



Germany, Fukushima and global nuclear governance

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The international order for nuclear technology and materials is based on a myth and is in urgent need of a complete overhaul. Contrary to the premises of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and in particular its third pillar (Article IV), which is concerned with “inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes,” there is no commercial legitimacy for so-called “civilian” nuclear programs.

Nuclear power has no business case. There never was one, and most likely there never will be. Economists and energy managers know there are less costly and less risky ways to ensure electricity supply than using nuclear power. Nuclear engineers and managers in the sector are either blind to the real costs and risks, or cynical in their pursuit of subsidies and other privileges to continue their trade. At the same time, international lawyers and negotiators ignore these facts and instead believe in some distinction between military and “civilian” nuclear technology. They work on the basis of an

assumed and legally construed legitimacy of the pursuit of civilian nuclear technology, notably of nuclear power.

Governments in most countries and all relevant international institutions are now locked into path dependencies created by institutional statutes or remits, or by negotiation dynamics. They are thus unable to address the nuclear security policy dilemma, with its manifest contradictions. As a consequence, the world faces a high and rising security policy price for the careless proliferation of nuclear technology. The spreading of knowledge, equipment and materials exacerbate the risks emanating from rogue states and non-state actors, including nuclear terrorists.

This state of affairs has become obvious and been brought into focus by the confluence of:

- The long-standing policy of Germany to phase out nuclear power and shift towards renewable energy.
- The 2011 nuclear disaster in Fukushima and subsequent energy policy shift in Japan.
- The failure to stop Iran's aggressive and destabilizing nuclear weapons program, and concerns about nuclear weapons held by Pakistan given its rising militancy and risk of instability.

Against this background, this essay sketches the emergence of Germany's nuclear phase-out and its shift to green power, explains the consequences for energy policy in Germany and the European Union, and explores some of the possible consequences for European and global nuclear governance.

A tale of three countries: Germany, the US and Japan

The future of nuclear power died in Germany with the catastrophe in Chernobyl in 1986. But before then, Germans played an important role in its development. Scientists including Werner Heisenberg, Otto Hahn, Lise Meitner, Fritz Strassmann, Ida Noddack, Carl Friedrich von Weizsäcker, as well as Albert Einstein, laid theoretical foundations and moved theory to laboratories and work benches. Lise Meitner's nephew Otto Frisch emigrated via Britain to the United States and brought German knowledge into the Manhattan Project, building the first atomic bombs, which the US detonated over Hiroshima and Nagasaki. Pride and guilt shape the memory of Germany's role in the early years of nuclear technology.

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After World War II, the US not only continued its nuclear weapons program but initiated a nuclear arms race that was one of the key facets of the Cold War. President Dwight D Eisenhower, realizing the unethical nature of the enterprise, needed a civilian veil over the nuclear program and a way to redeem the evil it had brought into the world over Japan. His 1953 speech "Atoms for Peace" to the United Nations presented a program for expanding

the “peaceful” use of nuclear technology, while at the same time preparing US allies – and her enemies – for the shift from conventional arms to nuclear weapons.

“Atoms for Peace” established the vectors of nuclear proliferation that enabled other countries to develop their own nuclear programs, from Russia and France to Pakistan, Iran and North Korea. Germany and Japan stood apart and remain special cases to this day. As aggressors of the war, they foreswore nuclear weapons (with which they would not have been entrusted anyway), but both became nuclear technology providers with a focus on civilian uses. Japan maintains, as is widely understood, capabilities and stockpiles so that she can avail herself of nuclear weapons within months in case the protective umbrella should be withdrawn by the United States.

Germany, as a member of NATO and the EU, with nuclear-armed France and Britain as neighbors, has no such need. Germany is today the “most civilian” of the significant nuclear technology providers and, reflecting this, the links between the industry and the national security establishment are weaker and different from those in, say, the US, France, Britain, China or Russia. Opposition to nuclear power cannot, in the German context, be construed as sedition or attacked as unpatriotic (as it is in France, for instance), and this provided the antinuclear movement in Germany with more political space than in other comparable countries. The fact that Germany was a presumed nuclear battlefield in most scenarios about Cold War confrontation ensured that Germany – East or West – never learned to “love the bomb.”

