Energiewende – a pricey challenge?

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Germany has set a goal to be the first major industrialized country to successfully transition to a new energy system based primarily on renewables and energy efficiency. The transformation of the country's energy system, known in German as the *"Energiewende"*, is unique not only because of the country's decision to move away from fossil fuels, but also because it has chosen to simultaneously phase out nuclear power. As a result, the electricity sector will face some of the most immediate and largest restructuring challenges. The last nuclear reactors will be shut down in 2022. Meanwhile, renewable energy is to constitute an increasingly central pillar of the country's supply system. By 2050, renewables are to supply at least 80 percent of total electricity consumption (Table 1). The technical feasibility of building an electricity system almost entirely based on renewable energy has been repeatedly studied and is today only rarely questioned (SRU 2011; Öko Institute and Prognos 2009; UBA 2010 ; DLR et al. 2012). Critics now focus instead on the perceived high costs of the Energiewende, often pointing to rising electricity prices. As a solution, they recommend fundamental changes to current renewable energy support structures. Many want to see an end to the current feed-in tariff scheme. This paper will argue that the costs of the Renewable Energy Sources Act (EEG) and the Energiewende are exaggerated, but that market support must nevertheless aim for a cost-efficient energy transition. This is best achieved by incremental reform maintaining some of the essential pillars of the current support scheme. We will evaluate the factors that have caused price increases in the past, discuss the true costs of electricity, assess assumptions for future cost projections, and analyze the role of policy. The following arguments will be developed:

a. While the costs of the EEG are growing, the majority of electricity price increases are a result of rising fossil fuel costs.
b. A successful transformation of the energy system initially demands incurring incremental costs greater than those required under a business-as-usual scenario. In the long term, however, investments can produce net savings as renewable energy technologies become cheaper and fossil fuel prices continue to rise.
c. If electricity markets were to account for the true costs of electricity, renewable energy would already be a cost-competitive option.

Table 1
Germany's main energy policy goals

Target Area	Goal
Greenhouse Gas Emissions	Reductions of 40% by 2020, 55% by 2030, 70% by 2040 and 80 to 95% by 2050 compared to reference year 1990
Primary Energy Consumption	Decline by 20% by 2020 and by 50% by 2050
Energy Productivity	Increase by 2.1% per year compared to final energy consumption
Electricity Consumption	Reduction of 10% by 2020 and 25% by 2050 compared to 2008
Heat Demand in Buildings	Reductions of 20% by 2020, while primary energy demand is to fall by 80% by 2050
Renewable Energy	18% share of gross final energy consumption by 2020, 30% by 2030, 45% by 2040, and 60% by 2050. At least 35% share of gross electricity consumption by 2020, 50% by 2030, 65% by 2040, 80% by 2050

Source: BMU (2012).

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d. The surcharge paid by electricity consumers to cover the costs of the EEG is artificially high due to industry exemptions.
e. Over the past few years, electricity suppliers have enjoyed reduced procurement costs, but have not passed on any savings to household consumers.
f. Nonetheless, current policy mechanisms have reached their limits in ensuring optimal management of the country's energy transformation. An incremental reform process is preferable to fundamental change.

Rising household electricity prices: Fossil fuel costs are the main cost driver

Electricity prices in Germany have risen consistently over the past 12 years (Figure 1). While a three-person household had to pay on average 13.94 ct/kWh in 2000, this amount has increased to 25.74ct/kWh today. These price increases are largely attributed to the costs of the EEG (BDEW 2012). The EEG levy is a surcharge added to energy users' bills to cover the cost of the feed-in tariffs. As the amount of renewable energy capacity – especially solar PV – has grown, the surcharge has increased from 0.2 cents per kWh in 2000, at the introduction of the EEG, to 3.59 cents per kWh in 2012. However, a closer look at past price developments shows that the surcharge is not the main driver of rising electricity prices.

