Nuclear Power in Germany

- **Germany until March 2011 obtained one quarter of its electricity from nuclear energy, using 17 reactors.**
- **A coalition government formed after the 1998 federal elections had the phasing out of nuclear energy as a feature of its policy. With a new government in 2009, the phase-out was cancelled, but then reintroduced in 2011, with eight reactors shut down immediately.**
- **Public opinion in Germany remains ambivalent and at present does not support building new nuclear plants.**

Germany is one of the biggest importers of gas, coal and oil worldwide, and has few domestic resources apart from lignite and renewable.

The country's 17 operating nuclear power reactors, comprising 15% of installed capacity, supply about 28% of the electricity (133 billion kWh net in 2010). The last unit came into commercial operation in 1989. Six units are boiling water reactors (BWR), 11 are pressurised water reactors (PWR). All were built by Siemens-KWU. A further PWR has not operated since 1988 because of a licensing dispute.

Responsibility for licensing the construction and operation of all nuclear facilities is shared between the federal and Länder governments, which confers something close to a power of veto to both.

Germany has about one third of Europe's installed wind generating capacity, amounting in 2008 to about 17% of its total capacity. This provided 6.4% of the electricity then.

German nuclear power units

Plant	Type	MWe (net)	Commercial operation	Operator	Provisionally scheduled shut-down 2001	2010 agreed shut-down	March 2011shutdown & May closure plan
Biblis-A	PWR	1167	2/1975	RWE	2008	2016	yes
Neckarwestheim-1	PWR	785	12/1976	EnBW	2009	2017	yes
Brunsbüttel	BWR	771	2/1977	Vattenfall	2009	2018	yes
Biblis-B	PWR	1240	1/1977	RWE	2011	2018	yes
Isar-1	BWR	878	3/1979	E.ON	2011	2019	yes
Unterweser	PWR	1345	9/1979	E.ON	2012	2020	yes
Phillipsburg-1	BWR	890	3/1980	EnBW	2012	2026	yes

Sources: WNA website, *Nuclear Engineering International, Feb 1996; July 2004; NEI World Nuclear Industry Handbook 2004; IAEA 2003, Country Nuclear Power Profiles. Bundesnetzagentur, May 2011,*

Plant	Type	MWe (net)	Commercial operation	Operator	Provisionally scheduled shut-down 2001	2010 agreed shut-down	March 2011shutdown & May closure plan
Krummel	BWR	1260	3/1984	Vattenfall	2016	2030	yes
Total shut down (8)		**8336**					
Grafenrheinfeld	PWR	1275	6/1982	E.ON	2014	2028	2015
Gundremmingen-B	BWR	1284	4/1984	RWE	2016	2030	2017
Gundremmingen-C	BWR	1288	1/1985	RWE	2016	2030	2021
Gröhnde	PWR	1360	2/1985	E.ON	2017	2031	2021
Phillipsburg-2	PWR	1392	4/1985	EnBW	2018	2032	2019
Brokdorf	PWR	1370	12/1986	E.ON	2019	2033	2021
Isar-2	PWR	1400	4/1988	E.ON	2020	2034	2022
Emsland	PWR	1329	6/1988	RWE	2021	2035	2022
Neckarwestheim-2	PWR	1305	4/1989	EnBW	2022	2036	2022
Total operating (9)		**12,003**					
Total (17)		20,339 MWe					

NB. The 8 shut-down reactors are not yet defueled, nor decommissioned and written off by their owners.

Nuclear power policy

German support for nuclear energy was very strong in the 1970s following the oil price shock of 1974, and there was a perception of vulnerability regarding energy supplies. However, this policy faltered after the Chernobyl accident in 1986, and the last new nuclear power plant was commissioned in 1989. Whereas the Social Democratic Party (SPD) had affirmed nuclear power in 1979, in August 1986 it passed a resolution to abandon nuclear power within ten years. *(But not actually abandoned in ten years)*

In October 1998 a coalition government was formed between the Social Democratic Party (SPD) and the Green Party, the latter having polled only 6.7% of the vote. As a result, these two parties agreed to change the law to establish the eventual phasing out of nuclear power.

Sources: WNA website, *Nuclear Engineering International, Feb 1996; July 2004; NEI World Nuclear Industry Handbook 2004; IAEA 2003, Country Nuclear Power Profiles. Bundesnetzagentur, May 2011,*

Long drawn-out "consensus talks" with the electric utilities were intended to establish a timetable for phase out, with the Greens threatening unilateral curtailment of licenses without compensation if agreement was not reached. In June 2000 a compromise was announced which saved face for the government and secured the uninterrupted operation of the nuclear plants for many years ahead. The agreement, while limiting plant lifetime to some degree, averted the risk of any enforced plant closures during the term of that government.