‘Nein’ to nuclear

In the 1950s, Germany was under the illusion that nuclear power would be a safe source of energy and fountain of peace and prosperity. The country is a founding member of the Euratom Treaty, Europe’s quasi-constitutional commitment to subsidize nuclear power, signed in March 1957, the year of the nuclear catastrophes in Windscale, Britain, and at the Mayak reactor near Kyshtym in the Soviet Union.

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In the 1970s, local opposition to a planned reactor in Wyl, in the southwestern state of Baden-Württemberg bordering Switzerland, not only stopped construction but also provided the nucleus for an increasingly knowledgeable, organized and influential antinuclear environmental movement. Germany’s first Green Party minister-president, Winfried Kretschmann, runs the state today, and the movement has gone into business developing renewable energies to displace nuclear and fossil energy. While the 1979 incident at the Three Mile Island reactor in Pennsylvania had an impact on the industry in the US, the 1986 Soviet catastrophe in Chernobyl, in present-day Ukraine, again focused German minds on the need to invest in “anything but nuclear.” To this day, radioactive pollution levels

caused by the Chernobyl tragedy are such that the berries and mushrooms collected, and the venison and wild boars hunted in parts of Germany, are unsafe to eat.

Since 1990, Germans have known what they want, and they have a law to make it happen. Influential, land-owning and politically conservative owners of hydropower dams in Germany's South obtained a federal law mandating that power utilities buy renewable electricity from them at stable rates. The German Power Feed-in Law (*Stromeinspeisegesetz*) is the achievement of an early alliance of conservative and progressive – or “green” – political forces. It accelerated the shift in German power generation towards renewable energy sources in a way that provided the stimulus for the development of a global industry, which other countries can now draw on in their own transition towards green and clean energy.

The debate about the future of nuclear power in Germany appeared settled when, in 1999 and 2000, the red-green federal government consisting of the Social Democratic and the Green parties negotiated a phase-out of nuclear power with the industry and upgraded the *Stromeinspeisegesetz* to become the Renewable Energy Act (*Erneuerbare-Energien-Gesetz*, or EEG). The much-copied law provided priority access to the grid for power from renewable sources, and stable rate support.

Under the negotiated phase-out, nuclear power plant operators were guaranteed residual operating time for each of their plants, roughly in line with their respective age and safety standard. Newer plants could run longer than older ones so that the power sold to the market would be

sufficient to cover the depreciation of the financial assets and allow operators to set aside sufficient reserves for decommissioning and legacy costs. The deal was crafted to avoid “expropriation in kind” (through regulatory action), which also meant that regulators could not demand safety retrofits at the expense of operators. Residual running time could be transferred from older plants, which presented the highest-risk profile, to new plants, were regarded as less unsafe, in “trades” that allowed operators to consolidate operating time for economic gain. The end of the nuclear age in Germany would have come sometime between 2021 and 2023, depending on the rate of power production during the two decades of the phase-out.

Since the 1980s, renewable energy and energy-efficient technologies were developed, building up, layer by layer the industrial base for a great energy transformation. This process included the definition of new professions and the establishment of new education and training programs for the industry, and was driven not only by misgivings about nuclear power, but also, later on, by concern about climate change. Today, the positive vision is one of a smart power grid with a mixture of large and small distributed renewable power plants, load-based tariffs stimulating demand response, and dynamically efficient feed-in from dispatchable generators and combined heat and power plants. Electricity would be stored in car batteries and stationary batteries connected to the grid, as well as in pump storage behind hydropower dams. The production of biomass for conversion into solid, liquid and gaseous fuels for storage, and later for conversion to (heat and) power when demand was high, is the most

economically and technologically dynamic sector today.

