CHATHAM HOUSE

briefing paper

Reset or Restart? The Impact of Fukushima on the Japanese and German Energy Sectors

Antony Froggatt, Catherine Mitchell and Shunsuke Managi

Energy, Environment and Resources | July 2012 | EERG BP 2012/03

Summary points

- Japan and Germany are on the brink of a national energy transformation, implementing new energy policies that reduce reliance on nuclear power as a direct result of the Fukushima disaster in 2011. Both are seeking a significant expansion of renewable energy and energy efficiency programmes that will lead to a decrease in consumption, with a higher reliance on fossil fuels also envisaged in the short term.
- In Germany the new national energy strategy, adopted by virtual consensus in the parliament, will phase out all nuclear power by 2022. In Japan, although some nuclear power stations are being restarted, it is doubtful that they will ever meet the pre-Fukushima contribution of 30% to the electricity mix, let alone the previously envisaged rise to 50% by 2030.
- Geopolitical considerations are vital for a successful energy transformation. Europe's integrated electricity grid has enabled Germany's relatively radical denuclearization without affecting energy service or price. However, Japan is unable to access electricity transmissions from neighbouring countries, and the fragmented nature of the national electricity grid has further exacerbated electricity supply.
- Public opinion has been a key driver for policy-making since the Fukushima incident. Public support has been and will remain the determining factor in the successful implementation of the new energy policies.

Introduction

The policy impact of the March 2011 Fukushima disaster on the nuclear power industry may not be evident in most countries, but both Germany and Japan have reacted with forceful decision-making. Before the Tohoku earthquake and tsunami in northern Japan and the consequences for the Fukushima Daiichi nuclear power plant, there were 54 nuclear reactors in Japan and 17 in Germany, providing respectively one-third and one-quarter of the countries' electricity. Within six months, nearly half of Germany's 17 nuclear reactors had been permanently closed and a new phase-out strategy for the remaining ones put in place. In Japan, by May 2012 all the country's nuclear power stations had temporarily closed. The unprecedented speed and extent of both nations' denuclearization, at a time when the global energy supply system is in a period of unparalleled instability, indicate a much greater public engagement and influence in energy policy-making. For the first time, Japanese consumers are making their views on energy known. It is unclear whether, even if it wanted to, the Japanese government could restart a supportive post-Fukushima nuclear policy.

> 'For the first time, Japanese consumers are making their views on energy known. It is unclear whether, even if it wanted to, the Japanese government could restart a supportive post-Fukushima nuclear policy'

However, while Germany – the government, industry and public – has managed to build a largely integrated and pragmatic energy system in line with public preference for lower carbon emissions as a result of energy efficiency measures and the use of renewable energy, Japanese energy policy is now stuck between public opinion, which is increasingly opposed to nuclear power, and the energy industry, which remains in the hands of the large centralized utilities seeking a continued role for nuclear energy.

Meanwhile, global energy consumption is increasing rapidly in emerging economies, particularly China; the depletion of conventional fossil fuel reserves is continuing; and the domestic impact of international emission reduction targets for avoiding the most serious consequences of climate change is having long-term implications for national and global industry shake-outs, by creating demand uncertainty.

Today's energy crisis offers both countries new challenges and new opportunities as they phase out or significantly reduce their use of nuclear power. Key to this process will be the accelerated deployment of renewable energy, often leading to more localized generation which brings planning and grid integration issues. Equally important will be meeting energy efficiency and demand reduction targets across a whole range of sectors, especially construction and small and medium-sized enterprises.

Pre-March 2011 nuclear policy in Japan and Germany

Japan has few fossil fuel resources and relies on imports for 84% of its energy needs. Before 2011 it strongly supported the development of nuclear power as a means of diversification. Following the oil shocks of the 1970s, it had introduced radical programmes that led to the Japanese economy becoming the most energy-efficient in the world. But this relative advantage over other countries diminished after 1990 as ambition dipped in the face of the increasing costs linked to scaling up energy efficiency and growing domestic demand and consumption.

During the late 1990s there were significant discussions on the future role of renewable energy and the potential role of Feed-in-Tariffs (FITs) and Renewable Portfolio Standards (RPS). However, the Japanese government eventually decided on establishing RPS, creating an obligation on electricity suppliers to produce a certain percentage of their electricity from renewable energy.

However, rather than stimulating non-hydro renewables, as intended, low targets effectively established a glass ceiling on successful integration.

