



The German Energy Transition: best practices in renewable energy and energy efficiency

Within the last 10 years, the share of renewables in electricity production tripled. Renewable energy (RE) is the second biggest energy source behind lignite (25.8%) and now delivers 23.9% of Germany's total energy production. Currently, Germany has a total installed RE capacity of 84 GW out of total installed electrical capacity of 160 GW. The total investment in RE in 2013 was €16.3 billion, and more than 370,000 people were employed in this sector.

Today, the German government is working on the so-called Energy Transition (*Energiewende*) as the biggest national infrastructure project. The main political objectives of the Energy Transition are:

1. Reduction of greenhouse gas emissions of 40% by 2020 and of 80–95% by 2050 vs. the 1990 level;
2. Complete phase-out of nuclear power by 2022 (40% of nuclear power plants were switched off after the Fukushima disaster and the remaining nine plants will be phased out by 2022);
3. Independence from oil and gas imports, since in 2012, Germany imported 98% of its petroleum, 86% of natural gas and 100% of uranium, making it vulnerable to price hikes or supply disruptions;
4. Competitiveness, since the Energy Transition offers the chance to secure an efficient, cost-competitive energy supply in the future and is seen as an engine for innovation, growth; and employment; and
5. Ensuring the security of the future energy supply for coming generations.

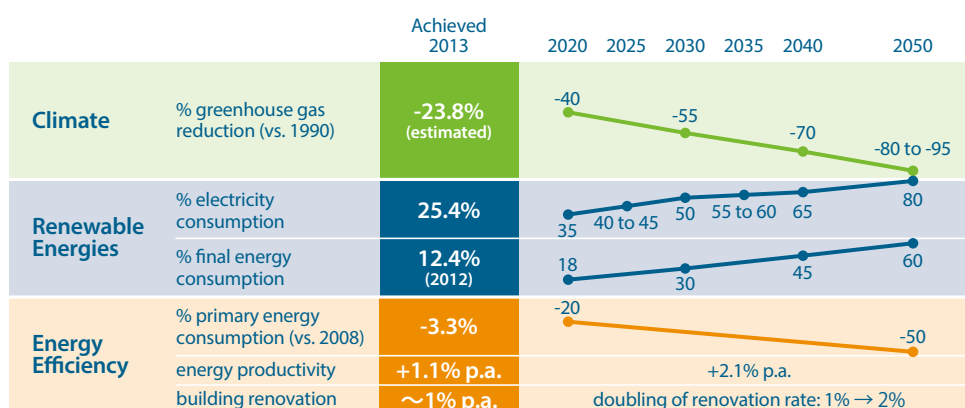
Core strategic targets

Based on the political objectives, the German government defined two core strategy targets as pillars of the Energy Transition (Figure 1). The first is to increase the share of RE in the overall energy mix. The energy supply will switch to a portfolio dominated by RE like wind, solar, geothermal, biomass and waste, and hydropower. RE will deliver 35% of electricity consumed in 2020 and 80% in 2050. The second is to increase energy efficiency (EE) and reduce energy consumption. The target is a reduction in primary energy consumption of 20% in 2020 and of 50% in 2050 vs. 2008. Energy productivity should increase to +2.1% annually. The results so far are remarkable, and Germany is on track to reach its long-term targets.

Renewable Energy Act

The Renewable Energy Act (*Erneuerbare-Energien-Gesetz*) supports the promotion and deployment of RE. It was the major success factor over the past 14 years because its enforcement has enabled RE use to grow at a rapid pace. The core principles of the Renewable Energy Act are: 1) Renewables have guaranteed grid access and priority transmission and distribution. Network operators are required to feed this electricity preferentially into the grid. All have the right to become a utility and to feed electricity into the grid. 2) Every kilowatt-hour (kWh) generated from RE facilities receives a fixed feed-in-tariff (FiT) for a specified period, usually at a premium price reflecting the higher costs of RE compared with fossil fuels. 3) There is no charge to the public purse. The FiT is not a subsidy and not dependent on the tax budget. The additional cost or difference between the FiT paid out and wholesale stock exchange price is shared among all energy consumers.

