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The race for the nuclear exit

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In the wake of the Fukushima nuclear accident, many countries are undertaking major reviews of their energy strategies – with Germany announcing the most ambitious intentions. David Elliott looks at the radical changes that are afoot.

Germany's move away from nuclear power

There has been strong opposition to nuclear power in Germany since the 1970s, when there were major demonstrations against proposed new plants. Anti-nuclear and pro-renewable energy policies were at the core of the emerging Green party, and were reinforced by the Chernobyl disaster in 1986. Subsequently, with the Greens becoming part of a coalition government in 1998, a nuclear phase-out policy was established, based on limiting the life of existing plants. In parallel, Germany embarked on a major expansion of renewable energy – becoming a world leader in wind and solar power. Wind generation capacity expanded from less than 3 gigawatts (GW) in 1998 to more than 27GW in 2010. During the same period more than 17GW of solar photovoltaics (PV) were installed.[1] These were facilitated by an innovative feed-in tariff support system. Around 370,000 jobs have been created in the renewable energy industry as a whole, with many more expected in the future. The recent growth of the German renewables sector is shown in Figure 1 (see p.20).

However, with the rise of centre-right politics, and the Greens out of the coalition, Angela Merkel's government sought to soften and delay the nuclear phase-out and also started cutting back on the feed-in tariff – although there was never any suggestion of a nuclear new-build programme.

But then, in March 2011, the Fukushima nuclear disaster in Japan changed the situation dramatically. With regional elections due and massive demonstrations in favour of a complete and rapid nuclear phase-out, the German government immediately shut down all of Germany's oldest nuclear plants. In the event, despite its temporary nuclear moratorium, the government still did badly in the elections. Polls also showed that public support for nuclear, already very low at around 10%, had fallen to 5%. As the government undertook a review of its energy options, the Deputy Environment Minister publicly stated that the eight oldest nuclear plants would be shut down permanently by the end of the year, followed by a rapid phase-out of the remaining nine.[2]

This policy was backed by the German Association of Energy and Water Industries (BDEW). It called on the government to set everything in motion to speed up the transition toward a stable, ecologically responsible and affordable energy mix without nuclear power.[3] The association represents about 1,800 utilities, among them the operators of the

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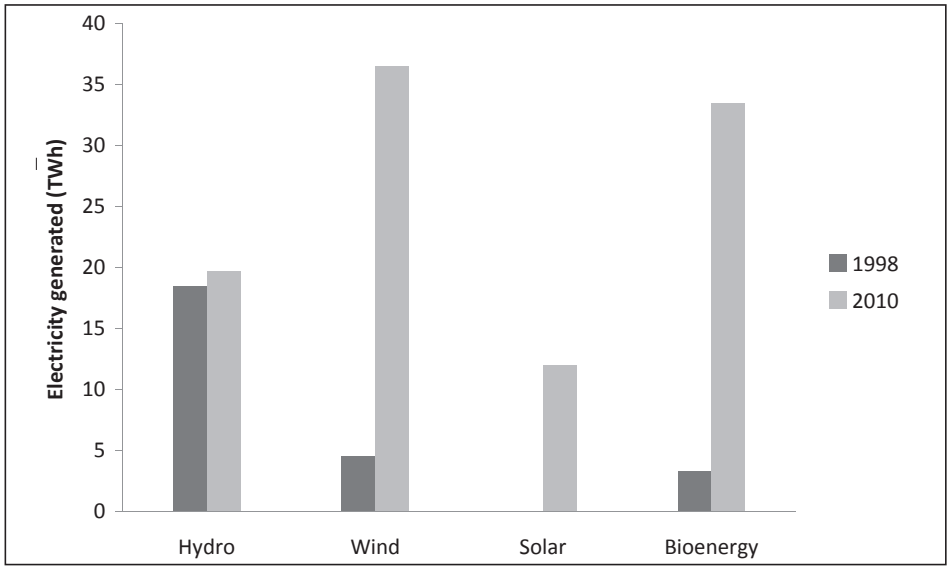

Figure 1 – Electricity generated by renewables in Germany for 1998 and 2010

country's nuclear reactors, which, when all were running, generated 26% of Germany's electricity. The two biggest operators, E.ON AG and RWE AG, opposed the decision, but were outvoted.