Japan's energy policy before Fukushima was framed within the Basic Act on Energy Policy of 2002. This set out the general direction of policy in accordance with three fundamental principles: 'securing of a stable supply', 'environmental suitability' and 'utilization of market mechanisms'. The Basic Act led to the establishment of the Basic Energy Plan in October 2003 and to the Strategic Energy Plan of Japan in 2007, and its main targets for 2030 focused on raising Japan's 'energy independence ratio' from 38% to about 70%; increasing zero-emissions power sources from 34% to 70%, primarily through an increase in renewable energy and nuclear energy; halving CO_2 emissions from the residential sector; and maintaining and enhancing energy efficiency in the industrial sector at a world-leading standard.

On the other side of the world, until Fukushima, nuclear power was one of the dividing lines in German politics: the Social Democrats were traditionally anti-nuclear and the Christian Democrats were largely pro-nuclear. Political uncertainty and the viability of alternatives meant that no new reactors had been ordered since 1982, four years before the Chernobyl disaster in 1986. At the individual state (*Land*) level, political intervention led to the closure of specific facilities: the Wackersdorf reprocessing plant was abandoned in 1989, as was the Kalkar fast-breeder project in 1991 and the Hanau mixed oxide fuel production facility in 1995. Moreover, following unification in 1989, all five operating reactors in eastern Germany were closed and projects under construction were abandoned.

After the formation of a coalition government between the Social Democratic Party and the Green Party in 2002, the parliament approved a nuclear phase-out law restricting the operational life of each reactor to about 32 years. However, the utilities had a total nuclear electricity generating 'budget' of 2,623 billion kWh and could transfer any remaining kWh from one reactor to another. The construction of new nuclear plants and spent fuel reprocessing facilities was also prohibited. The two reactors at Stade and Obrigheim were rapidly shut down under the phase-out law. A third unit, Mülheim-Kärlich, which had been under long-term mothballing since 1988, was also closed permanently.

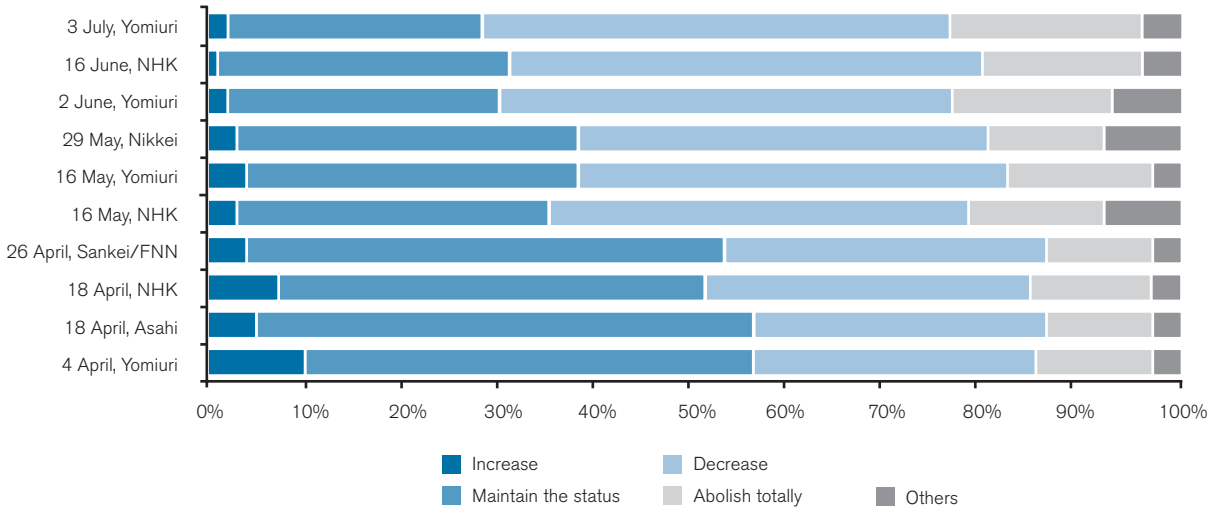
In the wake of elections in 2009, the coalition government of the Christian Democrats and the Free Democratic Party significantly amended the phase-out legislation. As a result, older nuclear units could operate for eight years longer, while more recently built units could operate for up to about 12 years longer provided that they underwent additional safety analysis and upgrading. The construction of new reactors remained explicitly prohibited. As under the 2002 legislation, a generation 'credit' could be transferred from an older plant to a newer one. The overall generation credit was increased by more than 40% in return for enabling longer-term operations, and the operators had to pay a substantial nuclear fuel tax,[1] which fed an energy and climate fund for boosting energy efficiency and renewable energy measures.

