Turning energy around: Coal and the German *Energiewende*

The energy systems of most developed countries have traditionally been centralized and based mostly on fossil fuels. As awareness of climate change has grown, however, it has become clear that energy systems need to be fundamentally transformed, to become low- or zero-carbon.[1]

Germany, a long-time leader on environmental and climate issues, has set out to reshape its energy system, aiming to reduce greenhouse gas emissions to 40% below 1990 levels by 2020 and to 80–95% below 1990 levels in 2050, and to phase out nuclear power by 2022. The goals are to be achieved by increasing the share of renewable energy and improving energy efficiency.[2]

This *Energiewende* – typically translated as "energy transition", but more literally "energy turnaround" – creates significant challenges. The renewable technologies that will replace the existing system produce energy in a decentralized manner, requiring different infrastructure and a different market design. Moreover, new actors are involved, whose interests are likely to clash with those of the incumbents keen on maintaining as much of the old, centralized energy system as possible. This is especially true in Germany, where the electricity market is dominated by four big players, and coal retains a significant role in the economy.

This brief examines the coal sector in Germany amid the *Energiewende,* starting with a review of the transition so far, including related economic and energy security challenges, as well as the role of the coal sector in the Germany economy and energy system. The analysis then focuses on how key coal sector actors have responded to a government proposal to levy an additional charge on coal-fired power plants. The goal is to shed light on how stakeholders in the status quo are framing their case against the *Energiewende,* and how their arguments might be countered constructively.

How is the energy transition doing?

Germany has sought to make its energy system more sustainable since the 1990s, but the transition gained new force with the 2000 Renewable Energy Law (*Erneuerbare-Energien-Gesetz,* or EEG).[3] The law regulated support for renewable energy sources, mostly via feed-in tariffs (FiTs) and an obligation for transmission grid operators to prioritize renewables. It has been amended several times, increasingly exposing renewables to market dynamics (such as replacing most FiTs with auctions for new installations; see box), while still aiming to maintain predictability.

In 2010, led by Chancellor Angela Merkel, the government adopted a strategic vision ("Energy Concept") for the energy system up to 2050, including the 80–95% emission reduction goal.[4] In 2011, prompted by the Fukushima disaster, Germany decided to phase out nuclear power by 2022.[5] In harmony with European Union policies, Germany also adopted two additional goals for 2020: to reduce energy consumption by 20%, and to increase the share of renewables in the electricity mix to 35%.

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The Solar Settlement in Freiburg, in Germany's 'Sun Belt', is a collection of homes and businesses that produce a positive energy balance and are carbon-neutral.

This *Energiewende* has made significant progress. Between 2000 and 2014, emissions decreased by 13.5%, to 902 million tonnes CO_2e (this is 27% below 1990 levels) – arguably a feat for a nation where 30% of value-added GDP comes from the industrial sector.[6] Nine nuclear reactors have been shut down without compromising grid stability (see below). The share of renewables in electricity consumption has grown from 6.5% in 2000 to an estimated 32.6% in 2015.[7]

Yet 42% of German's power production in 2015 still came from coal, and CO_2 emissions from coal combustion in 2013 were 329.3 Mt – more than Spain's total greenhouse gas emissions that year.[8] Emissions from coal use have declined far more slowly in Germany than EU-wide, and they actually rose by 4.7% from 2010 to 2013. As shown in Table 1, some *Energiewende* objectives are likely to be missed unless additional efforts are made. Emissions have remained relatively stable in recent years, and from 2014 to 2015, they increased by 0.6%. Renewables uptake in the heat and transport sectors is lagging behind, and although the *Energiewende* aims to reduce energy consumption by 20% from 2008 levels by 2020, energy consumption only decreased by 7.4% from 2008 to 2014, which suggests efficiency is improving too slowly to meet the target.[9]

The uneven progress of the *Energiewende* has not only kept it in the news, but has also led to a contestation of the energy transition on multiple fronts. Critics have raised issues ranging from technical questions, to concerns about social justice, but the dominant themes are economic challenges and energy security.