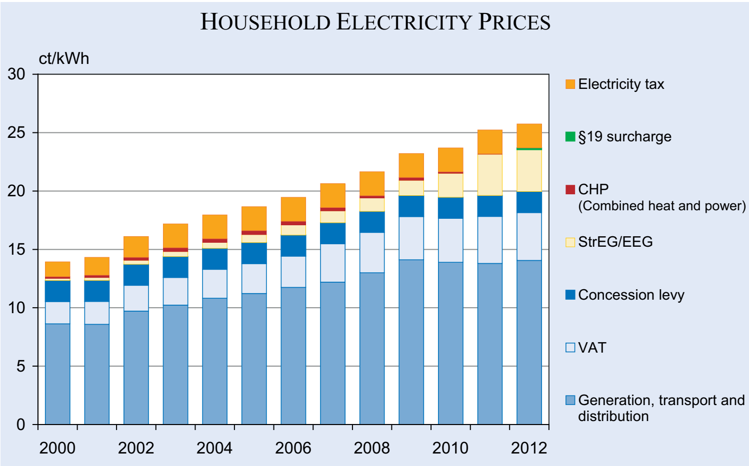
Since 2000, consumer electricity prices have increased by almost 12 ct/kWh. While the costs of the EEG are indeed a contributing factor, they only account for about 3.39 ct/kWh (4.03 ct/kWh including VAT) or 28 percent (34 percent including VAT) of that increase. Price increases primarily reflect rising fuel costs for conventional power. The costs of electricity generation, transport, and distribution have risen by 5.43 ct/kWh (6.46 ct/kWh including VAT) over the same period, accounting for more than 45 percent (about 54 percent including VAT) of the entire price increase.

Figure 2 depicts the price indices for coal and gas imported into Germany. Both indices show a steady upward trend interrupted only by a steep increase in 2008, followed by a subsequent collapse in 2009 back to pre-financial crisis levels. Today, gas prices are once again close to their 2008 peak numbers. Coal prices have settled at levels slightly below their peak four years ago.

Renewable energy as a safeguard from future fossil fuel price increases

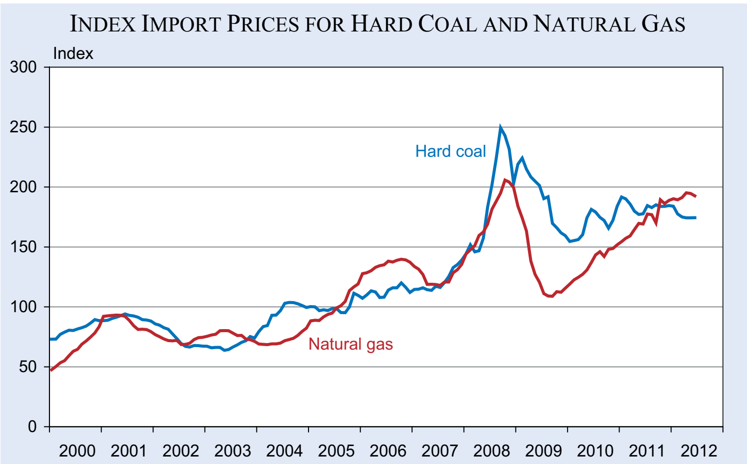
Fossil fuel costs are not only a central driver of recent electricity price increases; projections for future changes in cost also

Figure 1



Source: BDEW 2012.