The agreement was a pragmatic compromise which limited political interference while providing a basis and plenty of time for formulation of a national energy policy. An industry leader reminded his government that "Reliable and cost-effective energy supply must remain an important component of German economic policy". Some speculation centred on the future of the agreement and the revised Atomic Energy Act which followed it under any new government. Parliamentary opposition party leaders said that they would reverse the decision when they could*.

* A major element in the federal government's war of attrition through 1999-2000 against the nuclear utilities was a law retrospectively to tax funds amounting to DM 50 billion which have been contributed by electricity users and set aside in trust as provision for waste management, decommissioning nuclear power plants and rehabilitating lignite mines. Early in 1999 industry promptly served notice that this would be vigorously contested as "a blatant breach of German constitutional rights and legal principles", as depletion of these funds by some DM 25 billion through the tax will leave future generations liable for much of the future costs. However, despite a scathing attack on it by the Chancellor, Mr Schroeder, in cabinet, the tax measure was approved by the upper house on the last day that the new coalition enjoyed a majority there.

The Federal Ministry of Economics & Technology (BMWi) implements national energy policy.

Utilities wanted to extend the lifetimes of all 17 reactors initially to 40 years (from average 32 years) and then individually seeking extensions to 60 years as in the USA.

The new Christian Democrat (CDU) and Liberal Democrat (FDP) coalition government elected in September 2009 was committed to rescinding the phase-out policy, but the financial terms took a year to negotiate.

In September 2010 a new agreement was reached, to give 8-year licence extensions (from 2001-agreed dates) for reactors built before 1980, and 14-year extensions for later ones. The price exacted for this was several new measures: a tax of EUR 145 per gram of fissile uranium or plutonium fuel for six years, yielding EUR 2.3 billion per year (about 1.6 c/kWh), payment of EUR 300 million per year in 2011 and 2012, and EUR 200 million 2013-16, to subsidise renewables, and a tax of 0.9 c/kWh for the same purpose after 2016. However, utilities may reduce their contribution to renewables if safety upgrades to particular individual nuclear plants cost more than EUR 500 million. At the end of October these measures were confirmed by parliamentary vote on two amendments to Germany's Atomic Energy Act, and this was confirmed in the upper house in November.

All these arrangements were thrown into doubt when in March 2011 the government declared a three-month moratorium on nuclear power, in which checks would take place and nuclear policy

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would be reconsidered. Chancellor Angela Merkel decreed that the country's nuclear power reactors which began operation in 1980 or earlier should be immediately shut down. Those units then closed and were joined by another unit already in long-term shutdown, making a total of 8336 MWe offline under her direction, about 6.4% of the country's generating capacity.

Then on 30 May 2011, after increasing pressure from anti-nuclear federal states, the government decided to revive the previous government's phase-out plan and close all reactors by 2022 but without abolishing the fuel tax, thus reneging on the new fuel tax trade-off. The Bundestag passed the measures by 513 to 79 votes at the end of June, and the Bundesrat vote on 8 July confirmed this.

This leaves the eight oldest reactors closed, and will result in the remaining nine closing by the end of 2022. **France, Poland and Russia (Kaliningrad) are expecting to increase electricity exports to Germany, mostly from nuclear sources, and Russia is expected to export significantly more gas.**

The country's four nuclear power utilities are pressing claims for compensation and in particular are suing the government over continuing with the nuclear tax introduced in relation to the 8- and 14-year licence extensions agreed in September 2010. **The German government appears to be facing claims of over EUR 10 billion.**

Bundesnetzgentur Report

The German federal network agency and grid authority, Bundesnetzagentur, reported at the end of May 2011 on the implications of plans to close down nuclear generation. "The historically singular simultaneous shutdown of power plants amounting to 5,000 MW capacity and the long-term lack of some 8,500 MW capacity bring the transmission grids to the edge of their resilience." Consequently there are many hours in which secure network operation is impossible, meaning that it is vulnerable to a single failure. "As a consequence, the original objective of competition-driven market results is replaced by a more or less centrally controlled planning approach. This is dubious in terms of energy economics, economically inefficient and ecologically harmful, but must be accepted for a transitional period and is unavoidable at the moment." Reserve capacity is fully utilised, no buffer is left, and "For this reason the risk of non-controllable network disturbances is increasing distinctly." The summer "risk will increase markedly during the winter semester due to higher load on the network linked to higher domestic and foreign power demand and significantly lower PV generation."

