

The Ethics of Nuclear Energy: Germany's Energy Politics after Fukushima

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I. Introduction: Nuclear Energy Policy in Japan and Germany after WWII

At a time when Japan is debating the future of its nuclear industry, it is very interesting to think about why Germany has fought so hard against nuclear energy. It was not Germany but Japan that experienced the dropping of atomic bombs on Hiroshima and Nagasaki; fallout from a hydrogen bomb test in the Bikini atolls that exposed the crew of the fishing boat, the Daigo Fukuryū Maru (Lucky Dragon No. 5), to harmful radiation levels; the criticality accident at the Tokaimura uranium processing plant that led to the deaths of two workers; and, the explosions and core meltdowns at the Fukushima Daiichi Nuclear Power Plant that resulted in the evacuation of tens of thousands of individuals.⁽¹⁾

Germany like Japan invested heavily in nuclear energy and in the 1960s and 1970s looked toward nuclear energy as a modern electricity source. Atomic energy was seen as a potentially almost endless energy source that would meet

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- (1) There is an exhibition in Tokyo of the Daigo Fukuryū Maru, see df5.org. An English synopsis of what happened can be found at American University, TED Case Study No. 310, Lucky Dragon Incident, <http://www1.american.edu/TED/LUCKY.HTM>. A review of the Tokaimura nuclear accident is available from the United States Nuclear Regulatory Commission Division of Fuel Cycle Safety and Safeguards Office of Nuclear Material Safety and Safeguards, "NRC Review of the Tokai-Mura Criticality Accident," April 2000, <http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2000/secy2000-0085/attachment1.pdf>.
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the rapidly growing economy's hunger for electricity. A strong nuclear industry supported by academic researchers and the political establishment took root and Germany became a leading producer of nuclear energy and exporter of nuclear energy equipment. The nuclear accidents at Three Mile Island (1979), Chernobyl (1986), and Fukushima (2011), however, each began to eat away at this support as larger and larger percentages of the population began to question the economic, environmental, and ethical dimensions of nuclear energy.

II. The Atoms for Peace Initiative

In Germany, prior to and during World War II there were efforts to unlock the secrets of atomic energy and to build a nuclear bomb, an effort which failed because many of the country's best scientists were lost to the war. In the closing months of World War II, Germany was heavily bombed. By the time the war ended, its industrial centers and major cities lay in ruins. Most Germans, and certainly the international community, wanted to make sure that Germany would never again launch an aggressive war. The horrors of the Holocaust and the millions of lives lost at war across the globe became a strong normative basis for the development of a strong peace movement in the country. The similarity with the efforts of the Occupation Forces to demilitarize and democratize Japan and the strong pacifist movements that emerged there are strong.

By the early 1950s, the Cold War between the Soviet Union and the United States and their respective efforts to develop nuclear weapons were leading to global concerns about further military uses of atomic energy. Worried about Soviet advancements as well as public fear of nuclear bombs, in 1953 Dwight D. Eisenhower delivered a speech before the United Nations in which he called for shifting research away from military uses of nuclear technologies to peaceful ones. The Atoms for Peace Initiative, the idea of pursuing atomic energy for peaceful economic and conventional energy production quickly captured attention. Under the initiative, the United States began to export nuclear technology and to cooperate with allies and potential allies in nuclear energy research and development. Its efforts to sell the idea of the peaceful use of

atomic energy were particularly intense in Japan. This was partly because of Japan's experiences with Hiroshima and Nagasaki as well as in an effort to quell the mounting wave of protests against nuclear bomb testing after the Daigo Fukuryū Maru was showered by radioactive fallout from U.S. nuclear weapons testing in the Bikini Atoll in 1954.⁽²⁾

The Atoms for Peace initiative is a remarkable example of how image transformations can work. The large-scale campaign to put a peaceful face on atomic energy was highly successful. Soon many countries, including Japan and Germany, were developing their own nuclear industries. Germany began with small experimental reactors in the 1950s, opened its first nuclear power station in 1962, and then over the next two decades built over 30 additional power plants. Nuclear energy was embraced by large parts of the population. Still, from the beginning there were voices raising questions about how nuclear waste was to be handled and arguing that civilian nuclear energy development could contribute to nuclear proliferation.