While there has been political disagreement on the future role of nuclear power, Germany has become a world leader in renewable energy. Over the past decade, production has grown fivefold; and under the National Action Plan developed in 2010 it is expected to double to 19.6% in 2020. This will mean that the share of renewable energies in the electricity sector will be 38.6%, in the heating/cooling sector 15.5% and in the transport sector 13.2%. In 2011, 2,000 MW were added to the grid. Total installed wind capacity is almost 30,000 MW, with four German states generating over 45% of their power from wind, and one of the largest, Lower Saxony, now fulfilling 25% of its needs from this source.

An unexpected new boom in the photo-voltaic (PV) sector was also registered in 2011, with a record 7,500 MW of capacity connected to the grid. The total of nearly 25,000 MW PV has generated 18.6 TWh, up by 60% from the previous year. According to the German Solar Industry Association (DSW), the share of solar power in the electricity mix will increase by 70% over the next four years, to 7%, and rise to 10% by 2020.

1 The tax is €145 ($200) per gram of plutonium-239, plutonium-241, uranium-233 or uranium-235. It is due with the introduction of the nuclear materials into a reactor.

Figure 1: The future of Japanese nuclear power: opinion polls post-Fukushima, 2011 (%)



Source: Japanese Atomic Industrial Forum, *Summary of Opinion Polls*, 2011.

The aftermath of Fukushima: one shock, two reactions

Since the Fukushima disaster, major questions have been raised about the future energy mix and the role of nuclear energy. During 2011, even after the nuclear disaster first occurred, support for nuclear power fell continuously in Japan, as shown in the summary of opinion polls in Figure 1. In April 2011, 10% of the population supported an increase in the use of nuclear power. This fell to just 2% by October, while the proportion who wanted to decrease or phase out nuclear power had increased from 41% to 68%. According to a more recent poll by the Japan Association for Public Opinion Research undertaken in March 2012, 79.6% of those asked were in favour of phasing out the use of nuclear power.[2]

Germany's swift decision to close eight nuclear reactors in the fact of overwhelmingly negative public opinion about nuclear safety indicates that if there is political consensus and will, incredibly rapid changes can occur in a country's energy system. These can be not only environmentally but also financially beneficial. So far, the decision has had no lasting harmful impact on the pricing and availability of electricity in Germany or elsewhere in Europe. Somewhat surprisingly, and contrary to much media commentary, by October 2011 Germany had become a net exporter of power again. It is now being held up as a positive example of the ability to harness post-shock opportunities by fusing citizens' aspirations with policy-making that supports innovation and technology.

New policy initiatives in Germany

In the immediate aftermath of the Fukushima disaster, the German government introduced a number of policy measures. On 3 August 2011, it adopted the Sixth Energy Research Programme. A total of €3.5 billion is available until the end of 2014 to support Research, Development and Deployment activities in renewables, energy efficiency, storage, grid technologies and renewables integration. This is a budget increase of 75% compared with the 2006–09 period. The weatherproofing support programme is to be increased to €1.5 billion annually from 2012 to 2014. Individual support to homeowners is calculated according to the degree and timing of renovation measures, with 10% of the costs potentially deducted from income tax.

2 AFP, '80% in Japan support nuclear phase-out: poll', 3 March 2012.

By 2020, there are expected to be at least one million electric vehicles in Germany, and some six million by 2030. The government has doubled R&D funding to almost €2 billion until 2013. Advantages for users of electric cars include a 10-year tax exemption, dedicated parking spots with charging stations and the option to use bus lanes.

As of 1 January 2012, the support scheme for micro-CHP (combined heat and power) has been renewed and extended. The government will provide €200 million of support up to 2014 for the development of storage technologies. Projects include a 90-MW compressed-air plant, to be built at Staßfurt (Saxony Anhalt). This can store up to 360 MWh and reach 70% system efficiency, in particular through heat recovery. On 16 September 2011, a test centre for smart grids and electro-mobility, supported by a government grant of €4.5 million, was opened in Rothwesten, close to Kassel. The centre allows for the development and testing of components for renewable energy-based systems.[3]

The debate in Germany about future grid transformation needs is ongoing. On 19 July 2011, the Federal Grid Agency opened the assessment process, in which operators must develop 10-year grid development plans established according to the Renewable Energy Law (6 June 2011). These must contain the following information:

- All grid extension measures to be implemented over the next three years;
- A timeline for all implementation measures;
- Pilot grid extension measures for high-efficiency power transmission over long distances.[4]

In parallel, the Ministry of Economy and Technology has created a platform called Sustainable Energy Grids, for the main stakeholders from industry, grid operators and federal and regional authorities to present and discuss respective proposals for grid transformation and modernization according to various energy and CO_2 pricing and energy-mix development scenarios.