Figure 2



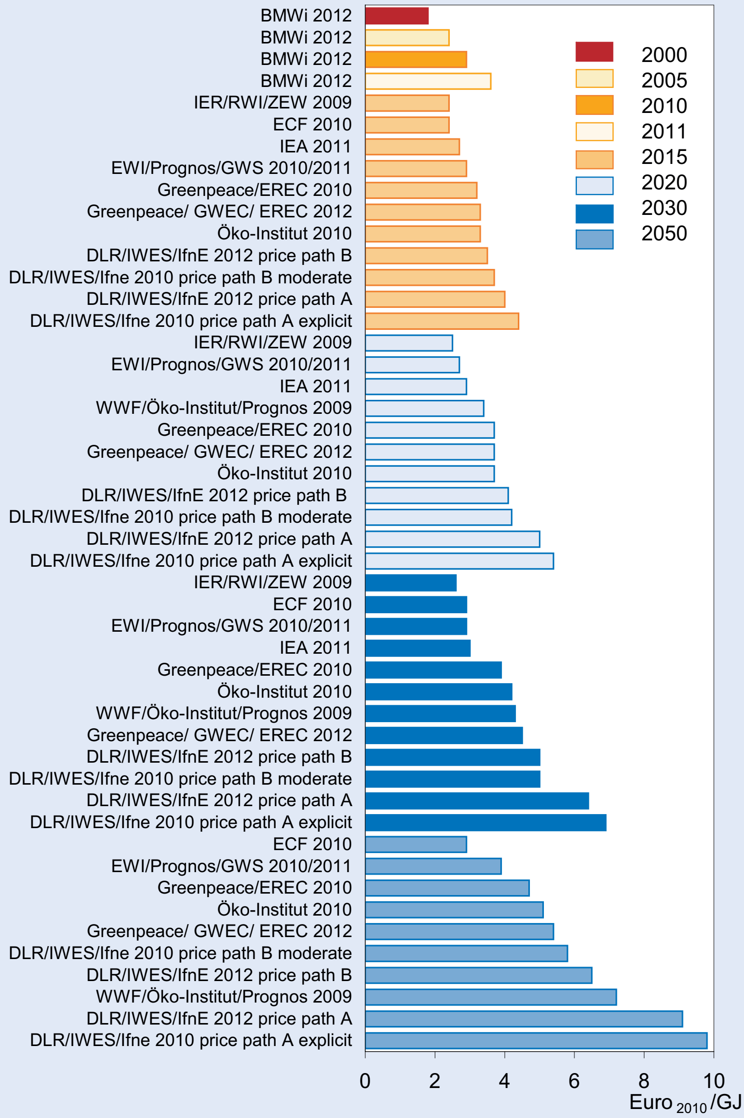
Source: Destatis 2012.

play a decisive role. The costs of the energy transformation are considered to be much higher if stagnant or even falling fossil fuel prices are assumed. On the contrary, higher cost projections for fossil fuels translate into much lower costs of restructuring German's energy supply. Comparing a selection of recent studies shows the wide array of projections prevalent across scenario analyses (see Figure 3 for import prices of coal). To some degree these diverging assumptions reflect the unpredictability of fossil fuel costs. They are also, however, one of the main reasons for contrasting views on the costs of Germany's energy transformation.

Given that scenario analyses have proven sensitive to assumed cost projections, they must be based on the best available knowledge. Increased public discussion and scrutiny of reasonable assumptions should therefore take place. For example, the assumption that the price of conventional energy will either remain stagnant or decrease must be questioned in the context of growing global demand for energy and limits to an easily available supply.

Figure 3

PROJECTIONS OF IMPORT PRICES FOR HARD COAL IN DIFFERENT STUDIES



Source: Based on Agentur für Erneuerbare Energien 2012.

The costs of renewable energies, on the other hand, have been falling and are expected to continue to fall in the future (IRENA 2012; IPCC 2011; for Germany SRU 2011; UBA 2011). Technologies become cheaper as manufacturers accumulate experience, make improvements and enjoy economies of scale. The best wind farms in the world already produce electricity as economically as coal, gas and nuclear reactors; the average wind farm is expected to be fully competitive by 2016 (BNEF 2011; IRENA 2012). In Germany the life-cycle costs of new renewable energy generation sources are nearing those of new conventional power plants. Onshore wind energy in good locations can already compete with gas and coal plants (Fraunhofer ISE 2012).

