Three Targets of the Energy Transition: Description

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The term "*Energiewende*" has a longer history in the political debate in Germany; it was first used in 1980 when it primarily meant the abandonment of nuclear energy and oil in the energy supply. Since then it has gone through several iterations. Generally speaking, the term "*Energiewende*" is mostly used today to refer to the transition in energy supply from fossil fuels and nuclear energy to renewable energies, in all three major energy-consuming sectors: electricity, heat and transportation.

In this book we use the term "*Energiewende*"—as already stated in the introduction—as an umbrella for (the key elements of) the federal government's energy policy since June 2011 *relating to the electricity sector*.

The *Energiewende* in this sense is characterized by **three pivotal targets**:

- Shutdown of nuclear power plants—by 2022
- Expansion of renewable energies in electricity generation—to at least 80% in 2050
- Increase in electricity efficiency—at a growth rate of around 1.6% per year

We will explain these three targets in more detail below. The *specific target figures* indicated are mainly taken from the "Lead Study 2011" [1] for the Federal Ministry for the Environment, scenario 2011A. The extent to which these targets *for 2015* have actually been achieved will be the main subject of the second part of this book.

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2.1 Shutdown of Nuclear Power Plants

Germany's nuclear power plants, of which there were 18 at its peak, were built mainly during the 1970s and 1980s. Between 2000 and 2010 they generated a power output of about 20 GW and produced on average about 160 TWh of electricity each year [2]. Nuclear power plants thus provided approx. 20% of the required power output and approx. 25% of the required electricity in Germany.

Originally—from the 1950s to the mid-1970s—the peaceful use of nuclear energy was broadly accepted in Germany, even massively encouraged politically and supported by way of substantial subsidies. Since the late 1970s, however, the use of nuclear energy in power plants has been among the most violently and controversially debated topics not only within German energy policy but also within the overall political debate in Germany.

This is primarily a German phenomenon although other countries have had, and continue to have, similar discussions (e.g. Sweden, Switzerland and Italy). However, generally speaking these debates are not as significant within the political agenda.

The primary reason for the political debate surrounding the use of nuclear energy is the conflicting assessments of the risks posed by nuclear power plants for the present generation and by the radioactive waste they produce for future generations. Yet nuclear power plants indisputably have their advantages: in particular the avoidance of CO_2 emissions and the low cost of generating electricity in *existing* nuclear power plants. Therefore, the position one takes on nuclear power plants depends on how one weighs these benefits against the risks mentioned above. Ultimately this makes it a matter of value judgement.

The *Energiewende* target "shutdown of nuclear power plants" states, more specifically, that the remaining nuclear power plants are to be gradually shut down until 2022 (Table 2.1). Seven nuclear power plants with approximately 8 GW capacity were already closed in 2011, by order of the federal government, in the wake of the nuclear power plant accident in Fukushima, Japan.

This book does not address the various secondary issues involved: decommissioning of nuclear power plants, the search for locations to dispose of radioactive waste, allocation of the costs thus incurred, etc.

Table 2.1 Planned number of active nuclear power plants in Germany, 2000–2022

Year	2000	2010	2015 (planned)	2020 (planned)	2022 ff (planned)
Number	18	16	8	6	0

[1, 3]

2.2 Expansion of Renewable Energies in Electricity Generation

The term "renewable energies" (RE) is used to refer to energy sources that are present on the earth due to natural circumstances and are available, independently of any anthropogenic use, over long periods in the same manner. Since their use does not exhaust the natural resources of the earth, they are *sustainable*, and they are *CO2-free*. For electricity generation in Germany today, the available RE are mainly:

- Electricity from hydropower
- Electricity from wind power
- Electricity from sunlight (photovoltaic energy = PV)
- Electricity from (renewable) biomass

In the longer term, and depending on advances in technology, there could well be other forms to come, such as electricity generation through tides, waves, ground heat and others.