On rapid completion of its energy review, the government formally announced at the end of May, that all nuclear power stations would be closed by the end of 2022, and there would be a speedy transition to an energy system based on renewable energy.[4]

Will Germany succeed?

German Environment Minister, Norbert Röttgen, told *Der Spiegel* that he was confident that it could be done, given the rapid growth of renewables and the potential for energy saving, but "everyone will have to invest in the energy turnaround. The expansion of renewable energy, the power lines it requires and the storage facilities will cost money... But after the investments are made, the returns will follow."[5]

So what is envisaged? Röttgen explained: "First we'll have to focus on retrofitting buildings. The €460 million currently budgeted for that program won't be enough." Secondly, there would be a major expansion of renewables, although he said there would be no need to cover Germany with wind farms, as some critics had suggested. "We will achieve the biggest capacities by replacing smaller wind turbines on land with more powerful ones and by generating wind energy in the North and Baltic Seas." He concluded "The events in Fukushima marked a turning point for all of us. Now we jointly support phasing out nuclear energy as quickly as possible and phasing in renewable energies."

In 2010, 17% of Germany's electricity came from renewables, rising to over 20% in the first half of 2011,[6] and the potential for expansion is certainly there in the long term. In addition to backing a nuclear phase-out, last year's *Energy Concept* review, produced by the Federal Environment Ministry (BMU), projected that renewables could supply 35% of electricity by 2020, rising to 80% by 2050.[7] It saw offshore wind as a major growth area – with 25GW in place by 2030 – as well as major new bioenergy projects, with biogas seen as a key new option, replacing imported natural gas. The review also called for primary energy consumption to be halved by 2050, via a major energy efficiency programme. Overall, the review aimed for a 40% cut in greenhouse gas emissions by 2020.

This review has provided the basis for a new German programme, with increased support for renewables, including €5 billion to increase offshore wind power, financed by the German State Development Bank, KfW, and plans for the construction of 'electricity highways' to bring renewable power from windy northern Germany to industrial areas in the south. Some of the existing 7,800 kilometres of high voltage grid run by the German railways may be used for part of this. It also planned major increases in grid integration with the rest of the EU. The Wall Street Journal said the report "marks a significant shift as Germany ceases to debate whether to phase out its reactors and focuses more on how quickly and at what cost".[8]

It won't be easy. But the political will seems to be there to try.

Will Japan follow Germany's lead?

What about Japan? After all, it now has a much more direct and pressing incentive to change its energy policy. The very large anti-nuclear demonstrations in Germany were not matched in size by those in Japan, but then public protest is a rare thing in that country – and getting 7,500 on the street was surprising. According to an Ipsos-Mori poll conducted in May, opposition to nuclear power had risen to 58%.[9]

After many protests concerning the five-reactor Hamaoka complex, on the coast near an earthquake fault around 200km from Tokyo, the operators agreed to close it while sea defences and safety upgrades were installed. A government analysis had predicted an 87% chance of a magnitude eight earthquake in the Tokai region within 30 years with the risk of a major tsunami.[10]

The government has also said that it would abandon its plan to expand nuclear power. Before Fukushima, nuclear power was supplying 29% of Japan's electricity, and there were plans to expand that to 50%. But now the emphasis will be on renewables and energy efficiency.[11]

Japan has no significant indigenous fossil fuel resources and imports most of its energy, and it has downplayed renewables in favour of nuclear power. However, it was at one time a world leader in solar PV production, and it has extensive renewable resources, including offshore wind, wave, solar, hydro, biomass and geothermal.

