

2. The Energy Transformation in Germany

2.1 What is the *Energiewende*?

In the aftermath of the 2011 Fukushima nuclear meltdown, the German Chancellor Angela Merkel has advanced the reversal of her nuclear policy under the label *Energiewende*, which “refers to the move towards the age of renewables and energy efficiency. The German government decided that Germany's energy supply should be generated primarily from renewables by 2050. This requires our energy supply system to be fundamentally restructured, presenting Germany with economic and technological challenges”, as the environmental ministry describes the government's ambitions (BMU, 2013c). Although the German government only lately began to officially coin its historic plan as *Energiewende*, the transition towards renewables in fact has been long underway beforehand, as *figure 1* shows. The spectacular nuclear turn in the wake of the Fukushima disaster only set the final seal on a new policy course.

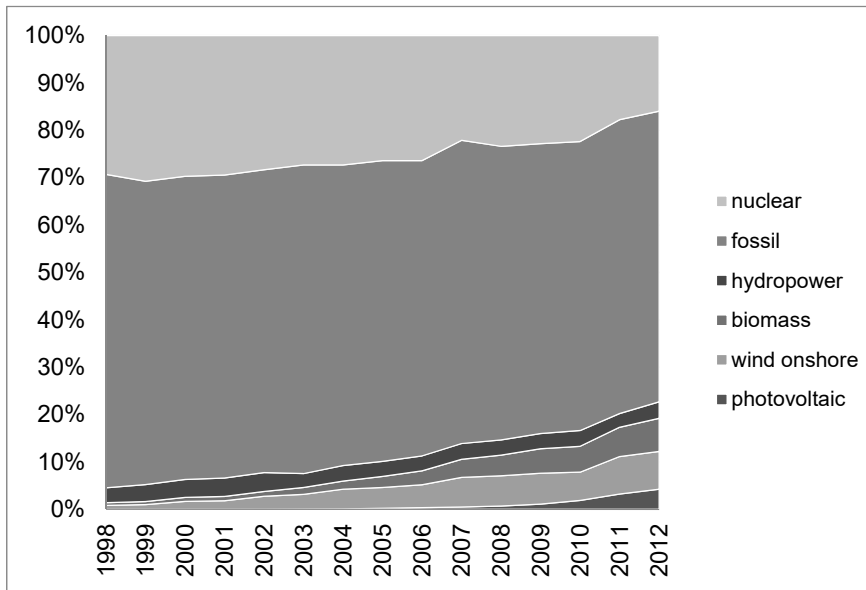
Since then, the label *Energiewende* has swiftly spread far beyond national borders, worming its way into the English language (Hockenos, 2012; 2013). *The Economist* (2012) and the *New York Times* (2014) have introduced the term in their reports and also academic journals began to use the idiom. The adequate translation of “*Energiewende*” is contested, however. Quite common are “energy transition”, “energy transformation”, “energy turnaround” or also “energy revolution”, while only the latter transports the particular notion the word “*Wende*” conveys in the German language, stemming from the 1989 revolution in the formerly Communist eastern part of the country.

The origins of the term can be traced back to German nuclear opponents who adopted the vision of a nuclear-free energy supply based on efficiency and renewable energies, inspired by US physicist Amory B. Lovins' book on “Soft Energy Paths” (1977; 1978). In 1980, the term “*Energiewende*” first appeared in the title of a book that transferred Lovins' ideas to the German situation, launched by the alternative Institute of Ecology (Krause, Bossel & Müller-Reißmann, 1980). Over the years, several other books adopted the terminology, including a report by the former research minister Volker Hauff (Hauff, 1986) in the context of the Chernobyl nuclear disaster, and so did anti-nuclear and environmental groups, the Green party, the alternative press and, after 1998, the

environmental ministry and left social democrats (Hockenos, 2012; Stefes, 2013, pp. 2-3).