III. Anti-nuclear Movements and the Green Party

As more and more plans for nuclear power plants were drawn up, the public in Germany began to protest. The protests brought together hundreds and in some cases thousands or even tens of thousands of people. Some of the protest actions lasted for years. Many protesters were opposed to the building of nuclear power in their own backyards. Some argued against building nuclear power plants in anyone's backyard; their message was simply "no to nuclear power." One of the most important such early actions occurred in response to plans for a nuclear plant in the village of Wyhl in Baden-Württemberg. Anti-nuclear community activists won support from students, residents, and professionals in

(2) Peter Kuznick, "Japan's Nuclear History in Perspective: Eisenhower and Atoms for War and Peace," *Bulletin of the Atomic Scientist*, 13 April 2011; John Krige, "Atoms for Peace, Scientific Internationalism, and Scientific Intelligence," in John Kirge and Kai-Henrik Barth eds., *Global Knowledge Power: Science and Technology in International Affairs*, Osiris 21 (University of Chicago Press Journals, 2006) pp. 161-81.

nearby Freiburg and other communities in their efforts to block the beginning of construction. In a decade long process that involved the occupation of the construction site, law suits, international coalition building, the circulation of petitions, letters of concern expressed by evangelical priests, and election campaigns by anti-nuclear activists, the movement successfully blocked the construction plans for Wyhl. Nearby Freiburg, a university town, became an early leader in the introduction of renewable energy largely because in the end the nuclear power plant was not built and as a result alternative sources of energy had to be found. This action inspired other movements. Protest actions spread across the country; protestors and the police clashed, sometimes violently. There were large protests in Brokdorf (outside of Hamburg), Wackersdorf, Bonn, and Gorleben. While the protests failed to block construction in some places like Brokdorf, they succeeded in others, like Wyhl and Wackersdorf. German society became increasingly divided on the nuclear question.⁽³⁾

For the protesters, the government's use of force against them raised questions about the depth of German democracy and the willingness of the government to listen to the will of the people. The push by governments both at the state (*Länder*) and the national level to develop nuclear energy over the objections of the people alarmed many and planted some of the seeds that gave birth to the German Green Party. It may be one reason why grassroots democracy is so strong in Germany. Discussions began in society about who should have the right to decide what kind of energy was to be developed, who has the right to decide where facilities should be built, and what voice the people should have regarding the development of the energy and economic systems of

(3) On the anti-nuclear movement in Germany see Dieter Rucht, "Campaigns, Skirmishes and Battles: Anti-Nuclear Movements in the USA, France and West Germany," 1990. *Industrial Crisis Quarterly* 4, pp. 193-222; Dorothy Nelkin and Michael Pollak, *The Atom Besieged: Extraparliamentary Dissent in France and Germany* (Cambridge: MIT Press, 1981); Joachim Radkau, "Eine kurze Geschichte der deutschen Antiatomkraftbewegung," 11 November 2011, Bundeszentral für politische Bildung, <https://www.bpb.de/apuz/59680/eine-kurze-geschichte-der-deutschen-antiatomkraftbewegung?p=all>.

the country.⁽⁴⁾

One of the reasons why nuclear power is being phased out is because of the rise of the Green Party. In 1983, the Green Party for the first time entered the German parliament. With their political ascendancy, ethical discussions over the use of nuclear energy and society's responsibility to protect the planet and consider what kind of earth we are leaving behind for our children became increasingly common place.

The electoral success of the Green Party certainly came as a shock to established politicians. Whereas the normal dress code in the Bundestag (the parliament) consisted of dark suits, the newly elected Green parliamentarians had long hair and wore jeans and sweaters. There were also many women among them as the party's rules were based on gender equality and electoral seats were divided evenly between women and men (with the first seat always going to a woman). One of the party's leaders, Petra Kelly, put flowers on the desk in front of her seat—to symbolize nature, but perhaps also to urge a change in the culture of the Bundestag by bringing women's voices and views into view.

The Green Party addressed four primary issues: anti-nuclear energy, environmental protection, women's rights, and peace. Thus, concurrent with the anti-nuclear protests, questions were asked about the relationship of Germany to NATO and the United States.⁽⁵⁾ This stemmed from the Cold War politics of the time and concerns with United States' plans to station long range cruise missiles pointed toward the Soviet Union, on German soil. The arms race between the Soviet Union and the United States had many Germans concerned about being

(4) For a series of photos of the anti-nuclear protests in Germany see: "Geschichte der Anti-Atomkraft Bewegung, Tagesspiegel, 18 March 2011, <http://www.tagesspiegel.de/sport/fussball-in-fukushima-mit-dem-geigerzaehler-zum-spiel/8384592.html>.