What are the economic challenges?

The cost of the energy transition and the price of energy are often used as indicators of the transition's viability. The *Energiewende* is largely financed via a levy on electricity, the "renewable energy surcharge" (*Erneubare Energie Umlage*). This surcharge rose from 0.19 €cent/kWh in 2000 to 6.17 €cent/KWh in 2015, increasing the costs for consumers from €667 million to €21.8 billion.[10]

Table 1: Assessing the progress of the Energiewende

Policy area	Objective 2020	Objective 2050	Status 2014
Emission reductions (from 1990 levels)	- 40%	- 80–95%	27%
Nuclear phase-out	Complete phase-out by 2022	–	8 reactors still running, delivering 8% of primary energy consumption
Renewable energy (in energy mix)	18%	60%	13.5%
Renewable energy (in electricity mix)	35%	80%	27.8% (32.6% estimates for 2015)
Energy consumption (from 2008 levels)	11,315 PJ (or -20%)	- 50%	13,103 PJ (or -7.4%)

Colour coding reflects relative progress towards 2020 targets; green means "on target"; yellow means "uncertain", and red means "target likely to be missed without additional efforts". Data sources: Umweltbundesamt, AG Energiebilanzen, Eurostat.

Other expenses – such as infrastructure investments needed to adapt the power grid to more decentralized production, expected to amount to €33 billion up to 2024[11] – further increase the energy bill, as do costs related to the nuclear phase-out. Altogether, electricity prices for a typical German household rose from around 20 €cent/KWh in 2007 to almost 29.5 €cent in 2015, the second highest in Europe after Denmark, even as added renewables lowered electricity prices on wholesale markets.[12]

The impact on industrial consumers has been mixed. Some buy power at wholesale and have benefited from the lower prices. Others – particularly those competing internationally – get exemptions that reduce the cost of the renewables surcharge. Still, on average, prices have risen for industrial consumers: from 11.5 €cent/KWh in 2007 to 17.3 €cent/KWh in 2015 for companies consuming 2,000–20,000 MWh per year, for example. This regularly leads to debates about the transition's impact on German industrial competitiveness.

The price increases have to be put in perspective, however. First, taxes and levies are only part of the electricity price – procurement and transmission costs are still major components. That means global fuel price fluctuations play at least as big a role as renewable energy subsidies in driving German electricity prices. Also, gains in energy efficiency mean that relative to GDP, German end consumers paid only 2.4% of GDP in electricity bills, a value lower than in 1992.[13]

Second, though some are more energy-intensive than others, 92% of German manufacturers spent, on average, only 1.6% of their revenue on energy.[14] And Germany's overall competitiveness seems not to have suffered, as its export surplus rose from €59 million in 2000 to €248 million in 2015.[15] Third, the cost of renewable energy development is still lower than the cost of fossil fuel imports. For example, in 2014, Germany imported €23.5 billion worth of natural gas.[16] Yet by meeting a growing share of the country's energy demand, renewables are estimated to have helped avoid another €8.7 billion in fossil fuel imports that year, including gas, oil and coal.[17]

In the long term, energy transition investments could yield significant gains, particularly since the energy system needs regular investments anyway, as the infrastructure ages. A recent analysis thus concluded that a scenario that reduces emissions by 85% from 1990 levels by 2050 would be at least €600 million cheaper than the business-as-usual case in most pathways.[18]

Indeed, valuing long-term benefits over short-term costs may be why the *Energiewende* still enjoys widespread support in German society. Although the private sector is more critical,[19] and controversies about the transition resurface regularly, recent studies by a variety of polling firms confirm the large support the energy transition enjoys among German citizens,[20] though some "course corrections" are seen as necessary.[21]

That said, there are clearly winners and losers in the *Energiewende*, in the energy sector and beyond. This is particularly true for the "big four" utilities in Germany, which together produce more than half of the country's electricity, as shown in Table 2.