“Ja” to renewable energy

In a heavily industrialized nation of approximately 80 million people, renewable energy sources generated about 25 percent of Germany's power in the first half of 2012, up from 20.8 percent from the same period in 2011. The industry employed about 381,600 workers as of 2011 at various skill levels throughout the country including in rural areas, and in 2011 invested about 21 billion euros (\$26.4 billion) in new power plants (plus just under another 3 billion euros in other renewable energy plants). The industry's turnover (from energy sales) in the same year was more than 13 billion euros, and its dependable growth helped Germany weather the economic crisis of 2008-2009 better than other nations.

Households and small businesses pay the main stimulus (the Feed-In Tariff) through their electricity bills. The businesses and employees of the sector pay taxes and social security charges, making Germany's renewable energy policy fiscally positive, an advantage at times of general fiscal constraint in Europe. Renewable power and, to a lesser extent bio-fuels, substitute imports of energy (coal, oil and gas), which contributes to Germany's strong trade balance while reducing the strategic economic dependency on energy suppliers. Invention, innovation and business creation continue; even if photovoltaic panels are now imported from China, the machines for making them are still engineered and manufactured in Germany and configured and assembled on site in China by German companies and personnel.

As a consequence, clear majorities of Germans across the political spectrum generally support the nuclear phase-out and shift towards green power. Conservative forecasts of future developments in Germany indicate that 35 percent renewable power is achievable by 2020, 50 percent by 2030 and 80 percent by 2050. (Given that 25 percent of our power came from renewable energy sources in the first six months of 2012, and that the year-on-year change was up 5 percentage points, a target of 35 percent in 2020 looks timid.) These percentages are to be achieved essentially without demand response or measures to stimulate demand flexibility. More ambitious but still entirely possible scenarios show that 100-percent renewable power can be reached by 2050, possibly even earlier if the shift to electric mobility accelerates and provides massive additional storage capacity to even out variations in power supply and demand.

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It is dawning on the German public that the cotransformation of the power and transportation systems, where the large aggregate capacity of car batteries compensates for the predictable variations in wind power, will be easier and cheaper than separate reforms of each sector on its own. The price of electric cars made from light material is likely to come down even

faster than that of solar panels, and within a few years could fall well below the cost of current cars based on oil and steel, which need high maintenance. Indeed, concerns are emerging that the new individual mobility with electric cars will be so much cheaper that the shrinkage of the after-sales service and maintenance industry, and the business closures and job losses to be expected, may happen quite quickly and might turn out politically difficult to manage. However, Germany is suffering from a skills shortage in a number of sectors and regions, so the economy as a whole would benefit from such a development, as it would free up highly skilled technicians that are needed in other sectors, including renewable energy and the smart grid.

The parasitic nature of nuclear power and its security policy price

Contrast this with the history of outright and hidden subsidies for the nuclear industry: in research, development, and training; through cheap loans and loan guarantees for investment; government support for managing the fuel cycle and storing nuclear waste; and by society and future generations bearing the legacy costs and the catastrophic risks of nuclear technology. The economic case for nuclear power is dismal, as studies show in Germany as well as the US and Britain, where the French state-owned *Electricité de France* is currently negotiating a subsidized long-term price from new nuclear plants that is significantly higher than the current market price for power, and higher than the cost of alternative supply from renewable sources.

If all of the risks and hidden costs were reflected in the price of nuclear power, not

one plant would run; the cost of insurance for catastrophic losses alone would ensure that even existing nuclear power plants would be taken off the grid. This is true anywhere in the world, including in countries with strong state involvement in the power industry, such as France, China and Russia. In addition to the outright economic costs, there is also a security policy price for nuclear power. The non-proliferation treaty provides a civilian veil for military nuclear weapons programs. The link from nuclear power to the proliferation of nuclear technology and materials to rogue states and potentially nonstate terrorist groups is not new, but with recent events, for example, in Pakistan, North Korea and Iran, it is attracting renewed attention.