(5) On the early history of the Green Party see Margaret Meyer and John Ely, eds., *The German Greens* (Philadelphia: Temple University Press 1998) and E. Gene Frankland and Donald Schoonmaker, *Between Protest and Power: The Green Party in Germany* (Boulder, CO: Westview Press, 1992)

drawn even more deeply into this ideological, political, and economic conflict. Green parliamentarians came to the Bundestag with poster-size images of victims of the Hiroshima bombing victims and other victims of war to remind people of the horrors of war.

IV. The Chernobyl Nuclear Accident

The Chernobyl nuclear meltdown had wide ranging implications not only for the Soviet Union (and now the Ukraine) but for Europe, and especially northern Europe. In Scandinavia, Germany and other parts of Europe, radioactive fall out raised concerns about human health. People were told not to drink the milk, eat salad or other leafy vegetables, and not to let their children play outside.

There was also a tremendous amount of discussion in Germany about the lessons of Chernobyl in terms of the level of preparation in society in the case of a nuclear accident. The Soviet Union was not at all prepared for the scale of accident that happened and had to resort to desperate means to prevent an even larger and more devastating explosion from occurring. Tunnels had to be built underneath the damaged reactor to secure the building from below and make sure the core melt down did not continue in a downward direction and reach the water table. It was also necessary to secure the damaged reactor site, contain the radiation emanating from within it, and clean up the radioactive materials that blew out of the core. When robots proved unable to withstand the radioactivity around the reactor, young soldiers, given the name of Chernobyl liquidators, were sent in to clean up the highly radioactive debris with their gloved hands. They wore little protective gear as they picked up the pieces of graphite that blew out of the reactor during the explosion and then threw them into a pit where they were to be buried with lead and concrete. Many of the Chernobyl liquidator suffered health problems and later died.⁽⁶⁾

(6) There are several excellent documentaries about the Chernobyl nuclear accident. See for example, Emanuela ANDreoli and Wladimir Tchertkoff, *The Sacrifice*, Switzerland, 2003; Discovery Channel, "Zero Hour: Disaster at Chernobyl," 2004.

The images of Chernobyl are ingrained in the minds of those Germans who were old enough at the time to remember the accident. If asked where they were when they heard the news about the Chernobyl accident, most Germans can remember. In the days, weeks, and months after the accident, much like in Japan after the Fukushima nuclear accident, people learned through media reports and expert discussions about the risks of radiation.⁽⁷⁾

The meaning of the nuclear accident and the lessons for Germany were interpreted differently by different actors. Those who supported the Atoms for Peace idea were quick to argue that an accident like that which happened in Chernobyl could not/would not happen in Germany. The Christian Democratic Union and their sister party in the state of Bavaria, the Christian Socialist Union, and the Free Democratic Party continued to support the use of nuclear energy in Germany. Their argument was that German reactors were of a different and safer design than the Soviet-designed reactors at Chernobyl. They argued that German technology and safety standards were much better than those used in the Soviet Union and thus, the chance of an accident in Germany was very low. The accident happened under a communist political system where there was little transparency and few checks and balances. They tried to assure the public that in the Federal Republic of Germany (West Germany), very high safety standards were in place.

For anti-nuclear activists the Chernobyl nuclear accident was a confirmation of what they had long argued could happen and why nuclear energy is too risky to use. For those who had not thought much about nuclear energy before, Chernobyl raised concerns about the nuclear power plants in Germany, including those in East Germany that were built using Soviet technologies. After the

(7) See David Tait and Nils Roos, “25 Jahre Tschernobyl — was ist geblieben?” BUND, Forschungsreport, 2/2011, http://www.mri.bund.de/fileadmin/Service/Pressemitteilungen/FoReport_1-11_Tschern.pdf; Karin Wurzbacher, “Radioaktive Belastung von Lebensmitteln nach Tschernobyl: Alles schon gegessen?” *Umweltnachrichten*, 91/2001, Umweltinstitut München, e.V., <http://umweltinstitut.org/radioaktivitat/20-jahre-tschernobyl/belastung-von-lebensmitteln-62.html>.

Chernobyl nuclear accident, no new nuclear power plants were approved in Germany. The Chernobyl accident thus can be considered the beginning of the end of the nuclear industry in Germany.