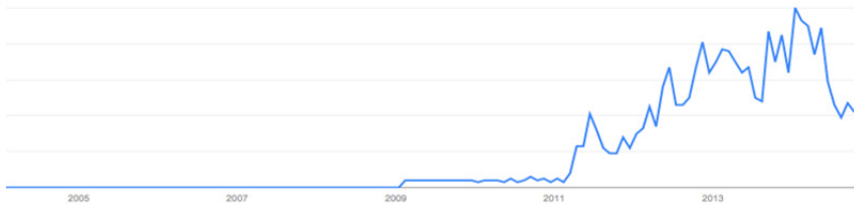
Although the *Energiewende* only lately advanced to the official trademark of German energy politics, the Merkel government neither invented the term nor the concept (Stefes, *Energy Transition: Critical Junctures and Path Dependencies Since 1990*, 2013, p. 2), nor did it take the leading or pioneering role. Indeed, the Merkel government's landmark decision in 2011 to accelerate the nuclear exit has had nothing but a catalyzing effect. "It is true, however, that *Energiewende* has entered common parlance only after the Merkel government introduced a legislative package under the same name in 2011 and successively sponsored and extensive public relation campaign" (ibid., pp. 2-3), as the striking development in Google search hits for "*Energiewende*" brings to mind (see *figure 2*).

Figure 1: Electricity Mix (1991-2012)



Notes: Geothermal energy and offshore wind power are omitted due to small quantities. Imports not indicated. Sources: BMU, 2013b, p. 18

Figure 2: Google Search Hits: “Energiewende”



Source: Google Trends, rev. 07.10.2014. No data available prior to 2004.

2.2 Milestones in German Energy and Climate Politics

It is hard to say when exactly the *Energiewende* started, as nuclear energy has been fiercely contested already since the Chernobyl disaster in 1986, while coal and other fossil fuels met scientific warnings against global warming already since the early 1990s when the first reports on climate change gave a wake-up call to prevent threats to ecosystems and human life. However, the conservative/liberal government under Helmut Kohl (1982-1998) has been resistant to change beyond declaratory goals or of incremental magnitude. After German reunification in 1990, economic stagnation and unemployment superseded the environment on the public agenda (Schmidt, 2007, pp. 426-430; Rudzio, 2011, p. 547).

After a long period of stalemate, the government change in 1998 – for the first time involving the Green party – opened a window of opportunity to overcome policy gridlock and enact environmental policy reform (Jänicke, Reiche, & Volkery, 2002). The new government under Gerhard Schröder (SPD) took the landmark decision to leave nuclear power and promote renewable energies, which constituted historical turning points in national energy politics (Schmidt, 2007, pp. 430-443; Rudzio, 2011, p. 547).

The aspired energy transformation changed the priorities in the goal triangle of energy policy, with environmental compatibility gaining in importance. The nuclear exit aimed to eliminate the residual risk of large nuclear accidents and to mitigate the unsolved problem of nuclear waste disposal, whilst bringing about the need to substitute approximately one third of electricity generation capacity and an even a larger part of base-load power plants cheaply to operate. The promotion of renewable energies, as envisaged in the Renewable Energy Sources Act in 2000, aimed at the reduction of greenhouse gas emissions, save costly

imports of fossil fuels from politically unstable parts of the world, and create growth and employment in an innovative and sustainable economic branch. On the initiative of the European Union, the Schröder government also introduced a cap and trade regime for the mitigation of greenhouse gases in industry and fossil electricity generation, and liberalized the Energy Market Act, which heretofore had granted regional monopolies to private utilities for electricity and gas, which now have been dissolved. In addition, the introduction of “green taxes” (*Ökosteuern*) on gasoline and electricity, the promotion of combined heat and power generation, tax privileges and quotas for bio-fuels and the subsidization of the energetic renovation of buildings have become further parts of the new energy policy. The following governments under Chancellor Schröder (until 2005) and Angela Merkel (since 2005, with varying junior coalition partners) have kept walking on this path, and laws once created have survived changing political environments, in spite of varying party compositions.