Given these facts and arguments, it is not surprising that not only the German public is opposed to nuclear power – over the years, opposition rarely fell below 70 percent in opinion polls. Most business owners and managers in Germany's *Mittelstand*, the often family-owned small and medium-sized businesses that are the backbone of the economy and technology development, not only share in the dislike of nuclear power but also in the mistrust of monopoly powers that the four big operators of nuclear power plants enjoy. A clear majority of government employees with academic degrees is solidly against nuclear power. The current German federal government also misread elite opinion when it unnecessarily extended the running time of existing nuclear plants in September 2010.

The decision to extend the running time of existing nuclear power plants was perhaps the most surprising event in Germany's energy policy over the past 40 years. The period was marked by great continuity of



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purpose and practice in the implementation of policy, irrespective of the composition of the federal government, or any state-level or Land government during that time. A member of the ruling conservative coalition, Josef Göppel, said when he voted against the party line that the extension of nuclear power carried the seed for the electoral demise of the ruling parties, notably his Christian Social Union in Bavaria, and the Christian Democrats in the rest of Germany. After Fukushima, his comment seems prescient, but even before the accident, the public anger about, and elite opposition to, nuclear power was high.

Fukushima and the endgame over nuclear power in Germany

The tragic but “normal accident” in Fukushima started the fight to end nuclear power that is currently underway in Germany. Given the continued need for subsidies, the need for secrecy and the lack

of transparency, the treatment of critics and victims of nuclear power, and its accidents in Germany and abroad, it is entirely rational for German voters, taxpayers and utility customers to demand a phase-out of nuclear power, and to switch to suppliers of renewable power in the thousands every week.

The forces opposing the great energy shift in Germany – the die-hard protagonists of nuclear power – are diminishing in number but still large in voice, finance, influence and access to political power. They are motivated partly by economic interests, for a number of them benefit from the subsidies going their way, but partly also by a fear of the future energy supply structure that they cannot or do not want to comprehend. The digital generations born after the Internet may have no difficulty envisioning a marriage of the power grid with modern communication and signal-processing technologies to produce a self-stabilizing grid with distributed generation

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and storage, and they see how load-based tariffs can stimulate demand response to cope with the variations of renewable supply. Older folks and mentally conservative people may fear innovations and change they do not understand.

The German issue in world markets and global nuclear governance

What might be the international consequences of Germany ending nuclear power? Other nations are also pulling back or at least taking the time for a rethink. The Swiss government aims for a slow phase-out but political dynamics may hasten the end. In a referendum in mid-June 2011, the Italian electorate voted overwhelmingly to end Italian Prime Minister Silvio Berlusconi's nuclear ambitions, with a majority of about 95 percent through a record turn-out of around 55 percent.

Belgium is now implementing a phase-out originally decided in 2003 but not acted upon at that time, and was forced to take an aging reactor off the grid for fear that metal fatigue may have weakened it. This finding may hasten the shutdown of reactors in other countries, such as Spain and the US, which have installed reactors of the same model. The new French government aims to close its 24 oldest nuclear reactors by 2025 and reduce the share of nuclear power from 75 to 50 percent (or probably

less). The Czech Republic scrapped plans to build 12 plants, but for the time being still wants to go ahead with two projects. In an age of fiscal austerity, however, it will be increasingly difficult to provide the state aid necessary to make nuclear power competitive as, for instance, the Bulgarian decision to abandon a new nuclear plant construction has shown.

Other EU countries, such as Sweden or the Netherlands, may soon join the general European phase-out. In fact, a majority of EU member states will soon have no nuclear power or a clear phase-out policy, and nuclear power is increasingly blocked and on the way out around the world, from Peru to Thailand, from Bangladesh to American utilities.