V. Institutional and Policy Change in Response to the Chernobyl Nuclear Accident

The first political reaction in Germany to the accident was to create a Ministry of Environment, Nature Conservation, and Nuclear Safety. Interestingly, nuclear safety responsibility was not placed with the Ministry of Economics, which was supporting the nuclear industry, but rather with the Ministry of Environment. Thus, there was a distinct effort to separate responsibility for nuclear development from nuclear safety by placing the offices in different ministries.

The Ministry of Environment also was given responsibility for renewable energy development. This became an opportunity for the German Ministry of Environment to start to push renewable energy more heavily than had been done in the past. In 1991, Germany introduced new regulation requiring that the electricity grid companies give access to the grid to producers of renewable energy, for example from solar photovoltaics or wind turbines. This was the first important change in the legal system that supported the growth of a renewable energy industry. A second important step occurred a decade later with the passage of the Renewable Energy Law that introduced Germany's feed-in-tariff system providing producers of renewable energy with guaranteed prices for the renewable energy they sold into the grid.

The Chernobyl nuclear accident certainly was a reason why after German reunification in 1990 a decision was reached to shut down the nuclear reactors operating in the former German Democratic Republic (East Germany) as these were Soviet-style reactors that did not meet the safety standards in use in the Federal Republic of Germany (West Germany). Thus, within five years after the Chernobyl nuclear accident it was decided to shut down and decommission the six nuclear reactors operating in eastern Germany.

Finally, another major impact of the Chernobyl nuclear accident was the shift it brought about in the position of the Social Democratic Party on nuclear energy. Prior to the explosions, the Social Democratic Party was internally divided on whether or not to support nuclear energy. After the accident, the Social Democratic Party made clear that they supported a phase out of nuclear energy in Germany. As the Social Democratic Party was Germany's second largest party, this shift had very important implications.⁽⁸⁾ And indeed, in 1998 when the Social Democratic Party and Green Party did well enough in the general election to form a ruling coalition, they made one of their first decisions to bring an end to the German nuclear industry.

Soon after the coalition took power they began negotiations with the nuclear industry to determine the speed and conditions under which the German nuclear power plants could be shut down. Of course, the industry did what it could to make sure the phase out would be as slow as possible. They were not supportive of the idea of shutting down Germany's nuclear industry, so they made sure that they would be allowed to run the existing nuclear power plants for about another twenty years with the last nuclear power plants to be shut down sometime in the early 2020s. In 2001 an amendment to Germany's atomic energy law was introduced requiring the shut down of Germany's nuclear reactors over the next two decades.

The Christian Democratic Union and Free Democratic Party did not support the law for the nuclear phase out passed under the Social Democratic Party and Green Party. Thus, when the Christian Democratic Union and Free Democratic Party formed a ruling coalition in 2009, they began a process to slow down the nuclear phase out in Germany. Using the climate change issue as an argument, they argued that Germany as an international leader in climate change policy, needed to maintain nuclear energy for a longer period of time than the phase out

(8) See also, Arnulf Baring, "Kernenergie: Geschichte eines Realitätsverlusts," *Frankfurter Allgemeine Zeitung*, 2 July 2009, <http://www.faz.net/aktuell/wirtschaft/wirtschaftspolitik/kernenergie-geschichte-eines-realitaetsverlusts-1829454.html>.

planned for the early 2020s under the 2001 Atomic Energy law amendments. They called for an additional 8 to 14 years of operating time for each of Germany's 17 remaining nuclear power plants (8 years for the older plants, 14 years for the younger plants and an average of 12 years for all the plants combined). Thus, rather than shutting down the last nuclear power plant in the early 2020s, the last nuclear power plant would be shut down in the mid-2030s. It is quite possible that the conservative political parties were hoping that if nuclear power were allowed to be used long enough, the memory of Chernobyl would fade, and the German population would slowly again come to accept nuclear energy use and that maybe in the future it would even be possible to once again build nuclear power plants in Germany.⁽⁹⁾

1. The 2010 Climate and Energy Package

The conservative political parties argued that nuclear energy was needed for a longer time so that there would be sufficient time for the development of more renewable energy without the threat of electricity blackouts when renewable energy production was insufficient (due to low wind or solar energy production). Nuclear energy they argued was necessary to provide a stable base load for times when there was little renewable energy production. In 2010, the coalition released a new climate and energy plan for Germany. The plan set targets for the reduction of carbon dioxide emissions, improvements in energy efficiency, and development of renewable energy. Carbon dioxide emissions were to be cut by 40 percent by 2020 and 80 to 95 percent by 2050 relative to 1990 emission levels. Energy efficiency was to be improved leading to a 50 percent cut in energy needs. Renewable energy was to be expanded to meet 80 percent of