High-power lines usually have low public acceptance. The quality of the democratic debate will therefore significantly affect the pace, scale and nature of grid transformation. The most interesting attempt to develop a methodology was carried out in 2010 under the auspices of Deutsche Umwelthilfe, a large environmental NGO based in Berlin. The project, named Plan N (for *Netzumbau*, grid transformation), involved a two-year discussion between stakeholders. This led to the formulation of recommendations to policy-makers for action on a variety of issues relating to both grid extension and alternatives, such as decentralized sources and smart grids.[5]

Japan at a crossroads?

In contrast to Germany, which benefits from the EU's integrated electricity grid enabling flows between countries, Japan's energy policy-making remains hampered by problems of peak demand and a lack of energy integration.

As a result, the most immediate impact in Japan of the accident at Fukushima was the rapid reduction in electricity supply capacity, especially in areas supplied by the Tokyo Electric Power Company (TEPCO) and the Tohoku Electric Power Company (Tohoku EPCO). In response to the accident, rolling blackouts were implemented in March–April 2011 in the operational areas of those companies.

Subsequently the government further demanded that TEPCO and Tohoku EPCO should introduce energy-efficiency measures to curb peak consumption by 15% and that there should be a 10% reduction of consumption in areas served by Kansai EPCO. Other, unspecified savings were required in the rest of west central Japan. In particular, Article 27 of the Electricity Business Act was used to impose restrictions on large users.[6] Those percentage targets were applied equally to large and small businesses and to private households.

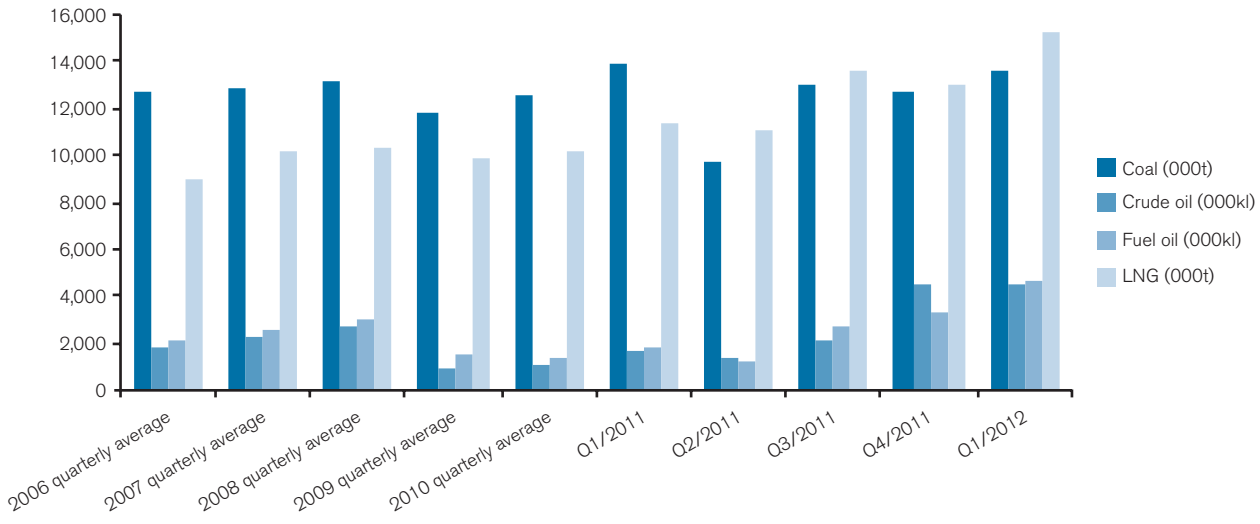
3 Unless otherwise noted, sources for these bullet points are from various pages of the German government website www.bundesregierung.de.

4 Dena (2011), 'Scenario framework for network development plan 2012, Germany Energy Agency.

5 Deutsche Umwelthilfe, 'Forum Netzintegration Erneuerbare Energien – Handlungsempfehlungen an die Politik' [Forum for the Integration of Renewable Energy – Policy Recommendations], November 2010.

6 'Electricity Supply-Demand Measures in Summer Times,' Ministry of Economy, Trade and Industry, 13 May 2011.

Figure 2: Fossil fuel consumption by electricity utilities, 2006–12



Source: Source: *IEEJ, Energy Indicators of Japan*, June 2012.

Reductions in demand in the TEPCO, Tohoku EPCO and Kansai EPCO areas were seen as necessary not only to cope with insufficient capacity but also to restrict the use of expensive, obsolete or disaster-stricken thermal power plants. Action was required from all sectors of society, and companies undertook many measures, including shifting their operations to weekends and evenings. Public information campaigns were conducted to raise awareness of the balance between supply and demand, including warnings when a supply shortage was expected. These campaigns and measures were successful, and targets were met. In TEPCO's region small-business users reduced their usage by 18%, households by 17% and heavy industry by 15%.[7] The slightly lower level of use by heavy industry may well have been due to the earlier introduction of higher energy-efficiency measures in this sector to reduce costs.