Table 2: The 'big four' electricity producers in Germany, 2014

Utility	Employment	Share of power production (total = 627.8.4 TWh)	Installed capacity	Share of coal in installed capacity	Renewables share in power production
RWE	36,411	~24%	26.5 GW	59%	~ 1%
E.ON	11,749	~13%	17.3 GW	32%	8% (mostly hydro)
EnBW	20,092	~9%	13.7 GW	41%	12.4%
Vattenfall	16,158	~11%	15.9 GW	67%	< 6%*

Source: Official data from each provider (via reports on their websites). Except for as noted, data are for German operations only.
* Vattenfall renewables data are only available for "UK and continental" European operations.

The "big four", which represent the status quo of centralized, fossil fuels-based energy production, face growing competition from decentralized renewables. Moreover, the rapid rise in renewable generation has created a large surplus of power, driving down wholesale electricity prices and squeezing profits for the utilities. RWE alone reported a net loss of €200 million and asset impairments worth €2.1 billion in 2014.

At the same time, the "big four" have invested heavily in natural gas technologies , increasing German gas generation capacity by 8.5 GW from 2002 to 2014. But because coal remains cheap, and allowances in the EU Emissions Trading System (EU ETS) are low, gas power is comparably more expensive and less profitable. Coal has thus maintained its dominance in the German power sector, with emissions rising as the profits of the "big four" shrink. The companies have also mothballed some of their gas capacity, raising concerns about the security of power supply.

These difficulties, along with growing pressure to embrace the *Energiewende,* may be why RWE and E.ON have both chosen to separate their renewables business from coal and gas plants.[22] And while this might be a first step towards embracing the energy transition instead of fighting it, recent legal developments in Germany might benefit the incumbents and their business model (see box at right).

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A gas turbine power plant in Hamburg-Moorburg.

Security of supply and generation adequacy

Security of supply is defined by the European Commission as "uninterrupted access to energy sources at an affordable price".[23] If Germany relies heavily on intermittent renewables such as wind and solar, without a backup to keep the lights on during windless and/or cloudy days, it could face shortfalls in power generation. From that perspective, to the extent that the *Energiewende* causes financial difficulties for dominant market players and leads to reductions in gas-fired power, it could compromise energy supply security. Another concern from a supply security perspective is that wind and solar power surges would strain the grid in Germany and neighbouring countries.[24]

Yet this is only one side of the story. Germany, like most European countries, has a significant surplus of power generation capacity.[25] And while competition from renewables is a real challenge, the increase in gas capacity was the power generators' choice. There are other ways to integrate intermittent renewables, such as by increasing electricity trade with other EU countries,[26] adopting a more flexible market design,[27] better managing demand, and through storage – conventional (e.g. pumped-storage hydropower) and new technologies (e.g. electric vehicles).[36] Also, while gas-powered plants for load balancing may still be needed to some extent, it is important to keep in mind that much of this gas comes from Russia, a source of geopolitical troubles and supply disruptions.[37]

The energy transition could reduce this dependency on fossil fuel imports (both gas and hard coal), since each kWh produced from renewables is one less kWh of fossil-fuelled power that is needed. As noted above, renewables have already reduced import needs. Energy efficiency measures, another key aspect of the *Energiewende*, will further reduce import dependency. And while some measures to better deploy and

From FiTs to auctions: A new stumbling block for the Energiewende?

In July 2016, the German government amended the Renewable Energy Law (EEG), making several changes, effective January 2017. The most important one is to transition from feed-in tariffs (FiTs) to auctions; instead of developers receiving the same fixed payment for their electricity from renewables, they submit bids, and the lowest bidder gets to develop the project; this is known as the pay-as-bid principle (small-scale installations are exempt). The law also provides for a "deployment corridor" (Ausbaukorridor) to be maintained that explicitly states how much clean energy capacity can be added to the grid each year.