2006/07: “Climate Chancellor” Merkel on the International Stage

Drinking water, food production, health, extreme weather conditions and natural disasters. Stern recommended for swift and determined action, also through renewable energies, as the benefits of early action outweighed the costs. The report involved particular significance because it provided the very first specific figures for economic costs associated to global warming.

The new scientific assessment report on climate change launched in 2007 by the International Panel on Climate Change (IPCC), a scientific body under the auspices of the UN, strongly confirmed previous evidence that global warming is man-made and caused by greenhouse gas emissions from incineration of fossil fuels (IPCC, 2007). The IPCC report attracted as much media attention in Germany as none of the previous reports before (Weingart, Engels & Pansegrau, 2007).

At the same time, by pure coincidence, the German government held both the presidency of the G8 and the EU Council. Chancellor Angela Merkel used this opportunity to push for ambitious climate protection goals on EU and international level and boost her positive public profile as “climate chancellor” (*“Klimakanzlerin”*). Under her leadership, the G8 Summit held in Heiligendamm on 7 June 2008 adopted a final communiqué on climate protection. For the first time in history, the G8 agreed that climate change is man-made, acknowledged the scientific evidence represented in the IPCC reports and recognized the UN as negotiation platform. Furthermore, they declared to substantially extend the share of renewable energies and to “consider seriously [to strive for] at least a

halving of global emissions by 2050" (G8, 2007, p. 14). This concession is to be considered as breakthrough in international climate politics, against earlier resistance of the USA and Russia who have blocked any progress. Environmental organizations such as Germanwatch (2007) and WWF (2007) appreciated the leading role of industrialized countries and applauded the successful persuasion work by Chancellor Merkel.

With Merkel's support, also the EU devoted much attention to climate protection and renewable energies in the course of 2007 and 2008 (Dagger, 2009, pp. 90-100). The spring summit of the EU Council on 8/9 March 2007, held under German presidency, approved a new EU energy package and agreed on a joint action plan, including the seminal "20-20-20 targets by 2020": 20% renewables in total EU energy consumption, 20% energy efficiency increase and 20% greenhouse gas reduction (30% if further states follow) (Council of the European Union, 2007). This decision was meant to provide a signal for the upcoming UN climate negotiations in Bali 2007 as well as in response to rising fossil fuel prices.

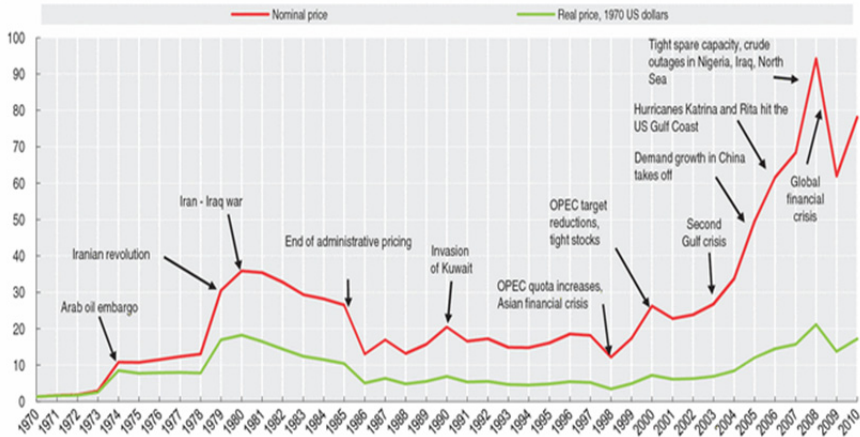
Climate change at the time has attracted more political and public attention than barely any other issue and than ever before. The Society for German Language picked the term "climate catastrophe" ("*Klimakatastrophe*") as "word of the year" (GfdS, 2007). The international commitment for climate protection advanced to the cornerstone of the legislation period and brought about Merkel's positive public reputation as "climate chancellor" (Schabedoth, 2009, pp. 46-50; Sohre, 2014, p. 367), providing the ground for favorable personal popularity ratings among the public and shielding her against attacks from Green or social-democratic environmentalists. On the other hand, this profile of the Chancellor and the new EU targets also reinforced the *Energiewende* course and undermined political resistance (Hirschl, 2008, p. 395; Dagger, 2009, pp. 108-110).