(9) For further reading see Miranda A. Schreurs, "Orchestrating a Low-Carbon Energy Revolution Without Nuclear: Germany's Response to the Fukushima Nuclear Crisis," 2013. *Theoretical Inquires in Law*, Vol. 14, No. 1, pp. 83-104; Miranda A. Schreurs, "The Politics of Phase-Out," 2012. *Bulletin of the Atomic Scientist*, Vol. 68, No. 6, pp. 30-41; Lutz Mez, "Germany's Merger of Energy and Climate Change Policy," 2010. *Bulletin of the Atomic Scientist*, Vol. 68, No. 6 pp. 22-29.

electricity consumption and 60 percent of primary energy (power generation, transport, and heating/cooling) by 2050. Intermediate targets for 2030 and 2040 were also set. This plan was passed with the assumption that nuclear energy would continue to be available through the mid-2030s.

To win public acceptance for their plan to allow nuclear energy to be used until the mid-2030s, they called for a tax on nuclear fuel rods with the funds to be used to support the development of renewable energy.

Despite the conservative parties efforts to win public support for their nuclear energy policy shift, the public responded with large-scale protests. Hundreds of thousands of protesters took to the streets in cities across Germany carrying signs calling for an end to nuclear energy use and challenging the decision process by which the policy change was reached. Once again the question of whether or not energy policy was being driven by democratic decisions or economic ones was raised.

2. The Fukushima Dai-ichi Nuclear Power Plant Explosions and Core Meltdowns

The decision in 2010 to extend the allowable operating time of Germany's nuclear plants was made less than half-a-year before the Fukushima nuclear accident. The timing could not have been worse for the conservative political parties. The public was already angered by the extension decision, and then the Fukushima nuclear accident occurred. The Fukushima nuclear accident was extensively covered by the German media. The fact that 2011 was also the 25th anniversary of the Chernobyl nuclear accident meant that the German media was already prepared with stories about the Chernobyl nuclear accident. The German public was given weeks of almost non-stop coverage of the Fukushima triple disaster. They watched the scenes of explosion at the Fukushima Dai-ichi nuclear power plant. They saw interviews with evacuees from the zone around the nuclear accident. And they were told about the chaotic and desperate efforts of the government and TEPCO tried to bring the reactors back under control. Fukushima brought all of the memories of the

Chernobyl accident back.⁽¹⁰⁾

The conservative political parties suddenly found themselves in a very difficult situation. The Fukushima nuclear accident happened two weeks before an important state-level election in Baden-Württemberg, a conservative stronghold in Germany. Baden-Württemberg is an automobile manufacturing center and was under the control of the Christian Democratic Union basically since the end of the war, a little bit like the situation in Japan where the Liberal Democratic Party controlled national politics for decades. Reflecting the public's anger with the conservative parties' nuclear politics, the Christian Democratic Union lost over 20 percentage points compared with the previous election. The Green Party in contrast saw a huge jump in their support rate and together with the Social Democratic Party formed a new government in the state. For the first time in German history, a Green Party politician, Winfried Kretschmann, became minister-president (comparable to a governor) of the state (*Land*).⁽¹¹⁾

Chancellor Angela Merkel responded quickly to the Fukushima nuclear accident. She had the seven oldest nuclear power plants and one that had had technical problems temporarily stopped. This temporary stop was later made permanent. She charged the nuclear safety commission with doing a report on the safety of Germany's nuclear power plants in light of the information that the Fukushima nuclear accidents had occurred due to loss of electricity to their cooling systems. She also established an extraordinary ethics commission to consider the ethical dimensions of Germany's energy supply and to consider the implications of a transition away from nuclear energy.

(10) Miranda A. Schreurs and Fumikazu Yoshida, eds., *A Political Economic Analysis of a Nuclear Disaster* (Sapporo: Hokkaido University Press 2012).

(11) Thorsten Faas, "Wahlen in Schatten der Kernenergie," 25 March 2011, Zeit Online, <http://www.zeit.de/politik/deutschland/2011-03/wahl-atomkraft-gastbeitrag>; Heike Mohr, "Fukushima und die Folgen in Deutschland," 27 December 2011, Deutsche Welle, <http://www.dw.de/fukushima-und-die-folgen-in-deutschland/a-15562222>.