Proponents of this reform argued that it was needed to expose renewables more to the market[28] and to rein in extensive renewables capacity additions (and costs) to guarantee grid stability and align capacity additions with electricity grid extensions.[29] Indeed, installed capacity of renewables other than hydropower has skyrocketed, rising from 13.9 GW to 92.9 GW between 2002 and 2015 and straining the grid (see below).[30]

However, the reform also drew criticism from environmental NGOs, renewables companies and local politicians, who argued it might slow the Energiewende and stifle citizen participation.[31] Germany has been lauded for having more than 45% of installed capacity owned by private individuals, farmers and citizens' initiatives.[32] In 2012, those stakeholders contributed 31% (or €5.1 billion) of all renewables investment in Germany,[33] which is generally seen as having a favourable policy environment for bottom-up renewables development.[34]

But small cooperatives and individuals are not well positioned to compete in auctions, because they lack relevant expertise, face higher transaction costs, and cannot achieve the same economies of scale as large companies. This is why the reform of the EEG in 2016 could be seen as helping the big German utilities to invest in renewables, potentially at the expense of small, broad-based renewables projects. And while having a foreseeable corridor or capacity additions is beneficial for grid stability, and it is still too early to tell how auctions might affect renewables development, it is noteworthy that new solar PV installations have already fallen from 462.7 MW from January–May 2015 to 350.2 MW in the same period in 2016.[35]

manage renewables create challenges, Germany is much better positioned to deal with them under European and German rules and regulations than it is to influence non-EU countries and global energy markets.

The *Energiewende* and coal supply

A more delicate issue is how to reconcile the Energiewende with Germany's continued role as a coal producer. The country has an estimated 40.5 billion tonnes of coal reserves, almost all lignite (brown coal) – enough to maintain current production rates for more than 200 years.[38] In 2014, Germany produced about 7.6 million tonnes (Mt) of hard coal and 178 Mt of lignite, the latter mined mainly in the Rhineland (94 Mt) and in Lausitz (62 Mt).[39] Coal consumption stood at about 232 Mt in 2014, including almost all the domestically produced coal, plus about 50 Mt of hard coal imports. Lignite use and hard coal imports have fluctuated, but both are higher than in 2000.

Although coal is used in some industries, such as steel and chemicals, the vast majority of Germany's coal goes to the power sector. In 2015, 42% (274 TWh) of German electricity generation was coal-powered. While generation from hard coal has dropped by 17.5% since 2000, lignite-based power is actually up by 4.5%. As noted earlier, this has direct implications for CO_2 emissions.

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The lignite mine Garzweiler, a 42km² surface mine operated by RWE in the state of North-Rhine Westphalia.

Coal production is also a sizeable economic activity. According to the German Statistics Office, coal mining (hard coal and lignite combined) paid €1.3 billion in wages in 2015, with average monthly employment of about 24,100, and had €2.4 billion in turnover in 2015.[40] Comparable turnover and wage figures are not available from industry sources, but industry estimates of employment (in 2014) are much higher: about 21,400 in lignite and 12,100 in hard coal, for a total of 33,500.[41]

Citing a study it commissioned, the German Lignite Federation says that in 2009, the "induced" production value of the lignite industry, including power plants, was €8.1 billion, and turnover was €2.7 billion). The same study estimates about 2.5 indirect and induced jobs for every direct job in the industry. While such calculations need to be handled with care, it is true that in some places, coal mining is central to the local economy. That is why Vattenfall, for example, argues that some 33,500 jobs depend directly or indirectly on its lignite operation in the Lausitz region alone.[42]

Yet the coal industry also benefits from government subsidies, accounting for roughly half of Germany's €4.5 billion in total fossil fuel subsidies in 2011.[43] Hard coal production, which is too costly to compete internationally, received a combined €1.9 billion in subsidies from the federal government and the state of North-Rhine Westfalia in 2010. Lignite, although competitive and not directly subsidized, is exempt from royalties under the Federal Mining Act, saving at least €279 million in 2010.[44] However, Germany has decided to phase out its hard coal subsidies by 2018, thereby declaring an end of its hard coal industry by the same date (see box).