The decrease in solar PV costs has been both unexpected and unprecedented. Crystalline silicon PV module costs have fallen by over 60 percent in the last two years (IRENA 2012) and are now competitive with residential electricity tariffs in many countries, including Germany. For example, the levelized costs of electricity (LCOE) for small PV systems in locations with solar radiation of 1300 kWh/m2/year, typical for southern Germany, range from 14 to 16 cents/kWh. LCOE for PV systems in northern Germany, with an average radiation of about 1100 kWh/m2/year, tend to be around 20 cents/kWh or lower (Fraunhofer ISE 2012). The life-cycle costs of even the most expensive systems are therefore substantially below consumer electricity tariffs of 25 to 26 cents/kWh.

Further cost reductions are expected if capacity growth can be maintained. Scenario analyses for Germany have concluded that renewable electricity generation costs may be in the range of 6–7 cents/kWh by the year 2050 (DLR et al. 2012; SRU 2011). The Association for Electrical, Electronic and Information Technologies (VDE 2012) argued that generation cost increases in an electricity system where renewable energy accounts for 80 percent by 2050 do not exceed ten percent in comparison to 2010, even when accounting for the costs of electricity storage.

Initially, financing the *Energiewende* requires additional investments (DLR et al. 2012; SRU 2011, chapt. 4). However, these investments are likely to become net savings in the long-term. Future fossil fuel costs, along with the speed at which the cost reduction potentials of renewable energy technologies can be fulfilled, largely determine when this tipping point will be reached.

Questioning the economics of Germany's energy transformation neglects the dangers of continued reliance on fossil fuels, as well as the advantages renewable energy can bring in the future. The energy turnaround should be regarded as a safeguard capable of shielding Germany, an energy importer, from volatile global markets. Critics are, however, correct to call for careful management of the energy transformation in order to reduce initial costs and maximize long-term benefits. Effective and efficient policy design is crucial in this regard (see discussion below).

The true costs of conventional electricity: renewable energy as a competitive energy source today

Fossil-fueled electricity production constitutes the greatest source of GHG emissions in Germany and is therefore a major cause of global climate change. In addition to carbon dioxide, conventional power plants also emit nitrogen oxides (NOx), sulphur oxides (SOx), and particulate matter (PM), all of which damage human health, infrastructure and buildings, as well as ecosystems and biodiversity. They can also have negative impacts on crop yields; even so, conventional power has historically received significant government support.

Debates over the costs of Germany's energy transition often neglect to take into full account the pollution and climate change costs of coal and gas power, the risks of nuclear energy, and the amount of public support different generation technologies have received. Electricity prices do not reflect these costs of electricity generation to society. The EU emissions trading scheme and the electricity tax internalize some of these costs. However, they only do so partially. The price of carbon is determined by the marginal cost of avoiding the last unit of carbon that allows a country or state to meet its short-term emissions target. It is not a measure of potential future damages due to climate change. The electricity tax is also at best a partial internalization of the environmental costs of electricity consumption (Breitschopf and Diekmann 2010). While it increases with consumption levels, several exemptions apply to industry. The tax rate is also independent of the energy source used to generate electricity.

To measure the true costs of electricity, Küchler and Meyer (2012) incorporated direct financial support, tax concessions, and currently un-priced environmental damage to wholesale electricity prices and compared these to average levels of EEG support given to various renewable technologies. Un-priced damages arising from pollution and climate change are the biggest factors changing the relative competitiveness of renewable and conventional electricity generation technologies (for an assessment of environmental costs see also Krewitt and Schlomann 2006 and Breitschopf et al. 2011). The societal costs of one kWh of wind energy amount on average to 8.1 cents, and those of hydropower to 7.6 cents. In comparison, one kWh of coal power costs on average 15.6 cents (lignite) or 14.8 cents (hard), of natural gas 9.0 cents, and of nuclear power 42 cents. Apart from the high average support given to solar PV (36.7 cents/kWh), renewable energies are therefore cheaper today than conventional power.