VI. The Ethics Commission for a Safe Energy Supply

The Ethics Commission for a Safe Energy Supply was co-chaired by Klaus Töpfer, Germany's first environment minister, and Matthias Kleiner, the former president of the German Research Society.⁽¹²⁾ The fact that Klaus Toepfer was asked to chair this committee is very important given his experience with Chernobyl. As the first environment minister in Germany he traveled to Chernobyl and was very involved in learning about what happened there and helping the Soviet Union in thinking about what to do after Chernobyl. He was also environment minister when Germany introduced the law requiring access to the electricity grid for renewable energy. Of course, he took that knowledge with him into the commission.

The Ethics Commission included academic specialists on ethics, technologies and risk, consumer issues, and the environment. The German churches were represented on the committee by the Catholic Cardinal, Rainer Marx, and the Protestant Bishop, Ulrich Fischer. It is noteworthy that in the 1970s the churches had released statements questioning the approach of the government to nuclear energy production and its use of violence against protesters. They stated that there were ethical questions that could be raised about the use of nuclear energy. In addition, the committee included former politicians from the Christian Democratic Union, the Christian Socialist Union, and the Free Democratic Party as well as the CEO of one of Germany's largest electricity using industries, the BASF (Jürgen Hambrecht). Hambrecht expressed his concerns that a more rapid transition to renewable energy would be very

(12) Ethik-Kommission Sichere Energieversorgung, "Deutschlands Energiewende—Ein Gemeinschaftswerk für die Zukunft," Berlin, 30 Mai 2011, http://www.bmbf.de/pubRD/2011_05_30_abschlussbericht_ethikkommission_property_publicationFile.pdf. For a Japanese translation with commentary see Fumikazu Yoshida and Miranda Schreurs, *Doitsu Datsugenpatsu Rinri Iinkai Houkoku*, (Tokyo: Ohtsuki Shoten, 2013). For an English translation see Ethics Commission for a Safe Energy Supply, "Germany's Energy Transition: A Collective Project for the Future," 30 May 2011, http://www.bundesregierung.de/Content/DE/_Anlagen/2011/05/2011-05-30-abschlussbericht-ethikkommission_en.pdf?__blob=publicationFile.

expensive for industry.

Noteworthy was the absence of representatives of environmental non-governmental organizations and the nuclear industry. This was certainly a conscious choice by the chancellor, perhaps to reduce strong ideologically driven argumentation. Apparently, Ralf Fücks, the director of the Heinrich Böll Foundation (closely aligned with the Green Party) turned down an offer to be involved in the Ethics Commission because environmental NGOs had not been invited into the commission.

The Ethics Commission was in session for about two months and during these two months there were several very long and intense meetings. In those meetings we discussed many things. We considered arguments about the safety of Germany's nuclear power plants and the strong tradition of precision and safety in the country comparing them with the situation of Japan, another country with a strong tradition of engineering and high quality products. If an accident like the Fukushima nuclear meltdowns could occur in Japan, then although the nuclear power plants in Germany probably are among the safest in the world, an accident in Germany cannot be ruled out. Safety standards that were established at the time Germany's nuclear power plants were built were established with the known risks at the time. In the meantime, we have knowledge of new risks, such as the kind of terrorist attacks that occurred in the United States on September 11, 2001. The nuclear standards of the past required nuclear power plants to be able to withstand direct hits from airplanes, but they did not imagine airplanes of the size of today's airplanes. Thus, the nuclear safety standards that exist are only as good as the imagination of those thinking about potential risks at the time they are established.

Of course, the chances of something happening are relatively small. Estimates are that nuclear accidents on a scale of Chernobyl only have a chance of happening once in every 10,000 years, but if you have about 430 nuclear power plants in the world that comes down to the chance of one big accident every 25 years, exactly the time between Chernobyl and Fukushima.

We also talked about the consequences of an accident. Accidents happen in

all kinds of energy systems: coal mines, gas plants, oil rigs. There can be fires, explosions, mine collapses, technical disasters. And in relation to all energy systems there can be health issues and loss of life. Yet, major nuclear accidents on the scale of Fukushima or Chernobyl do not just affect the people who are working in those firms by choice but also the communities around them, maybe even communities very far away and maybe even future generations if you consider the genetic implications of exposure to radioactivity. And accidents larger than Chernobyl and Fukushima are also possible. Thus, nuclear energy is in a different category than other forms of energy. Although the residual risk of an accident is small, nuclear accidents cannot be ruled out and even the best of safety systems can not foresee all possible accidents that could happen. Much like safety engineers did not foresee a level 9 magnitude earthquake followed by a 30-40 foot tall tsunami in the case of Fukushima, there could be terrorist attacks, hurricanes and floods or technical malfunctions that could trigger future serious accidents.