The German hard coal phase-out

Germany adopted a law in 2007 to phase out federal subsidies to hard coal. In part, it was bowing to EU pressure: with some exceptions, state aid and subsidies are forbidden under Article 107 of the Treaty on the Functioning of the European Union. Indeed, in 2010, the European Parliament, together with the Council of the European Union, adopted Decision 2010/787/EU, specifying that all subsidies for hard coal mines should be phased out by 2018.

Yet the subsidy phase-out was also a recognition of economic realities, since hard coal production in Germany is almost three times as expensive as imports.[45] Already in 2005, the German government had decided to reduce hard coal production. That same year, an agreement was reached for early closure of the Walsum mine in North-Rhine Westphalia, after a consultation between the industry, labour, and government officials. The "Walsum Agreement" (Walsumer Verständigung) aimed to cushion the social impact of the closure, which occurred in 2008. Among other things, it provided for "adaptation money" (Anpassungsgeld) for people of a certain age who lost their jobs, for up to five years. According to the Ministry of Economy and Energy, €116 million was spent on that measure in 2015 alone.[46]

This case illustrates how a shift away from fossil fuels might work. First, it may take years of advance planning, for a phase-out rather than an abrupt stop. Second, it is likely to involve legislation, possibly at multiple levels of government. Third, successful implementation requires engaging all key stakeholders, favouring consensus over confrontation. Fourth, social policies may be needed to soften the impact on workers and communities.

The renewable energy sector is subsidized as well, but it is taking a very different trajectory. In 2014, German manufacturers of renewable energy equipment and components had €21.8 billion in sales, up from €7.2 billion in 2004 (but down from a record €26 billion in 2012).[47] Although German photovoltaics production has declined amid strong global competition, onshore wind has grown steadily, to €11.8 billion in 2014, driven by exports. Renewables employ than 10 times as many people as the coal sector: about 355,000 in 2014, including 130,500 in onshore wind and 48,600 in solar technologies. Of course, the jobs and economic development associated with renewables may not benefit the same people who now depend on coal for their livelihoods, which is why appropriate social policies are needed to ease the transition. Still, it is clear that renewable energy is not only transforming Germany's power sector; it is also a major economic force.

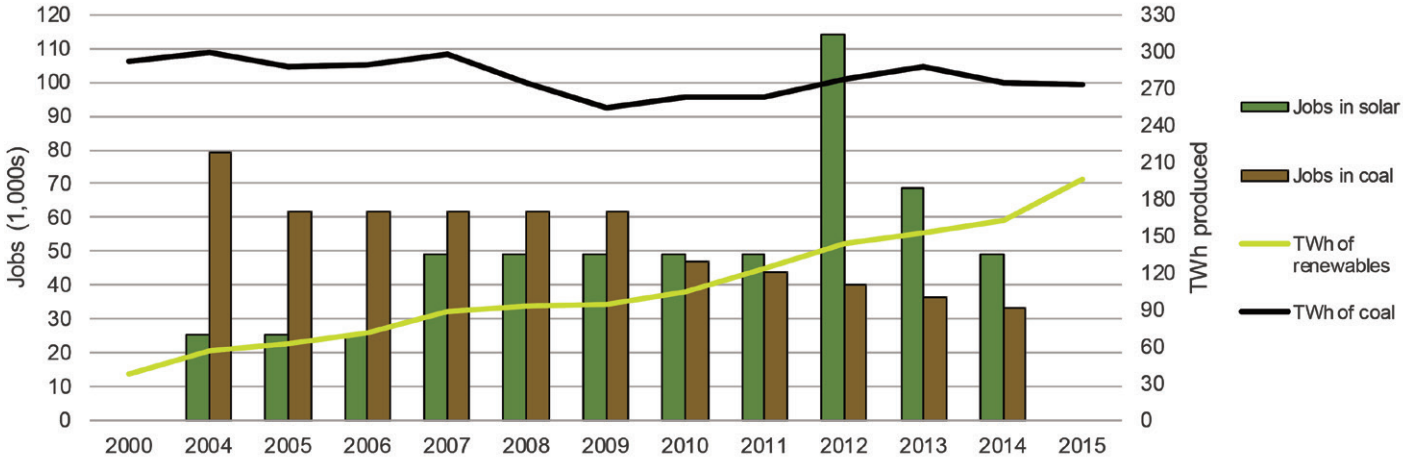

Figure 1: German electricity production trends and jobs in the coal and solar sectors