While PV and wind together sometimes contribute up to 28 GW, "leading to a manageable network situation" during favourable spring weather conditions, it is evident "that this capacity is not available in a reliable manner, but regularly disappears completely." Also, "The changed network load pattern due to the shutdown of the 7+1 nuclear power plants has already led to postponements of scheduled service and maintenance works in the transmission grid, because many such works can only be undertaken when there is little or no load." This has obvious implications for reliability. "Maintenance work at transformer station Großkrotzenburg, a major north-south network node close to Frankfurt, for instance, had to be postponed because the

Sources: WNA website, *Nuclear Engineering International, Feb 1996; July 2004; NEI World Nuclear Industry Handbook 2004; IAEA 2003, Country Nuclear Power Profiles. Bundesnetzagentur, May 2011,*

relevant circuits are indispensable." Bundesnetzagentur warns of very uncertain supply situations likely over winter, especially in southern Germany, along with increased costs. **In case of a permanent shutdown** of the eight nuclear reactors affected by the moratorium, **Germany can no longer support security of supply in the European interconnected grid to the extent it has done so far.** Hence the German situation has implications much more widely in Europe, as the country becomes a net importer of power rather than major exporter, and grid stability is the other major concern along with generation and transmission capacity.

In September 2011 the government's continuing tax on nuclear fuel was rejected by the Hamburg Tax Court. The Court expressed "serious doubt" that the nuclear fuel tax was compatible with the German constitution. It granted a request from E.On to refund some €96 million, and nuclear fuel tax collections are to be suspended. The first lawsuit was from EnBW, which paid the tax when it refuelled a reactor in July and quickly launched legal action, claiming the tax was unconstitutional and contrary to EU law. The court's judgement said that the tax does not qualify under the constitution as a consumption tax, and anyway those should not be applied to single-purpose supplies like nuclear fuel. The court took its decision based on these constitutional points and did not consider other areas the utility had contested: whether the tax violated equality laws or EU directives on taxation.

Apart from contesting the fuel tax, all the nuclear generators are seeking compensation for the effective confiscation of generating rights from the eight reactors ordered shut after Fukushima, despite safety assurances from the regulator.

Economic and CO2 implications of nuclear policy changes

Fuelling the earlier dispute within the grand coalition government then in power, a January 2007 report by Deutsche Bank warned that Germany will :

- **miss its carbon dioxide emission targets by a wide margin,**
- **face higher electricity prices,**
- **suffer more blackouts and**
- **dramatically increase its dependence on gas imports from Russia as a result of its nuclear phase-out policy, if it is followed through.**

Meanwhile Germany spends some EUR 2.5 billion per year subsidising its coal mines to produce 55% of its electricity (cf nuclear 31% with no subsidy). Brown coal produces about 1.25 tonnes of carbon dioxide per MWh. Arising from the Kyoto accord, and as part of the differentiated EU "bubble", Germany is committed to a 21% reduction of greenhouse gas emissions by 2010.

In May 2007 the International Energy Agency warned that Germany's decision to phase out nuclear power would limit its full potential to reduce carbon emissions "without a doubt." The agency urged the German government to reconsider the policy in the light of "adverse consequences."

Sources: WNA website, *Nuclear Engineering International, Feb 1996; July 2004; NEI World Nuclear Industry Handbook 2004; IAEA 2003, Country Nuclear Power Profiles. Bundesnetzagentur, May 2011,*

If Germany were to continue with its nuclear phase-out policy and maintains carbon emission reductions, by about 2020 it would need to import some 25,000 MWe of electricity as base-load. The country already has significant interconnection with **France, Netherlands, Denmark, Poland, Czech Republic and Switzerland**.

This would put Germany in 2020 in much the same position as Italy today, being dependent on neighbours for electricity (**which would be mostly nuclear**) and a price-taker.

Germany's decision to shut its nuclear plants will, despite its massive investment in new renewables, create an extra 300 million tonnes of CO2 to 2020 from increased fossil fuel use. That will virtually cancel out the 335 Mt savings intended to be achieved in the entire European Union by the 2011 Energy Efficiency Directive from the European Commission.

Sources: WNA website, *Nuclear Engineering International, Feb 1996; July 2004; NEI World Nuclear Industry Handbook 2004; IAEA 2003, Country Nuclear Power Profiles. Bundesnetzagentur, May 2011,*