Debate about Peak in Energy Prices 2008

At the beginning of 2008, oil prices exceeded the symbolic 100 US\$ threshold and climbed to a new record close to 150 US\$ in July 2008, representing an all time high in real oil prices per barrel (OECD, 2012). However, in the aftermath of the worldwide recession, prices declined again in early 2009 and settled between 70 and 80 US\$, which was still a significantly higher level than a few years before (see *figure 5* below). This unexpected shock brought about rising energy costs for industry and private households and attracted broad media attention. The high oil prices enhanced the political support for renewables (Oschmann, 2009, p. 1), since environmental politicians and organizations used the

worrying trend in oil prices to advertise the further promotion of renewables. Even though electricity generation is not based upon oil but coal, nuclear and gas, certain interest groups and politicians applied the oil price as rhetorical means to legitimize their preferences with economic reasoning.

Figure 3: Development of Crude Oil Prices



(Source: OECD, 2012.)

The 2010 National Energy Concept and the 2011 Nuclear Turnaround

The National Energy Concept, launched in 2010 under the CDU/CSU/FDP Merkel government (2009-2013), reconfirmed and carried on the ambitious goals for the reduction of greenhouse gases, the further expansion of renewable energies and greater priority on energy efficiency (see *table 5* below). The nuclear phase-out, however, was decelerated by a lifetime extension of nuclear plants by 12 years yet not put into question per se and accompanied by the introduction of a nuclear fuel tax. In the wake of the Fukushima nuclear disaster on 11 March 2011, the government revised the nuclear lifetime extension and accelerated again the phase-out, with a timeline similar to the status quo ante under the initial exit roadmap (BMW & BMU, 2012, pp. 18-20). All other features of the National Energy Concept remained in force, unaltered by the nuclear turnaround.

Table 5: Selected Targets in German Energy Policy

	2011	2020	2050		
greenhouse gas emissions (compared with 1990)	-26.4%	-40%	2030 -55%	2040 -70%	2050 -80% to -95%
primary energy consumption (compared with 2008)	-6.0%	-20%	-50%		
gross electricity consumption (compared with 2008)	-2.1%	-10%	-25%		
renewables share (gross electricity use)	20.3%	min. 35%	2030 min. 50%	2040 min. 65%	2050 min. 80%
renewables share (gross end energy use)	12.1%	18%	2030 30%	2040 45%	2050 60%

Source: BMWi & BMU, 2012, p.16.

Table 6 : Important Events and Milestones in German Energy Politics

➔	1972	seminal report on the “Limits to Growth” by the Club of Rome
➔	1973/1974	Oil Crisis
➔	1979/1980	Second Oil Crisis
☢	1986	Chernobyl nuclear meltdown
➔	1988- 1990	Enquete Commission “Precaution for the Protection of the Earth’s Atmosphere”
☀	1991	Electricity Feed-In Act
➔	1992	UN Framework Convention on Climate Change
➔	1992-1995	Enquete Commission “Protection of the Earth’s Atmosphere”
➔	1996	EU Electricity Single Market Directive
➔	1997	Kyoto Protocol is signed
➔	1998	first federal government participation of the Green Party: SPD/Green government
☀	2000	Renewable Energies Act