The RE used to generate electricity have been massively expanded in Germany since 2000, mainly through the funding mechanism of the German Renewable Energy Act (*Erneuerbare-Energien-Gesetz*, GREA) (Table 2.2).

As such, this part of the *Energiewende* has been going on for around 15 years already.

As a crucial part of the *Energiewende*, the explicit target has been set to expand the share of RE to at least 80% of the electricity consumed in 2050. The key milestones set in between are listed in Table 2.3.

Table 2.2 Electricity production from the major renewable energy sources, 2000, 2010 and 2016 (in TWh)

	2000	2010	2016
Wind	10	38	77
PV	0	12	38
Biomass	3	34	52
Water	25	21	21
Total	**38**	**105**	**188**

[2]

Table 2.3 Planned expansion of RE in Germany (in % of gross electricity consumption)

2000	2010	2015 (planned)	2020 (planned)	2030 (planned)	2050 (planned)
7	17	>26	>35	>50	>80

[1, 2]

2.3 Increase in Electricity Efficiency

The term "energy efficiency" generally describes the ratio of energy consumption to benefit achieved, specifically, the rate of energy consumption to achievement of a certain economic output. A commonly used measure of a country's energy efficiency is the gross domestic product (GDP) achieved per kilowatt-hour of gross energy consumption in €/kWh (also called energy productivity).

With respect to electricity, the focus of this book, we will use the term electricity efficiency. An increase in electricity efficiency thus means—to put it simply—maintaining (or even reducing) electricity consumption while increasing economic performance.

This is exactly what has happened in recent years: Electricity consumption in Germany has been stagnating in the last 15 years, while the economic output (GDP) has increased by 15% in real terms.

In its design of the *Energiewende*, the federal government has set a target for reducing gross electricity consumption by 25% by 2050, despite presumed further economic growth of about 1% per year. It is to be noted, however, that according to Scenario 2011A, in this decrease the electricity consumption for the production of hydrogen (2050: 110 TWh, primarily to serve as fuel in the transportation sector) remains unconsidered. This means that the increase rate for electricity efficiency must rise from about 0.5% per year between 2000 and 2010 to around 1.6% per year between 2010 and 2050 (Table 2.4).

2.4 Target State in 2050

What this design of the Energiewende means specifically in terms of installed RE plant capacity and RE electricity production will, of course, depend on the assumed electricity consumption in 2050. In the main scenario 2011A of the Lead Study 2011" [1] the three targets of the *Energiewende* and the respective milestones entail that electricity generation in Germany excluding electricity exports—i.e. gross electricity consumption—will develop up to 2050 as shown in Tables 2.5 and 2.6.

The balance in 2050 is also planned to include around 60 TWh of renewable electricity from abroad.

Table 2.4 Planned electricity efficiency (= gross domestic product/gross electricity consumption) (in €/kWh)

2000	2010	2015 (planned)	2030 (planned)	2050 (planned)
4.1	4.3	4.6	5.9	8.1

GDP at 2010 prices; 2010 = average of the years 2009–2011; [1, 4]

Table 2.5 Planned development of electricity generation in Germany in [1] (in TWh)[a]

	2000	2010	2015 (planned)	2030 (planned)	2050 (planned)
Nuclear energy	170	140	90	0	0
Fossil fuels	370	370	325	250	80
RE	40	105	170	300	430

[a] Excluding electricity generation for electricity exports; fossil energy = including others; 2030 adapted to current plans; electricity exports assumed to stem mainly from hard coal power plants; [1, 2]

Table 2.6 Planned development of electricity generation in Germany in [1] (in %)[a]

	2000	2010	2015 (planned)	2030 (planned)	2050 (planned)
Nuclear energy	30	23	15	0	0
Fossil fuels	63	60	56	45	16
RE	7	17	29	55	84

[a]Excluding electricity generation for electricity exports; fossil energy = including others; 2030 adapted to current plans; electricity exports assumed to stem mainly from hard coal power plants; [1, 2]

References

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