Japan also ended nuclear power because of the earthquake that crippled Fukushima and the risk of future earthquakes. As nuclear power plants came up for periodical inspections and relicensing every 13 months, regulators in Japan ordered a halt of operations. This forced utilities to rely on dirty power produced from coal and oil in old industry-owned power plants that were taken out of service and "mothballed" years ago but were brought back on line to stabilize the power grid after Fukushima. Japanese power utilities also invest in quick-to-build gas-fired power plants and gas-handling infrastructure such as LNG terminals. The Japanese race to gas is a challenge in the short run, but Japan will

then have a good proportion of responsive gas power to run alongside variable renewable generators. Japan already has a high number of electric hybrid cars with batteries that can help stabilize the grid.

Germany now finds herself in a competitive innovation race with Japan as both nations will test and extend the capacity, flexibility, reliability and resilience of their power grids. More sophisticated smart-grid energy management systems will be developed for high-voltage transmission, low-voltage distribution and anything in between. Germany and hopefully Japan will most likely demonstrate practical ways to achieve the shift to fully renewable energy supplies, as well as show the economic development opportunities associated with that transition. The example will strengthen those who argue for nuclear phase-out in other nations, and erode the arguments of those still clinging to nuclear power.

The future of the Euratom, IAEA and NPT regime

Germany, being the largest net contributor to the EU budget, pays the largest share in the funds of Euratom and thus subsidizes nuclear power in other EU states. That is unlikely to continue long into the future. German industry, fearing competitive disadvantages when other EU member states continue to receive aid for nuclear power, might ask for anti-state aid disciplines to be applied. These disciplines are meant to avoid distortions in competition in the European market, and can be applied beyond the EU to neighboring states participating in the European Internal Market generally or just in the area of grid-bound energies, namely

electricity and gas.

Think about it: how will future German governments explain to their voters and electricity customers that Germany is phasing out nuclear power, but at the same time contributing German taxpayer money to subsidize the nuclear power industry in other EU countries? How will German industry react when subsidies and privileges in other neighboring countries reduce the competitive position of German businesses? Expect the pressure to grow for Germany to leave the Euratom Treaty, or, as that is unlikely to succeed, work towards the treaty's repeal.

There has been an inconclusive debate about whether or not the nuclear phase out in Germany should be enshrined in the nation's constitution, the Basic Law. This debate ran out of steam, perhaps because changing the constitution and thus putting an end to a decade-long grand societal conflict was regarded as a symbolic move, not fitting for a time when concrete, actionable decisions were needed to shape the future. Perhaps the debate will pick up again as Germans realize that their domestic nuclear phase-out marks the start of a constitutional debate over the Euratom Treaty within the European Union. Germany's hand would be greatly strengthened by a clear, constitutional commitment to correct the historical mistake of investing in nuclear power technology.

There are international treaties and institutions governing the proliferation of civilian nuclear technology, while hoping to avoid the proliferation of nuclear weapons capability. They also limit the (international) liability for damages to third parties in case of nuclear accidents to specific entities

(operators) and amounts. In essence, they protect the nuclear industry from claims and leave the burden of coping and paying compensation to the taxpayers of the states and communities where the damage occurs. A public admission that nuclear power is not economically feasible and even after 60 years of development still relies on subsidies, and that it is so risky that adequate third-party liability insurance for damages cannot be obtained other than in the form of government assistance, would destroy any remaining legitimacy of these treaties and institutions and hasten their abolition and replacement with regimes that assist countries in coping with the legacy of the nuclear age.

That would increase pressure to change the remit and statutes of the International Atomic Energy Agency (IAEA), perhaps even spur calls to disband it since it has lost so much of its credibility in recent years. The context for reviewing the Non-Proliferation Treaty is likely to change as well. With the civilian economic veil removed from

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nuclear weapons programs, controls on the export and trade of nuclear technologies and materials and inspections of nuclear sites anywhere in the world might soon be strengthened. The IAEA, imbued with a pro-proliferation culture, is not a suitable institution to assist countries in phasing out nuclear power.

Economics, risk assessments, security policy considerations, as well as general principles of good government all tell us that nuclear power must be ended as soon as possible. Germany will show how and how fast the shift to renewable energy can be achieved, and thereby how soon the nuclear endgame can be concluded.