	2000	nuclear phase out
	2001	EU Directive on the promotion of electricity from renewable energy sources
	2002	Offshore Wind Strategy of the Federal Government
	2004	1st amendment of the Renewable Energies Act
	2005	first trading period of EU Emissions Trading System starts
	2005	government change: CDU/CSU/SPD government takes office
	2005	National Climate Protection Strategy
	2006	“An Inconvenient Truth” documentary, Stern Report and IPCC reports
	2007	EU “20-20-20” targets for renewables, climate protection and energy efficiency
	2007	Integrated Energy and Climate Program of Federal Government
	2008	second trading period of EU Emissions Trading System starts
	2008	strong surge in crude oil prices
	2008	heated debate on ecological effects of biofuels
	2009	2 nd amendment of the Renewable Energies Act in force
	2009	EU Directive on the promotion of the use of energy from renewable sources
	2009	CCS Act fails first time
	2009	UN Climate Conference in Copenhagen fails
	2009	government change: CDU/CSU/FDP government takes office
	2010	new National Energy Concept
	2010	reform of photovoltaics promotion
	2010	CCS Act fails second time
	2011	“Non-CCS” Act is introduced

	2011	first Green prime minister in history elected in a German state
	2010	nuclear lifetime extension; introduction of nuclear fuel tax
	2011	Fukushima nuclear accident; accelerated nuclear exit
	2012	sharp increase in the renewables levy
	2012	amendment of Renewables Energy Sources Act in force
	2012	Bundesrat vetoes photovoltaics retrenchments with 2/3 majority
	2012	severe cutbacks in photovoltaics promotion
	2013	third trading period of EU Emissions Trading System starts

Source: own compilation.

2.3 Characteristics of the Energy Market

Conventional power plants – i.e. coal, gas or nuclear power plants – have three operating modes. In basic load, they continuously produce electricity around the clock and deliver the bulk of the steady electricity demand. Base load power plants therefore are considered as backbone of energy supply. Due to their low operating costs, still to date lignite-fired power stations carry out this task. Also hydropower plants are suitable. Medium-load power plants run about half of the year and cover times of higher electricity demand. Here, hard coal and natural gas are used. Peak load, which is only needed for a lower number of hours of very high electricity need, has usually been served by gas power plants and pump storage plants, as they can be flexibly regulated within the minute range, whereas coal power plants are not this easy to control due to technical-physical restrictions. Natural gas power plants, however, are expensive to operate because of high fuel costs. In the wake of the expansion of renewable energies, photovoltaics today provides an important pillar of peak load supply at noon, yet foremost in summer.

Stemming from the times of regional monopolies, there are large overcapacities of power generation in Germany still to date. Today, also large capacities of renewable energies add up to the electricity mix, yet their actual power supply is highly dependent from the fluctuating sources wind and solar; only bioenergy can be technically controlled and brought into accordance with the factual demand. This increases the need for grid stability and grid control measures.