A 2003 report commissioned by Greenpeace – *Energy Rich Japan* – claimed that Japan could make a full "transition to clean, renewable energy without any sacrifice in living standards or industrial capacity".[12] Technology has moved on massively since 2003, so, although demand has risen, a transition from nuclear should not be out of the question, over time. After all, some of Japan's nuclear capacity has, in effect, phased itself out – very painfully.

Notably, outgoing Japanese Prime Minister Kan said that Japan should "aim to realise a society in the future where we can do without nuclear power stations".[13]

Will others countries follow?

Technology is not really an obstacle to moving away from nuclear power. Many studies have suggested

that the EU and indeed the world could expect to get up to 100% of their electricity and most of their total energy from renewables by 2050.[14] Even the conservative International Energy Agency said that 75% of global electricity generation from renewables is possible,[15] with a recent report from the Intergovernmental Panel on Climate Change estimating that 77% of total energy could come from renewables by 2050.[16] The real issue is thus the political will to focus on renewables and the efficient use of energy, rather than diverting yet more resources to nuclear.

Many countries have already made up their minds. Within Europe, Austria, Denmark, Portugal, Ireland, Norway, and Greece are among those who have never had nuclear plants and remain opposed to the technology, while some others, including Spain, Switzerland and Italy, are implementing phase-outs.[17] Spain already had a nuclear phase-out policy before Fukushima, although it had to some extent stalled. However, major protests there are providing new impetus. This summer the Swiss government decided to abandon a nuclear plant replacement programme, so in effect nuclear power will be phased out by 2035. Italy voted in a referendum in 1987, after the Chernobyl disaster, to close its existing nuclear power plants, but the government had recently pushed ahead with legislation enabling new build to start. However, after Fukushima, public disquiet mounted and the government reverted to a 'no nuclear' policy, with a referendum producing a staggering 94% opposed to nuclear power.

In Sweden, which had recently reversed its nuclear phase-out policy, opposition rose after Fukushima, with 51% opposed to nuclear power.[18] Meanwhile, Finland is still facing major delays and cost overruns in the construction of its new nuclear plant at Olkiluoto.

Even traditionally pro-nuclear France is now wobbling. The new plant under construction at Flamanville has been further delayed as a new safety review is undertaken, while opposition to nuclear power rose to 67% according to an Ipsos-Mori poll in May.[19] The government recently announced that it would carry out a major review of energy policy, which would even include the option of a nuclear phase-out by 2050.[20]

In the USA, support has also collapsed. 71% had favoured nuclear power, according to a survey for the Nuclear Energy Institute carried out before Fukushima, but afterwards support fell to 39%, with 52% opposed, according to the Pew Research Center.[21]

In Asia, Thailand and Malaysia have both abandoned their nuclear programmes, while the Philippines government may 'rechannel' its £100m nuclear budget to renewables.[22] China has halted all new nuclear development projects, pending a review. It should perhaps be noted that China's renewables programme was already much larger than its nuclear programme. It is now the world leader in wind, with 45GW in place, and gets 16% of its electricity from renewables, with plans for massive expansion.[23] It was aiming to get 15% of its total energy (not just electricity) from renewables and other low carbon sources by 2020, whereas it was only planning to expand nuclear from the current 2% of electricity to 4% by 2020 – and that may now change. It has already indicated that it may double its solar PV targets.[24]

India is still pressing ahead with plans for nuclear expansion, although there has been strong opposition. Violence recently erupted at a demonstration against the proposed Jaitapur nuclear power plant, and a protestor died. Russia is also sticking with nuclear power come what may, as are some former Eastern-bloc states.

What about the UK? With some public opinion polls suggesting that roughly equal numbers are for and against, there are still proposals for the largest nuclear new build programme in Europe. This is in a country with some of the world's best renewables resources – most of which are so far untapped. However, city analysts have been scathing about the prospects for new nuclear investment in this country,[25] arguing that the government is being very optimistic. The Scottish government is taking a very different line to Westminster, opting for a new target to generate 100% of its electricity demand from renewable sources by 2020, with no new nuclear.[26]

The nuclear renaissance is looking decidedly shaky.

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