The coal sector pushes back on the *Energiewende*

The German energy transition may have policy and economics on its side, but it also faces powerful resistance. As noted earlier, the "big four" utilities have mostly stayed away from renewables; mining concerns and labour unions have also been vocal. These stakeholders still wield significant influence. Not only can they mobilize resources to fight policies that affect them, but they have a strong interest in shaping the discourse about the energy transition and setting the policy agenda in order to protect their interests amid growing pressure from renewables.

How problems are framed can determine which solutions are favoured or even considered. Prioritizing energy security in the *Energiewende,* for example, may lead to different policy measures than focusing on social justice. In their own advocacy efforts, German coal interests have often highlighted the need to protect jobs in their sector.

A prime example is the response to a proposed climate levy on power plants. Recognizing the paradox of rising electricity production from renewables and a simultaneous rise in CO_2 emissions from coal, in 2015 the German government proposed to levy a surcharge on polluting power stations. While the measure was presented as "fuel neutral", it clearly would have had a disproportionate impact on coal-fired power plants. Supporters described the measure as a cost-effective and efficient way to reduce power-sector emissions.[48]

What followed were heated debates, with vocal opposition to the levy from power industry unions, utilities, mining companies, and some politicians within the governing coalition. An analysis of press releases on key stakeholders' websites shows most rejected the levy vehemently. Coal producers and coal-fired power plant operators were, unsurprisingly, the most outspoken, though Germany's second- and third-largest labour unions and two business lobby groups were also vocal. The mining union IG BCE and other industrial stakeholders whose members' jobs were at stake offered a counter-proposal: to put certain coal-fired plants into a "capacity reserve for energy security and climate protection".[49]

However, there were notable differences among stakeholders. EnBW, which has the largest renewable energy portfolio among the "big four" utilities, even sent a letter to Sigmar Gabriel, Germany's economic minister, to voice moderate support of the government's decision.[50] Vattenfall, which recently sold its German coal operations, kept out of the public debate. Germany's largest union, IG Metall, voiced its support for a German coal phase-out;[51] this might be explained by the fact that many of its members work for renewable energy companies.

Still, the strongest voices were against the government's policy, and their arguments centred on the risk of job losses. In the 32 documents analysed, job losses are mentioned 77 times, supported sometimes by claims that entire regions

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More than 15,000 people employed in the energy sector demonstrate for a "just transition" outside the Ministry for the Economy and Energy in April 2015.

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About 17,000 people took to the streets of Berlin last November to call for climate action and support the Energiewende.

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A panorama of the lignite mine Welzow Süd, in Brandenburg, part of the Lausitz coal production area.

would suffer from actual and "social blackout". Another issue, mentioned far less often, was that the climate levy would cause unspecified economic losses and/or a loss of competitiveness. Internal energy security (grid stability, generation adequacy) was mentioned significantly less (27 times), while external energy security (domestically produced coal as an alternative to imported fossil fuels) was mentioned only once.

This focus is interesting since this brief has shown that renewables not only produce a growing share of Germany's electricity, but they employ hundreds of thousands of people who contribute to the German economy. Still, the beneficiaries of those jobs and that economic activity are not the same as those who rely on the coal industry, and there is little doubt that in some places, such as Lausitz, coal remains central to livelihoods. What is striking is the disproportionate political power of arguments focused on coal-sector jobs, particularly since the solar industry has had far more employment volatility. As shown in Figure 1, between 2012 and 2013, amid growing international competition, more than 45,000 people lost their jobs in the solar sector – a figure which far exceeds current employment in the hard coal and lignite sectors.