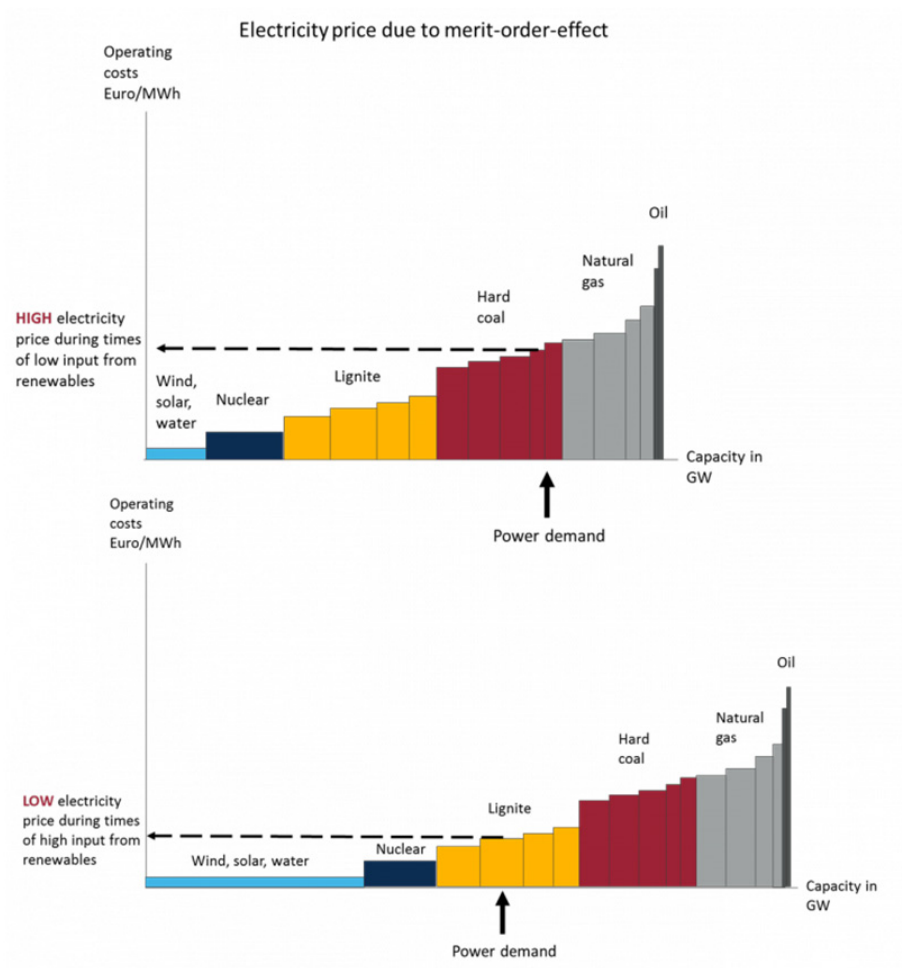
Shortage of supply has not become likely thus far; rather, due to temporary high production of solar and wind power, Germany still is net exporter of electricity to neighbor countries. Even after the shutdown of eight nuclear power plants in the aftermath of the Fukushima disaster, imports of nuclear power from foreign countries did not increase and the supply situation has been stable (Bundesnetzagentur, 2011, pp. 16-17).

The politically envisaged reduction of greenhouse gas emissions foremost affects energy production, given that 80% of the country's emissions are energy-related (BMW i & BMU, 2012, p. 80). Above all, lignite-fired and hard coal power stations are characterized by high greenhouse gas emissions per unit, particularly lignite. Gas has much less emissions, while nuclear power and renewables have zero emissions (if disregarding emissions from resources extraction for plant production). Since nuclear power is faced with declining public acceptance rates due to disposal issues with radioactive waste and the risk of nuclear accidents, the *Energiewende* strives to replace fossil and nuclear fuels by renewables. While the South of Germany benefits from relatively high solar radiation and prioritizes photovoltaics, the Northern part of the country has more wind and thus prioritizes wind power.

After the liberalization of the energy market in the late 1990ies, electricity prices are determined at the stock market following the price formation mechanism of the so-called merit order. This means that the most expensive power plant needed to meet electricity demand at a certain time determines the uniform price of electricity from all power plants, independent from their actual generation costs. In times of higher electricity demand, base-load power stations, thus, can make more profits, enhancing their economic viability.

The merit order comes into trouble in the wake of the expansion of renewable energies in conjunction with over-capacities in conventional power generation. As wind and solar power have marginal costs of close to zero (i.e. no fuel costs and minimal operational costs), and furthermore are legally granted priority feed-in to the grid, they supersede conventional medium- and peak-load power plants and, as a consequence, lowers the average stock market prices ("merit order effect"). As a consequence, gas power plants run to a lesser extent and become economically unfeasible, even though needed to compensate for fluctuating supply from wind and solar power. Moreover, also other conventional power plants get into trouble, since lower electricity prices also damage their economic viability. In international comparison, electricity prices in Germany are today slightly above European average for large industrial consumers yet high for small and medium industrial consumers and private households (BMW i & BMU, 2012, p. 91).

Figure 4: Electricity Prices and the Merit-Order Curve



Source: Clean Energy Wire CLEW, www.cleanenergywire.org/factsheets/setting-power-price-merit-order-effect (Rev. 3.5.2015)

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Drivers of Energy Transition

How Interest Groups Influenced Energy Politics in
Germany

Gründinger, W.

2017, X, 657 p. 61 illus., Softcover

ISBN: 978-3-658-17690-7