Another major concern is the nuclear waste. Nuclear waste is piling up around the world in interim storage systems. There are still no long-term high level radioactive waste facilities anywhere in the world (although they are now being built in Finland and Sweden). Is it really ethical to be building nuclear power plants and creating nuclear waste but leaving the problem of what to do with that nuclear waste to future generations? High level radioactive waste must be stored safely for tens of thousands of years. Nuclear energy is being produced for today's use and enjoyment, but the costs of its production impacts future generations in foreseeable and unforeseeable ways. And of course, there is the concern about nuclear proliferation.

If there were no other forms of energy available then one might argue that it is necessary to live with these risks, but there are other forms of energy that are safer, and in particular renewable energy where Germany had already made considerable progress. The ethics commission concluded that there is no good reason to continue with nuclear energy and that a more rapid phase out of nuclear energy should be pursued.

The commission thus turned its attention to the question of a relatively rapid nuclear shut down and build up of renewable energy. We agreed that Germany could lead internationally in addressing climate change by pursuing a transition away from fossil fuel energy and nuclear energy and by being a pioneer in energy efficiency and renewable energy technologies. This could have positive consequences for the economy—as it would trigger research and development in environmental technologies, create new industries and jobs, and lead in the long run to a low carbon dioxide society.

When we talked about the ethics of shutting down nuclear energy, we also considered what it would mean for jobs. There is the reality that if you shut down nuclear power plants some people are going to lose their jobs and some communities are going to lose their main investments. On the other hand, new jobs will be created and new investments would occur.

What was important was to make sure that a transition to a renewable energy society occurred at a pace that would make it possible to prevent a loss of stability in the energy supply and blackouts without having prices rise too much for consumers. We agreed that a transition to a renewable energy based system would be expensive, but much like the investment in a child's future, investment in a renewable energy based electricity system would lead to a better future for next generations. It would reduce many of the conflicts that had defined Germany's energy system as long as nuclear energy was being used. It would also make possible for more public involvement in the development of a new energy system.

The Ethics Commission also felt it important to involve the public in our deliberations and thus while several of our meetings were held behind closed doors, others were broadcast on television. We also interviewed dozens of experts to assess their opinions.

1. Implementing a Nuclear Phase Out

Soon after the Ethics Commission provided its report, the government released its plan for a more rapid nuclear phase out. The eight oldest nuclear

power plants were permanently shut down and a schedule for the shutdown of the remaining nine nuclear power plants was released. One plant is to be shut in 2015; one in 2017; one in 2019; three in 2021 and the last three in 2022.

Since the Bundestag passed new legislation in the summer of 2011 to speed up the phase out of nuclear energy, there has been a rapid expansion in renewable energy capacity. In 1998 only about 5% of Germany's electricity was from renewables. In 2012 it was 23%. Still there is a long way to go before Germany's 2050 target to achieve 80% of its total electricity supply from renewables can be met. Meeting this target will require a lot more energy efficiency, more offshore wind energy, larger wind turbines on shore and more high voltage grid lines. There will also have to be more investment in different forms of renewable energy: solar photovoltaic, solar heating, on-shore and off-shore wind, hydro power, geothermal power, tidal power, and the like.

Interestingly, much of the growth in renewable energy capacity has been due to individual investors. It has not just been big companies, but also individual households and farmers that have fueled much of the growth in renewable energy. In fact, about half of all investment in new renewable energy capacity has been by individuals. There has also been a large growth in energy cooperatives. Energy cooperatives are efforts by local communities to take energy production into their own hands primarily to promote renewable energy production and consumption. There were about 400 energy cooperatives in 2010 and 650 by the end of 2012. Many are pursuing a transition to 100% renewable energy in their own community.

There are now about 400,000 jobs that have been created in renewable energy. The largest number of new jobs has been in Bavaria where about 66,000 new jobs were created in renewable energy and Niedersachsen with 51,000 jobs.

What we are seeing is that jobs that are being lost in the nuclear field are being replaced by jobs being created in the renewable energy field. Of course, it is a difficult transition and there are losers. The costs of the energy transition are very large, but the cost of not doing the transition would be even larger due to rising fossil energy prices and the costs of pollution and climate change.