In the end, the climate levy proposal was scrapped, replaced by a plan to retire 2.7 GW of lignite-fired capacity in 2023. But until then, the plants are to be kept in a "capacity reserve" to fill gaps in renewable generation – a victory for coal interests. IG BCE welcomed the solution as "good for the climate, as well as for jobs and industrial locations", and said it combined climate goals with "economic reason and social responsibility".[52] Many critics have argued that paying to keep the plants online for years, despite Germany's excess power generation capacity, is sub-optimal economically and for the climate. Nevertheless, the proposal has been included in a new proposed electricity market law that is to be voted on in the second half of 2016.

The way forward

Many years into the *Energiewende,* it is clear that Germany's coal sector and other powerful stakeholders with an interest in the status quo remain strong enough to noticeably hinder the energy transition. But their focus on potential job losses, negative economic repercussions, and security of supply arguments seems to lag behind reality.

As this brief has shown, while integrating renewable energy sources into the economy at large is not without challenges, it is feasible in a manner consistent with economic growth, security of supply and emission reduction goals. And while a coal phase-out would be hard on a few German regions, for the country as a whole, the *Energiewende* is creating more jobs and more wealth than the coal sector and associated industries. Still, greater efforts are needed to understand the structural, institutional and social dynamics that support the status quo, to uncover why they remain so powerful and to identify new arguments and policy measures that could help change the dynamics.

Some options and policy priorities emerge from the analysis in this brief:

- To succeed, the *Energiewende* requires Germany's energy system to change on a structural level, embedded in the European context. Infrastructure investments and a new market design should facilitate renewable energy uptake, not hinder it. As the term implies, the *Energiewende* is a turnaround, not a small shift. This entails profound changes to the way Germany produces, distributes and consumes energy.

- In order to maintain the people's support for the *Energiewende*, there has to be an honest, broad-based discussion about what constitutes a "just transition" – and about who will do better or worse in the short term. Investments will be needed to foster new kinds of economic development and job growth in places such as Lausitz or the Rhineland where coal is a dominant employer. One way to fund this would be to redirect subsidies to coal – and other fossil fuels – to help communities to transition. It might also be reasonable to ask German industry to make a somewhat larger contribution to the cost of the *Energiewende*.

- Citizen participation in renewables deployment has to be encouraged, not stifled. Not only does this put citizens in the driver's seat of the energy transition, letting them build and benefit from their own renewable energy sources, but it may help avoid "not in my backyard" attitudes and thus foster continued support of the energy transition.

- Communications around the *Energiewende* can still be improved. The government needs to show, in the most transparent manner possible, how German society as a whole is benefitting, and how existing challenges will be overcome. The energy transition is under constant pressure from different angles, and the arguments often don't reflect realities on the ground. Research and advocacy organizations, some of which have already made substantial contributions, play a key role in laying out the facts and providing science-based analysis to help policy-makers and citizens make informed decisions.

Complex transitions such as the *Energiewende* have happened throughout human history, driven by innovation and techno-

logical progress. More is at stake this time, however, as we urgently need to reduce greenhouse gas emissions to avoid the most dangerous impacts of climate change. The good news is that Germany has a plethora of legal, technological and financial instruments to help it achieve its goals, and in a more democratic manner than ever before. The way forward is clear; what the *Energiewende* needs most now is political leadership and perseverance.

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The offshore wind farm DanTysk while under construction in 2014. The 288 MW installation, owned by Vattenfall, is in the German North Sea.

Endnotes

1 See, for example, IEA (2015). *Energy Technology Perspectives 2015: Mobilising Innovation to Accelerate Climate Action*. International Energy Agency, Paris. http://dx.doi.org/10.1787/energy_tech-2015-en.

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3 The original law and its updates, as well as explanations of the key provisions, are available at: https://www.erneuerbare-energien.de/EE/Redaktion/DE/Dossier/eeg.html?cms_docId=73930 (in German).

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6 All emissions data cited in this brief are from the German Environment Ministry (Umweltbundesamt): https://www.umweltbundesamt.de/themen/klima-energie/treibhausgas-emissionen. GDP data are from the World Bank: http://data.worldbank.org/indicator/NV.IND.TOTL.ZS.

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