Targets of the Energiewende until 2050



Source: Federal Government 2010, BMU/BMWi 2014, AGEE-Star 2014

Figure 1. Targets of the *Energiewende* (Energy Transition) until 2050. Drawn by the author based on data from the Federal Ministry of Economics and Technology (BMWi) and Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

Feed-in tariffs provide investment certainty and drive costs down

Simplified generalization of feed-in tariff with 20-year duration
 Source: Own estimates based on WFC

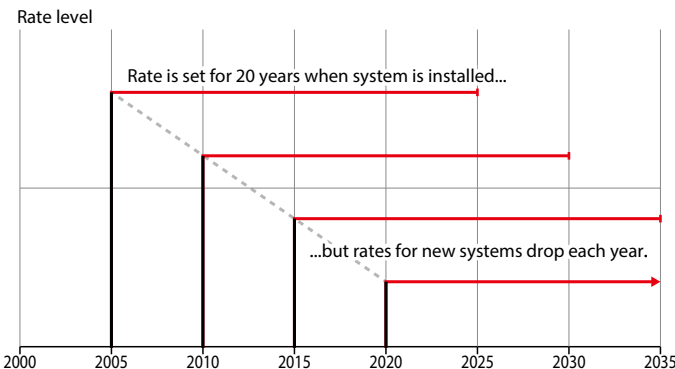


Figure 2. FiTs provide investment certainty and drive costs down: simplified generalization of an FiT with 20-year duration. Reprinted, with permission, from *Energy Transition—The German Energiewende*. Heinrich Boell Stiftung; www.energytransition.de.

These three principles lead to investment security, which builds the foundation of sustainable growth in RE. The positive experience in Germany shows that a FiT in combination with guaranteed grid access is the most successful model for the deployment of RE. This simple, straightforward model has lowered prices to the extent that solar systems in Germany are the least expensive worldwide.

The idea is that anyone generating renewable energy can sell the energy (kWh) produced for a 20-year fixed period. Tariffs are set to ensure a modest return on investment (ROI). The FiT supports each technology in relation to its market position and technological maturity (Figure 2).

Once the system is connected to the grid, the FiT is fixed for 20 years. Each year the rate drops only for newly installed systems. The idea behind the annual reduction of the FiT is to force price cuts, which are possible in accordance with the growth in market size and the corresponding learning curve. The overall target is to bring RE technology to a pricing level competitive with that of traditional energy sources.

Based on the success of the Renewable Energy Act and constant cost reductions for RE systems, the German government has started a transition from FiT toward a more market-based model. The Renewable Energy Act is the most successful political tool, which has enabled the deployment of RE sources and made them cost-competitive with traditional energy sources.

Feed-in-Tariff and System Prices

A feed-in-tariff (FiT) ensures a modest return on investment for the investor and encourages market growth. Growing markets and the increase in production capacity and output lead to cost savings due to scaling effects and learning curves. The annual decrease in the FiT makes sure that the cost-savings result in lower market prices for renewable energy systems. The most impressive example is the development of small photovoltaic systems (up to 30 kWp) as the following table shows:

Year	FiT	System price (€/kWp)	Installation (MW)
2004	0.540	5,000	660
2009	0.430	3,060	3,800
2012	0.190	1,800	7,600
2014	0.125	1,600	NA

NA, not applicable.

EE

EE, called “the world’s most important fuel” by the International Energy Agency, is the second important pillar of the Energy Transition. The overall approach to EE is a balance of: 1) legal requirements such as energy-saving ordinances, building codes, electricity tax, and EE-labeling ordinances; 2) support mechanisms such as market incentive programs, low-interest loans for renovations, and grants for cross-cutting technologies; and 3) information tools such as power checks for low-income households, heating reviews, energy-saving accounts, and various campaigns to raise awareness. EE measures are applied to multiple sectors, including transport, industry and business, buildings, and appliances and lighting. 🌞

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