In addition, peak demand was reduced by 20% in the area covered by Tohoku EPCO. Of this, 40% (or 8% of the total reduction in peak demand) was due to the direct effects of the tsunami and earthquake;[8] 35% (or 7% of the total) was due to energy-efficiency measures. Energy efficiency was delivered mainly by heavy industry (54% of savings); 27% came from smaller businesses and 19% from the household sector.

However, further measures will be necessary to improve security of energy supply and to meet higher peak demand arising from climate change (producing warmer summers and colder winters). The Ministry of the Economy, Trade and Industry (METI) therefore intends to make 9.8 GW of savings through demand-side measures, such as making pricing information and energy conservation equipment more readily available. METI is aiming to achieve a 2.33 GW increase in capacity through subsidies for renewables, private generation and co-generation and a 4.09 GW increase in capacity by improving supply capacity at power companies.[9]

7 Tokyo Metropolitan Government, Factsheet of demand reduction in Tokyo, 1 December 2011, http://www.metro.tokyo.jp/INET/CHOUSA/2011/12/DATA/60lc1100.pdf.

8 SankeiBiz, Decomposition of demand reduction in Tohoku, 30 September 2011, http://www.sankeibiz.jp/business/news/110930/bsd1109301749003-n1.htm.

9 NBR, 'Japan's Energy Security Outlook and Implications', 25 January 2012, http://www.nbr.org/downloads/pdfs/ETA/ES_Japan_roundtable.pdf.

Despite initial energy-efficiency measures, the reduction in nuclear power's contribution to Japan's electricity supply has already caused a sharp rise in fossil fuel use, as shown in Figure 2. The financial implications of this shift have already become apparent. In FY 2011, Japan had a trade deficit of ¥4.4 trillion (€41 billion), compared with a trade surplus in FY 2010 of ¥5.3 trillion (€50 billion). Increases in fossil fuel costs were responsible in part for the increase in import costs, with the value of imported liquefied natural gas (LNG) reaching a record high of ¥5.40 trillion (€51 billion) in FY 2011, up 52.2% from the previous year.[10] With the overall increase in gas consumption only 11%, price increases were responsible for the majority of the higher importation cost.

> 'There is no doubt that the German government's decision on the phase-out of nuclear power is bold and will require a radical change not only in the production, transmission and management of energy but also in wider society's use of energy'

During FY 2010, the cost of imported LNG in Japan was on average $10/million Btu (British thermal units); but by April 2012 it had increased to $16/million Btu, with some suggesting that the price might reach $20/million Btu. This is much higher than equivalent gas prices in other parts of the world – for example around $4 in the United States. This global difference has led to a call for the establishment of a global gas market and for gas exports from the US to Asia.[11] In April 2012, for the first time two of Japan's largest trading companies signed agreements for the import of LNG from the US. This new source of gas for Japan is important both in material terms and because it increases the linkages and hence price convergence between the currently regionalized gas markets. This is likely to lead to a reduction in the price in Japan.

Towards a new non-nuclear energy landscape?

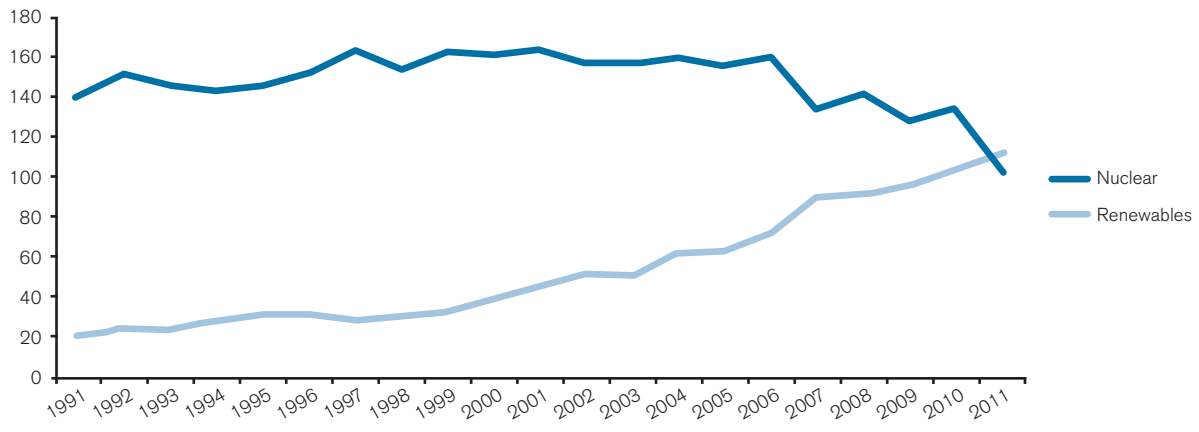
Developing national energy policies is an intricate and often lengthy process of balancing different priorities and complex negotiations. In most countries, policy-driven changes are frustratingly and often dangerously slow from the perspective of climate security. Many new governments may not have time to implement their election promises fully before facing voters again, never mind seeing the impact of policy changes on investments or levels of fuel consumption. As a result, although energy is a vital issue for society, there are arguably few votes to be won on the back of new policies, especially if policy shifts can be portrayed as leading to higher energy prices.