The competitiveness of renewable energies will also further improve with technical progress and innovation. If markets fully depicted the societal costs of electricity generation, investments decisions on new generation capacity would probably change dramatically. Wind energy would generally be a more attractive investment than coal power; and natural gas plants would be the only profitable conventional generation source.

The EEG levy: exceptions are driving up its costs

Critics tend to point to the EEG levy as proof of what are, in their opinion, uncontrolled increases in the cost of the energy transformation. In 2013 the surcharge is expected to take another big leap to between 4.8 and 5.3 ct/kWh. It is easy to point to Germany's solar power investment boom as the main culprit. However, a considerable proportion of the surcharge increase is also due to growing industry exemptions. The EEG levy should not be considered an adequate indicator of the costs of restructuring the electricity system, since a shrinking number of consumers carry the burden of paying for growing support for renewable energies.

Energy-intensive industries are largely exempt from the surcharge and pay only 0.05 ct/kWh. According to estimates by the Federal Network Agency (Bundesnetzagentur 2012), companies enjoying the reduced rate currently consume approximately 18 percent of electricity in Germany, but pay only 0.3 percent of the total amount collected by the surcharge. The burden of paying for the EEG consequently falls disproportionately on the remaining consumers, and especially on households and small and medium-sized companies. Instead of allocating the costs more fairly, the government has been further reducing the threshold that companies are required to meet to qualify for privileges, meaning that an increasing number is becoming exempt from paying for the costs of the EEG.

The exemptions for energy-intensive industries are justified mainly by reasons of international competitiveness. The criteria for qualifying for the reduced surcharge, however, include electricity consumption and the share of a company's electricity costs as part of its gross value added. A measure attempting to quantify exposure to international competition, however, is not included in these criteria.

Current criteria to qualify for exemption not only disregard a true measure of international competitiveness, but also create perverse incentives that might lead to increased overall electricity consumption. Companies that just barely clear the consumption threshold for exemption are encouraged not to invest in energy efficiency improvements. Companies close to the threshold are even encouraged to increase their electricity consumption in order to qualify for the exemption.

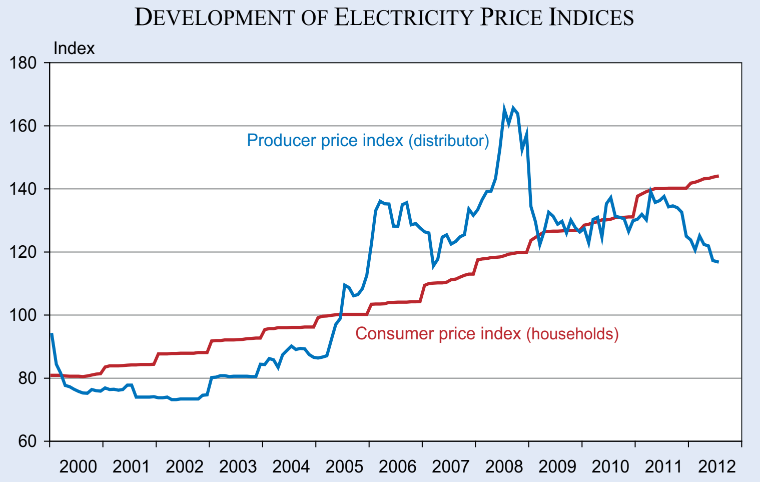
As concerns over rising household electricity rates grow, the extent of industry exemptions becomes harder to justify. Energy-intensive industries not exposed to international competition should pay a greater share of the EEG costs. This would reduce the current EEG levy of 3.59 ct/kWh paid by consumers by around 0.5 ct/kWh (Bundesnetzagentur 2012).

The rationale for granting privileges to industry should also be scrutinized in the context of current market developments. Wholesale electricity prices have fallen between 10 to 20 percent over the last year (Harms 2012), despite Germany's decision to retire 8 nuclear reactors. The price reductions have not only been visible in spot markets, but also in futures markets, which play a greater role in shaping the procurement strategies of electricity suppliers.

