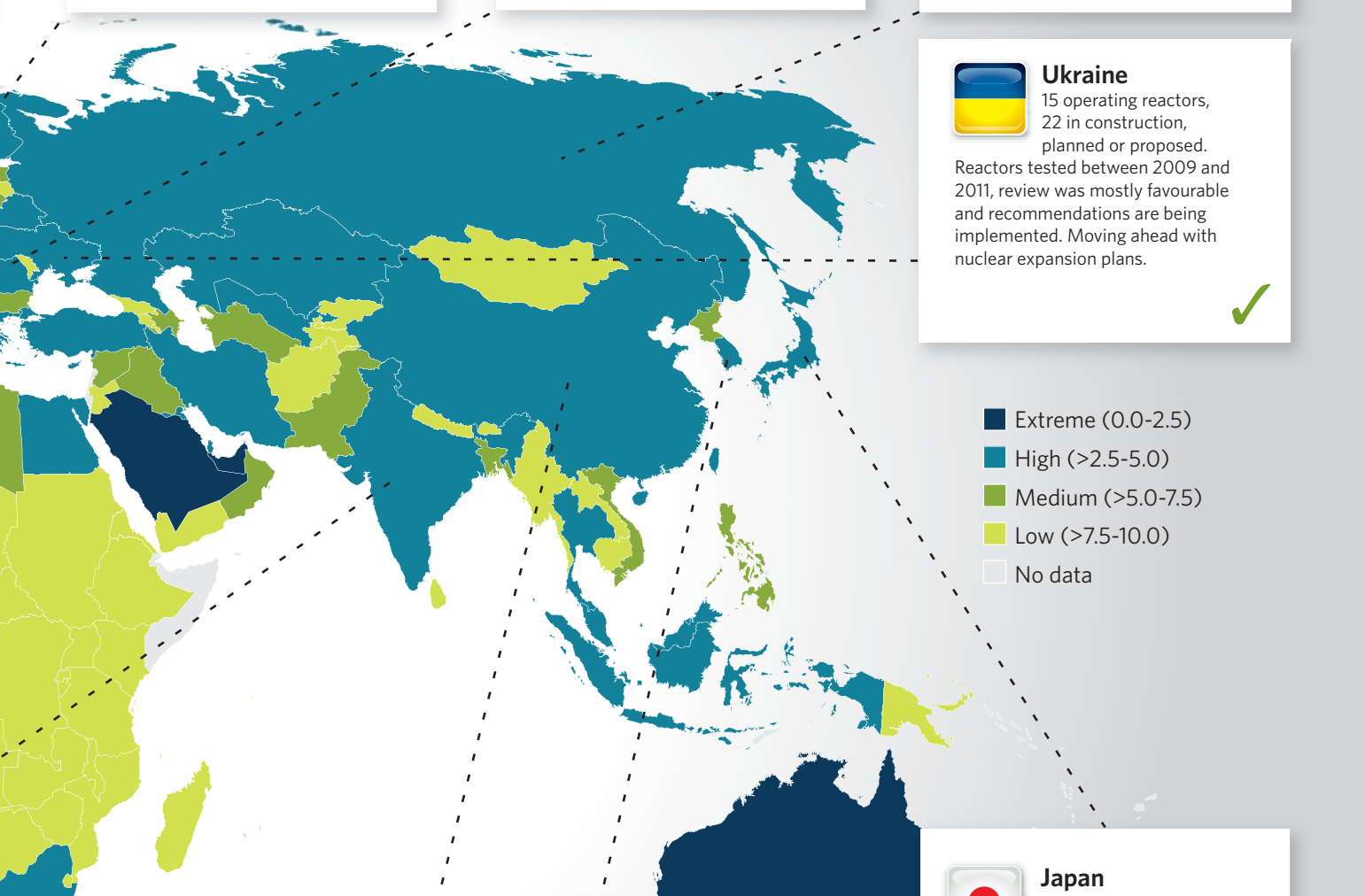
South Korea

21 operating reactors, 11 in construction, planned or proposed. Safety inspection led to some new recommendations. Given major reactor export plans and regional energy scarcity, no surprise that nuclear expansion plans will continue as intended, backed by public opinion.