There is no doubt that the German government's decision on the phase-out of nuclear power is bold and will require a radical change not only in the production, transmission and management of energy but also in wider society's use of energy; and as such, it has received much support for its introduction. However, similar decisions and phase-out strategies have been introduced in the past in European countries, including Germany, only to be abandoned or radically altered at a later date when costs have risen, new technologies have not materialized or a different government has come to office.

10 Mainichi, 'Japan logs biggest ever trade deficit of 4 tril. yen in fiscal 2011', 19 April 2012; http://mainichi.jp/english/english/newsselect/news/20120419p2g00m0bu025000c.html.

11 'Gas export move to ship US glut to rest of world', *Financial Times*, 2 June 2011, http://www.ft.com/cms/s/0/34fbf112-8d39-11e0-bf23-00144feab49a.html#axzz1sUYMvtZ7.

Figure 3: German renewable and nuclear electricity production, 1991–2011 (TWh)



Source: US EIA, *International Electricity Statistics*, IAEA PRIS Data-base from the *World Nuclear Industry Status Report 2012*.

The revised German energy policy, called the *Energiewende* ('transformation of the energy system'), relies heavily on changing energy consumption; and it is suggested that over the next decade, new policies will lead to a 10% reduction in electricity demand. Meeting this objective will require the rapid implementation of new policies and measures, some of which have high investment costs and would, if achieved, be among only a handful of examples of a net decrease in consumption. Failure to meet this target will lead to greater reliance on fossil fuels in the long term.

Renewable forms of energy have been scaled up in Germany, and its production of electricity has grown five-fold over the past two decades (see Figure 3). As noted, under the National Action plan the overall use of renewables is expected to double by 2020.

Germany's post-Fukushima energy policy does not envisage the 2020 target increasing appreciably, although it anticipates that the rate of increase after 2020 will be maintained, enabling renewables to meet 80% of electricity demand by 2050. Japan has not been as successful in the deployment of renewables; and although its pre-Fukushima policy objective was to double their contribution, it was starting from a relatively low base. Renewable energy is expected to provide no more than 13% of national electricity consumption by 2020. The lack of interconnection between the electricity regions in Japan has been, as noted, one of the barriers to greater renewable energy deployment.

Energy security is more than a measure of import dependence on fossil fuels. Both Germany and Japan have shown the importance of political and public understanding and support for particular technologies. Public opinion to date in Germany and Japan favours the phase-out of nuclear power, or at least a reduced role. However, public opinion and political levels of support can change. In the case of Germany, this seems less likely, as the nuclear phase-out legislation was proposed by the formerly most pro-nuclear of the parties and was adopted with unanimity. In Japan, as the government prepares its revised energy policy, it will try to balance the interests of the public, local communities and energy companies. Its position is still unclear on nuclear power, but there can be no doubt that, as in Germany, the central pillars of the new energy policy will be energy efficiency and renewable energy, with additional emphasis on the maximum utilization of existing fossil fuel power stations.

The closure of all the nuclear power stations in Japan offers a unique opportunity to test the ability of an industrialized country to change its electricity policy radically and at an unprecedented rate, and to introduce short- and medium-term measures to ensure that the necessary level of energy services can be delivered in a way that is both sustainable and affordable.

The impact on carbon emissions

Concerns about the safety and security of nuclear energy are coupled with serious concerns about energy supply security – when global energy demand is rising – while reducing CO_2 emissions to address climate change. The nuclear phase-out decision has been said by some to be a bad move from an environmental perspective, with claims that it will lead to an increase of CO_2. But as the overall carbon reduction targets in Germany and in the EU as a whole have not changed, there can be no net increase in national and/or European emissions as a result of the decision. Indeed, total CO_2 emissions in Germany fell by 2.4% during 2011.