Some regions in Germany are already producing very large amounts of their electricity from renewables: Schleswig-Holstein 37.6%, Bavaria 27%, Mecklenburg-Vorpommern 57% and Sachsen-Anhalt 27%. In contrast, the industrial region of Nordrhein-Westfalen produced only 5.8% of its electricity from renewables. Similar, the city of Berlin produces only 2.4% and Hamburg only 9.4% of the electricity they use from renewables. So the challenge for big cities and heavily industrialized regions is greater than for more rural areas.

2. Implications for Japan

The energy transition in Germany offers many exciting possibilities for society. It means a lot of opportunities for young people. It will require much research and development. In the 1960s, the United States was in a competition with the Soviet Union in space exploration. This led to the Apollo mission to be the first to send a man to the moon. It was a political decision that required tremendous technological innovation and human ingenuity. The energy transition to a low carbon energy system could be considered Germany's Apollo project. The biggest difference is that the Apollo mission was a single project. Germany's energy transition will require both a technological and a societal revolution.

There are some signs that an energy transition is occurring not only in Germany but across Europe. Austria rejected nuclear energy already before the Chernobyl nuclear accident and Norway never pursued nuclear energy. In a binding referendum, over 90 percent of Italians rejected the government's plan to pursue nuclear energy. Switzerland plans to shut down its last nuclear power plant in 2034. Belgium hopes to shut down its last nuclear power plant in 2025, although it is uncertain about how it will replace the electricity since about half of its electricity is supplied by its nuclear power plants. And France, which obtains 78% of its electricity from nuclear, is working to reduce that dependency to about 50% of its electricity supply. Thus, we are seeing many places in Europe that are moving towards far greater reliance on renewable energy and a reduction or even phase out of nuclear energy dependency.

The big question now is if Japan too will make the decision to transition away from nuclear energy to safer forms of energy. The examples of Germany and other European countries suggest an energy shift to renewables is possible.

The Ethics of Nuclear Energy: Germany's Energy Politics after Fukushima

<Summary>

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The Fukushima nuclear accident had a large impact in Germany, a country that was already greatly sensitized to nuclear risks. Germany had one of the larger nuclear power sectors in the world in the 1970s and 1980s. It began to build nuclear power plants in the 1960s and 1970s as a follower of the concept of the Atoms for Peace Program. The government and industry invested heavily in nuclear energy in the hopes of obtaining a cheap and sustainable supply of energy. Germany's anti-nuclear movement questioned the safety and costs of nuclear energy and pointed to the ethical concerns about leaving nuclear waste to future generations. In the 1970s the United States and its allies were in a Cold War with the Soviet Union. Germany was at the center of the Cold War as a country divided between east and west. Concerns grew about whether Germany might be used as a base for nuclear missiles and whether it would become ground zero in a conflict. Anti-nuclear protesters marched against the stationing of nuclear weapons and the construction of nuclear power plants in Germany. These movements became the basis for the emergence of Germany's very successful Green Party, the first political party to openly take an anti-nuclear stance. After the Chernobyl nuclear accident, support for nuclear energy in Germany dropped sharply. The Social Democratic Party responded by calling for a phase out of nuclear energy. With both the Green Party and the Social Democratic Party opposed to nuclear energy, the days of nuclear energy became

numbered.

The conservative political parties, the Christian Democratic Union, the Christian Socialist Union, and the Free Democratic Party continued to support nuclear energy arguing that German safety standards were very high and the chances of a nuclear accident in Germany extremely small. They also tried to find new ways to support nuclear energy linking its use to efforts to control climate change.

The election of a Social Democracy Party-Green Party coalition in 1998 opened the door for the first nuclear phase out law in 2001. A decade later, however, a conservative government coalition tried to slow down the nuclear phase out linking the extension of the operating time of Germany's nuclear power plants to a new climate and energy plan with ambitious renewable energy targets. This policy may have stayed in place had it not been for the Fukushima nuclear accident. The Fukushima nuclear accident brought back memories of Chernobyl and strengthened societal opposition to nuclear energy. The German government reached a second decision to phase out nuclear energy in 2011.

The main differences with the earlier phase out law are that this one led to the immediate shut down of the 8 oldest nuclear power plants and scheduled the shut down of the remaining nine nuclear power plants by 2022. The government's decision to phase out nuclear energy was supported by the work of an Ethics Commission for a Safe Energy Supply. An important argument made by the commission for the phase out of nuclear energy is that safer forms of low carbon energy are available. An energy transition to a renewable energy dominated system would lead to the development of a system that is less conflict ridden and can provide the world with a new energy model.