The so-called 'merit order effect' constitutes one of the primary causes of lower wholesale prices. In competitive wholesale electricity markets, available generation sources are ranked in ascending order of their marginal costs of production, such as fuel or operation and maintenance costs. Since sources with lower marginal costs are always able to outcompete generation technologies with higher marginal costs, they are the first to be brought online to meet demand. The plants with the highest marginal costs are last in the merit order and set the price all generation resources receive. Unlike producers of electricity from conventional power (who need to buy combustion fuel), wind and solar energy producers have marginal costs that are close to zero. While the lifecycle costs of electricity from wind and solar might be higher than those of some conventional power sources, they can produce electricity very cheaply once a plant is built. If electricity demand remains the same, a growing supply of electricity from renewable energy sources reduces wholesale electricity prices, as conventional plants with the highest marginal costs are pushed out the market. They are replaced by plants with lower marginal costs that consequently set a new, lower electricity price.

The EEG levy, however, does not take into account the benefits of lower wholesale electricity prices, especially for the energy-intensive companies that purchase their electricity directly on the exchange. On the contrary, as a result of how the surcharge is calculated, the merit order effect even leads to an increase in the EEG levy. Its amount is determined

Figure 4



Source: Destatis 2012.

by the additional costs that accrue after the profit from selling renewable electricity at the electricity exchange is subtracted from the total support costs of the feed-in tariffs. A lower electricity price at the exchange means less profit from selling renewable electricity, and the need for the surcharge to cover a greater share of the support costs. A better reflection of the EEG's costs would be to calculate a "net surcharge" by subtracting the extent of price reductions due to the merit order effect from the current amount of the EEG levy. Past studies have estimated the merit order effect to be approximately 0.5 ct/kWh (Sensfuß 2011). The effect is likely to grow with added renewable electricity production capacities. Like the EEG levy, it should be calculated annually.

Electricity price indices: rent seeking

Household electricity prices are not only unnecessarily high because of the artificially increased EEG levy; electricity suppliers are also failing to pass on the cost savings that result from lower procurement costs due to falling wholesale prices (see Harms 2012 for a discussion). A comparison of the price indices for household electricity and producer prices confirms this view. While household prices have been consistently increasing, the producer price index has been more volatile, but steadily decreasing since 2008 (Figure 4). Moreover, the trend of the price index for special-contract costumers, generally large industrial companies, also goes in the opposite direction. In comparison to its 2008 figures, prices have marginally declined.

Electricity consumers are advised to compare electricity rates of different suppliers and change their providers if necessary. The above analysis indicates that the EEG levy was used to push through unnecessary electricity price increases. Concessions were only made to large industrial companies, probably because they have significantly greater bargaining power than individual consumers.

Incremental versus fundamental change of the supporting policy mechanisms

Despite the exaggeration of the costs of the Energiewende in the form of the EEG, Germany's success in transforming its electricity sector, as well as its international replicability, will largely depend on reducing the costs to a minimum. Over the last few years the support for solar power has revealed the dynamic inefficiency of the EEG in adjusting its support levels to accommodate a rapidly changing market. The fact that the cost of photovoltaic (PV) modules fell rapidly while feed-in tariffs changed only slowly enabled investors to enjoy very attractive rates of return, which have channeled a great deal of money into PV development in Germany.

To some degree, the EEG has become the victim of its own success. It succeeded in attracting investments in PV and adding capacity to the market, both of which have been fundamental to achieving further technological development and subsequent cost reductions. However, the additions in PV capacity have far exceeded government targets. Solar power remains a more expensive renewable energy source when compared to wind or hydropower. The unprecedented capacity additions therefore also contributed to increasing the costs of the EEG. Additional tariff reductions were not sufficient to cool the overheated investment climate. Investments increased even further in the time between announcing and implementing tariff cuts because investors wanted to take advantage of the higher tariffs before they were reduced.