The World Nuclear Association has stated that it will 'create an extra 300 million tonnes of CO_2 to 2020 from increased fossil fuel use'.[12] And *Nature* magazine points out that 'analysts put the increase [at] between 170 million and 400 million tonnes of carbon dioxide between 2011 and 2020 (depending on different assumptions about the country's shifting power mix)'.[13]

However, in 2011 Germany continued to decrease its CO_2 emissions by 2.4% year-on-year as a result of the greater use of renewables, and milder weather. The German environment ministry said in April 2012 that this outcome showed Germany's Kyoto targets could be met despite economic growth and an accelerated exit from nuclear power, and it called for the tightening of European emissions targets.[14] At the same time, it was announced that the 1,640 power generation and industrial facilities required to participate in emissions trading in Germany emitted approximately 1% less carbon in 2011 than in 2010. According to preliminary calculations, emissions were reduced, especially in the energy sector.[15]

That finding fails to consider the wider context of the EU's emissions reduction target and the role of the emissions trading scheme. Most importantly, the German government has continually stated that it will stick to its existing commitment, namely a 40% decrease from 1990 levels by 2020. This means that any increase in emissions from the power sector will have to be matched by decreases in other sectors. But if Germany keeps importing electricity as it is currently doing to make up for some of its shortfall, this will potentially lead to an increase in emissions in other countries. Likewise, in exporting countries there will need to be a reduction in emissions either in the power sector or in other sectors.

However, given the general caps of the European Emissions Trading Scheme (ETS), there should not be an overall increase in emissions. The most likely impact should be on the price of carbon. A survey of analysts published in *Point Carbon* showed that they are expecting an average EU allowance price of €43/t CO_2 in 2020, in the event of an early shutdown of the German nuclear reactors, compared with €35 if the German reactors were started up again and ran as planned before Fukushima.[16] But it was further noted that an increase in the price of emission rights in the ETS will encourage additional abatement in other kinds of installations, thereby reducing its environmental consequences. The upward pressure on emissions from the electricity sector is therefore likely to remain limited.

12 World Nuclear Association, 'Nuclear Power in Germany', 27 October 2011, http://world-nuclear.org/info/inf43.html.

13 Richard Van Noorden, 'The knock-on effects of Germany's nuclear phase-out', *Nature*, 3 June 2011, http://www.nature.com/news/2011/110603/full/news.2011.348.html.

14 Federal Ministry for Environment, Nature Conservation and Nuclear Safet), 'Less Greenhouse gas with Less Nuclear', April 2012, http://umweltbundesamt.de/uba-info-presse/2012/pd12-017_weniger_treibhausgase_mit_weniger_atomenergie.htm.

15 Federal Ministry for Environment, Nature Conservation and Nuclear Safety, 'Röttgen: Greenhouse gas reduction efforts a great success', April 2012.

16 Point Carbon, 'German nuclear closures may increase emissions by 493 MT to 2020, 22 June 2011.

Prospects

The 2011 events in Fukushima undoubtedly made an impact upon the global consciousness; one public opinion poll found that over 95% of people surveyed in 24 different countries knew about the Japanese tsunami and subsequent nuclear disaster. However, in policy terms the impact has been much less apparent, with direct and immediate changes seen in only a handful of countries. Both Germany and Japan have either already developed, or are in the process of developing, a significantly different energy future, with proposals for a much wider deployment of renewable energy and the adoption of significantly increased energy-efficiency measures. The importance of the decision-making course that they have embarked upon should not be underestimated. As the third and fourth largest economies in the world, the way in which their national energy policies are shaped and developed matters globally – not only does it demonstrate what is possible in terms of energy reform, but also affects the markets for and manufacturers of new technologies.

Developing national energy policies is an intricate and often lengthy process of balancing different priorities and complex negotiations between often conflicting parties. So what key lessons about the short- and long-term implications of energy shocks can be extracted for others from the Japanese and German experiences? One vital message seems to be that if there is adequate political consensus and will, significant and rapid change can occur to a country's energy system, with big gains to be had not only financially but also for environmental sustainability. Germany has built, step by step, an integrated and pragmatic energy system. It has transformed support for a small-scale sector endeavour into a long-term strategic goal of society, including preventing incumbent energy companies from controlling the development of the energy system – although it has allowed them in turn to benefit from those changes.