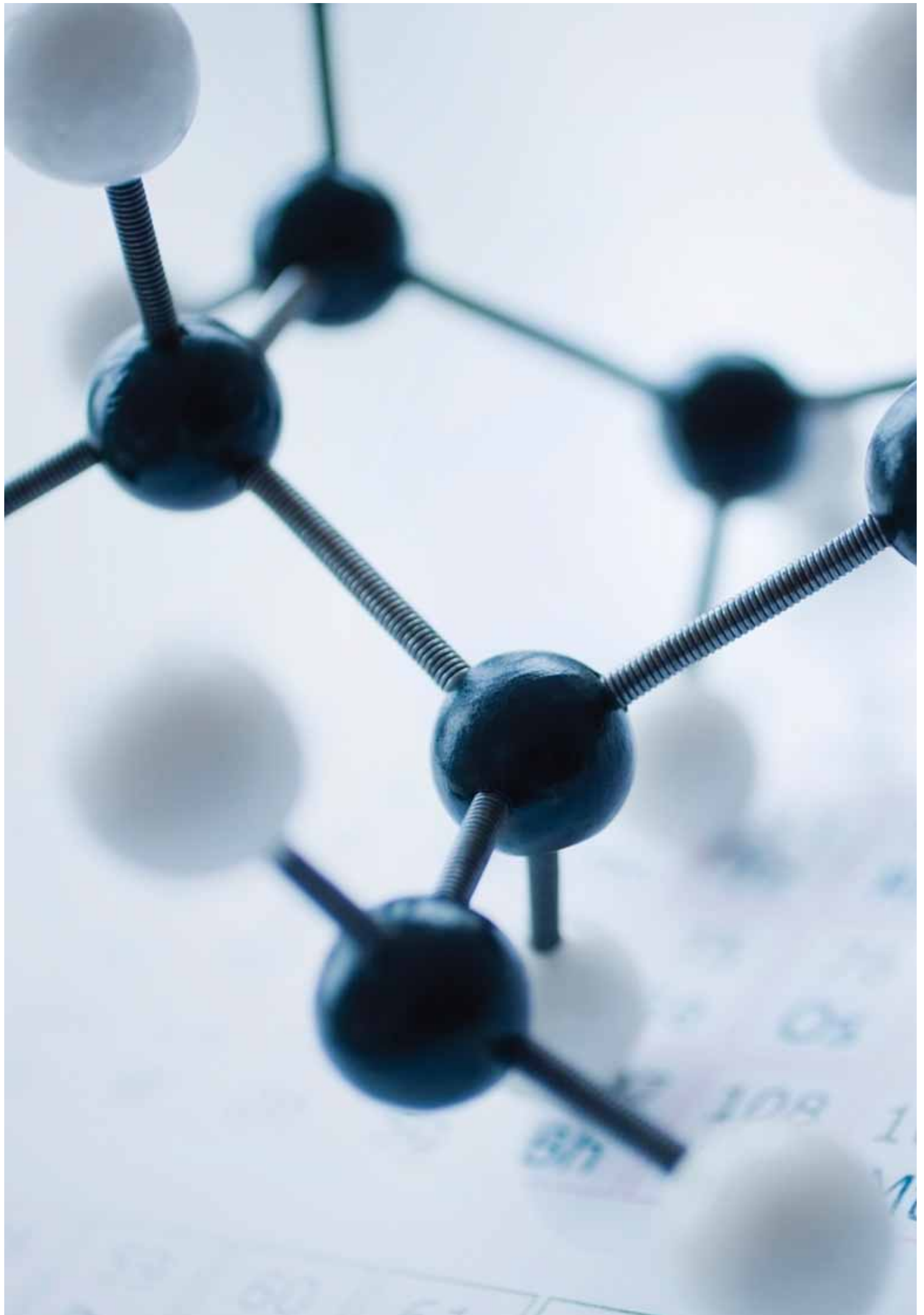
Japan

51 operating reactors, 17 in construction, planned or proposed. Tsunami's impact on Fukushima plant appears to have been well managed. As a major hydrocarbon importer, Japan had intended to reduce the zero-emission power source ratio to 70% by doubling nuclear generation to around 50% of energy generation. Some negative noises from politicians, and worsening data on contamination levels in some localities means the future for nuclear energy remains unclear.



Germany and Italy. Watching carbon regulation is therefore key for those investing in energy utilities and complementary sectors within the G8 and the large Asian economies.

It is, of course, hoped that there will be no more incidents similar to Fukushima, which lead to devastating impacts on communities and the environment. It can take decades for areas to become safe again. The area around Chernobyl still has dangerous pockets of radiation levels in places. Local and national economies can also take a long time to recover. Fukushima, like the incidents in Chernobyl and Three Mile Island, did not end nuclear overnight, despite some local phase-outs. In the immediate aftermath of Fukushima, many financial analysts were suggesting a sell nuclear/buy renewables trade. However, a worldwide phase-out programme has not been witnessed. Instead, some localised decisions to pursue a nuclear-free future have been more than balanced by decisions to continue with nuclear expansion. On a net basis, given carbon constraints, energy security and energy scarcity, we are likely to see more nuclear reactors globally. These are expected to offer greater efficiencies and more robust safety structures and processes over existing reactors.



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