Critics of the EEG and the Energiewende consistently cite solar power as the reason for why fundamental change in the support of renewable energies is needed (Acatech 2012; Monopolkommission 2011; Sachverständigenrat für Begutachtung der gesamtwirtschaftlichen Entwicklung 2011). Many advocate a quota system, also referred to as a renewable portfolio standard (RPS) or renewable obligation, whereby utility companies are required to ensure that a certain percentage of their generation sold or capacity installed comes from renewable energies. However, practical experience with quota systems has been mixed at best (Hey and Weber 2012). In comparison to feed-in tariffs, they have been less successful in incentivizing deployment of renewables. Quota systems have also not been as cost-efficient as economic theory claims. Although they channel investments into the cheapest available resource, banks charge project developers a higher risk premium for their loans. The profitability of projects is less certain than under feed-in tariff schemes because income streams depend on volatile markets for tradeable credits.
Quota obligations have often meant that for a given region, investors favored the same technology. A successful integration of renewable energy, however, is much easier when it adds a mix of renewable energies that can complement each other. Most quota obligations have either been replaced by feed-in tariff schemes or supplemented by additional provisions to attract investments in a broader mix of technologies.

The current policy structure needs to be reformed to manage the challenges of an electricity system that relies on growing shares of renewable power. Renewable technologies have matured, going from being a niche market to becoming a central pillar of the electricity market. Adding further generation capacity can no longer be the sole aim of renewable energy support policies. The aim must also be to optimize the renewable energy mix and to make supply more responsive to demand, either directly or indirectly by incentivizing central or decentralized storage technologies and combining electricity, heat, and mobility markets (Schleicher-Tappeser 2012; Lund and Münster 2006; Münch et al 2012).

The latest reforms of PV feed-in tariffs are a step in the right direction to prevent the solar market from overheating again. Monthly adjustments of tariffs ensure greater flexibility of the system to respond to quickly changing deployment costs. Establishing a foreseeable end to fixed tariff-payments once installed PV capacity reaches 52 GW may be useful, as long as it creates pressure for improved system compatibility of high PV levels. Greater cost efficiency for large infrastructure projects, such as offshore wind farms, can also be ensured by combining feed-in tariffs with competitive tenders, in which project developers bid for the level of support they need to build a wind park in a predefined location (SRU 2011).

The demands of renewable energy policy, however, also need to be realistic. Restructuring Germany's energy supply system cannot be accomplished solely by implementing good renewable energy support policies. Adjustments must also be made in the conventional power sector. The conventional system must accommodate renewable energy through greater flexibility in its own production (see VDE 2012 on the need for greater flexibility). Current government plans to build additional coal plants, however, counteract these efforts.
Moreover, energy efficiency must be made a higher priority. Reduced electricity demand makes the energy transformation cheaper, easier, and faster. It prevents the creation of additional capacity requirements, minimizes Germany's reliance on imported and climate-damaging fossil fuels, and reduces the likelihood of potential electricity price increases.

Conclusion

Transitioning Germany's electricity production to renewable sources in the most effective and cost efficient way possible will remain a matter of concern for quite some time. During a transitional phase, production costs for renewable energy will be higher than those for conventional sources. A dynamic, more comprehensive perspective that takes into account future technological development, however, reveals the enormous potential of renewable energy to become the cheapest energy source. If the external costs of conventional power were accounted for, renewables would already be cost competitive.

Despite some overdramatized arguments, the real driver of increases in German electricity prices is not the cost of renewable electricity, but rather the rising cost of fossil fuels. In view of those facts, calls for a fundamental revision of the German feed-in-tariff system are unjustified and counterproductive. They only seem aimed at curbing the growth and innovation trajectory of renewable energy technologies. Reforms of market design should offer a framework for stable growth, while ensuring the complementarity of generation sources, providing for dynamic efficiency, and improving market responsiveness of supply – including incentives for electricity storage and load balancing. Incremental reform of the feed-in-tariff system meets these criteria better than the frequently advocated quota system.

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