Japan, on the other hand, appears to be at a crossroads as it begins its restart programme. Its response to the 1970s oil shock was both technology-led and centralized through a world-leading programme of industrial energy efficiency and the development of its nuclear sector. Today's energy crisis offers new challenges and new solutions. The closure of all the nuclear power stations in Japan offers a unique opportunity to test the ability of an industrialized country to implement a radical change to its electricity policy, at an unprecedented rate, and to introduce short- and medium-term measures to ensure that a necessary level of energy services can be delivered that is both sustainable and affordable. On the one hand, technology will play a fundamental role and Japan could once again be at the forefront of research, development and deployment. On the other hand, the new energy future will also require much greater societal support and involvement than before. Working with this rather than against it could well be the opportunity needed to deliver a secure energy future.

‘One vital message seems to be that if there is adequate political consensus and will, significant and rapid change can occur to a country's energy system, with big gains to be had not only financially but also for environmental sustainability’

One of the most important overarching lessons from both countries is the resilience of the power sector. In both cases, significant quantities of base-load capacity have rapidly been taken offline. In Germany this has led to reduced, but still active, electricity export, increased production of electricity from renewables and some additional fossil fuel usage. Yet, despite this, CO_2 emissions continued to fall in 2011. In Japan, which during June 2012 had no nuclear plants generating (down from a 30% pre-Fukushima contribution), radical energy-efficiency measures and an increased reliance on natural gas, along with changes in electricity management, have kept the

economy growing, with emissions from the energy sector only marginally increasing (0.2%). However, probably the most significant 'Fukushima effect' has been on the regional gas price, which has risen 50% in the last year, and given Japan's level of gas imports this significantly affects the country's balance of payments.

However, there are a number of systemic, institutional and financial hurdles that are yet to be overcome and that may ultimately derail the reform programme. Many of these are most acute in the Japanese system, including the lack of interconnection, the power of the incumbents and the cumbersome licensing regime. While many of these obstacles have been removed or circumvented in Germany, new issues, such as the impact of a higher penetration of renewables on the electricity market price, now need to be addressed.

Achieving their policy objectives will not be easy for either Japan or Germany, but fortunately both have some key advantages. First, we know that the technology works. Germany and other European countries have shown that renewable energy, particular wind and solar power, can deliver large quantities of electricity. Secondly, the cost of these technologies is falling and the efficiency of deployment is further driving down the costs of renewable generated energy. Finally, there is widespread public support for renewable energy technologies and the energy reforms in general, especially in comparison with alternatives such as nuclear power.

Energy, Environment and Resources

The Energy, Environment and Resources research department (EER) at Chatham House plays an important role analysing and informing international processes, carrying out innovative research on major policy challenges, bringing together diverse perspectives and constituencies, and injecting new ideas into the international arena.

EER seeks to advance the international debate on energy, environment and resources policy and to influence and enable decision-makers and stakeholders – governments, NGOs, business and media – to take well-informed decisions that contribute to both achieving sustainable development and mitigating potential future climate and resource-related insecurities.

The department regularly hosts workshops and meetings which provide a neutral and non-confrontational forum where experts from different perspectives are able to network and meet to freely share opinions and experiences. Meetings are often held under the Chatham House Rule of confidentiality to encourage a more open exchange of views. The impact of EER's work is recognized internationally and its research output is widely read throughout the policy community.

If you would like further information or to join the department's email list for notifications of publications and events, please email eedp@chathamhouse.org or visit the institute's website at http://www.chathamhouse.org/eer.

Recent publications

- *Famine Early Warning and Early Action: The Cost of Delay*
  Programme Report
  Rob Bailey, July 2012
- *Arctic Opening: Opportunity and Risk in the High North*
  Chatham House-Lloyd's Risk Insight Report
  Charles Emmerson and Glada Lahn, April 2012
- *The Arab Uprisings and the International Oil Markets*
  Briefing Paper
  Paul Stevens, February 2012
- *Preparing for High-impact, Low-probability Events: Lessons from Eyjafjallajökull*
  Chatham House Report
  Bernice Lee and Felix Preston, with Gemma Green, January 2012
- *Burning Oil to Keep Cool: The Hidden Energy Crisis in Saudi Arabia*
  Programme Report
  Glada Lahn and Paul Stevens, December 2011

Chatham House has been the home of the Royal Institute of International Affairs for ninety years. Our mission is to be a world-leading source of independent analysis, informed debate and influential ideas on how to build a prosperous and secure world for all.

Antony Froggatt is a Senior Research Fellow at Chatham House. **Professor Catherine Mitchell** is at the Department of Geography at the University of Exeter. **Shunsuke Managi** is Associate Professor of Resource and Environmental Economics at Tohoku University.

Chatham House
10 St James's Square
London SW1Y 4LE
www.chathamhouse.org

Registered charity no: 208223

Designed and typeset by Soapbox, www.soapbox.co.uk