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FACTS & FINDINGS

Accelerated "Energy transition" in Germany after Fukushima: An Overview of the German "Energiewende"

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The concept for the German energy transition ("Energiewende") was approved at the end of 2010. Not long afterwards, the Fukushima disaster in Japan sped up the withdrawal from nuclear power and accelerated the timetable for the intended transition. Nevertheless, the transition's designated targets will be implemented as originally envisioned to satisfy the criteria of cost-effectiveness, energy security, and climate protection. Two years on, the German public views progress with considerable scepticism; some even speak of failure. But an in-depth analysis indicates that the energy transition can be economically viable as long as state subsidies for renewable energies are administered judiciously. Energy security can be improved if power grids are modernised and if incentives are created to encourage the use of fossil fuels as interim power sources to span the transition. The overriding goal of climate protection will be confined to Germany, as the country's efforts do not dovetail with those of the broader European regulatory community. But the country's position as a global role model may yet provide the impetus for similar transitions in other industrialised and emerging economies.

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ENERGY TRANSITION IN GERMANY

High expectations overshadow recognisable progress

In light of global climate change and the need for sustainable energy supplies, Germany promulgated policies aimed at ushering in the era of renewable energy in late 2010. Originally, nuclear energy was conceived as a kind of bridging element to span the transition without compromising energy security. But the devastating natural disaster and resultant accident at Japan's Fukushima power plant in early 2011 changed Germany's calculus, leading to a reassessment of the risks entailed in nuclear energy. As a result, a multi-party consensus in favour of an "accelerated" energy transition emerged. The objectives remained the same: Germany would seek to transition fully (or almost fully) to renewable energy sources by 2050, drastically reduce climate-damaging greenhouse gases, and improve energy efficiency. But this consensus also demanded that the country's share of energy derived from nuclear sources be eliminated incrementally by 2022; this measure changed one of the key assumptions of the energy transition. Against this backdrop, several new challenges will have to be tackled.

TARGETS:

- Climate-damaging greenhouse gas emissions are to be reduced by 40% by 2020, 55% by 2030, 70% by 2040 and by 80 to 95% by 2050, compared to reference year 1990.
- Primary energy consumption is to fall by 20% by 2020 and by 50% by 2050.
- Energy productivity is to rise by 2.1% per year compared to final energy consumption.
- Electricity consumption is to fall by 10% by 2020 and by 25% by 2050, compared to 2008.
- Compared to 2008, heat demand in buildings is to be reduced by 20% by 2020, while primary energy demand is to fall by 80% by 2050.
- Renewable energies are to achieve an 18% share of gross final energy consumption by 2020, a 30% share by 2030, 45% by 2040 and 60% by 2050.
- By 2020 renewables are to have a share of at least 35% in gross electricity consumption, a 50% share by 2030, 65% by 2040 and 80% by 2050.

Source: www.bmu.de

EUROPEAN AND INTERNATIONAL INTEGRATION

The German energy transition is taking place in the context of a global reconfiguration of the energy landscape. Within the European Union (EU), member states continue to determine the composition of energy sources within their borders, precluding shared energy policies. Germany's energy transition needs to find a way to challenge this reality.

There are thirteen countries in the EU (including Denmark, Austria, and Latvia) that do not operate any nuclear power plants of their own. These thirteen countries, which comprise just under half of the EU's membership, use fossil fuels and renewable sources as the basis for their energy supplies, but they also import power derived from nuclear energy. Far from reflecting a binary EU energy policy, these circumstances attest to the national character of energy policy as stipulated under the Lisbon Treaty. These circumstances also highlight the commodity-like qualities of energy products such as electricity; EU members are constantly buying and selling electricity from one another. It is hardly surprising, then, that ideas concerning the uses of nuclear energy are rather diverse and politically unpredictable. Sweden at one point resolved to phase out nuclear energy only to reverse the decision under a succeeding government. Italy experienced similar political whiplash, albeit with a different outcome. Its government abandoned nuclear power in the wake of the Chernobyl disaster; then, shortly before the Fukushima accident, considered reintroducing it, but relented in the face of stiff opposition from the public. On the other hand, Switzerland, which is not an EU member, recently decided to phase out nuclear power for good by 2034. Poland, which has been relying almost exclusively on fossil fuel sources such as coal and gas, announced its foray into nuclear power with the construction of six new plants. The Polish government is in no small part motivated by its growing dependence on Russian gas imports. France, for its part, appears to represent continuity within Europe where nuclear policy is concerned, generating over 70 percent of its electricity from its reactors. It was something of a shock, therefore, when the new French President Hollande declared that this percentage would be rolled back to 50 percent by 2025. Other European countries, such as the Czech Republic and the United Kingdom, have announced the construction of additional nuclear power plants. In this way, they mirror the rest of the world. China plans to build 51 plants; India hopes to construct 17. There are also several new plants on the drawing board in the United States, though not nearly as many as in emerging economies. Comparable developments can be observed in other industrialised countries outside of Europe. It is hard to predict Japan's future energy mix against the backdrop

of Fukushima. For a while, it appeared that Japan aspired to opt out of nuclear energy altogether. The current government, however, questions whether it could feasibly dispense with nuclear power because opportunities for renewable energies in Japan are rather limited.

Following the launch of its energy transition, Germany was roundly criticized for inadequate consultation with fellow EU countries, particularly with its neighbours. The criticism has a certain logic to it, as Germany's economic and geographic centrality assures direct, cross-border impacts arising from the energy sector reorganisation. In one example, the twin realities of Germany's burgeoning renewable sources and its dearth of domestic grids led to a situation in which electricity generated in northern Germany was routed to southern Germany via transmission lines in Poland and the Czech Republic. (Poland intends to set up mechanisms on the German-Polish border to inhibit cross-border flows of electricity.) The energy transition is also causing cross-border economic disruptions. Heavily subsidised renewable energy in Germany can undercut rival power suppliers in neighbouring countries, as was the case when a natural gas operating company Netherlands had to shutter its facilities. Nevertheless, Germany's energy transition also represents an opportunity for its neighbours. Norway, for instance, could work with Germany to solve the riddle of storing renewable energy in the form of dam reservoirs.

Germany's energy transition comes at a time when the geopolitics of energy is changing dramatically. Rising global energy demand is raising the profile of nuclear power, but it is also increasing the political salience of fossil fuels such as coal and gas. There are several signs that bear witness to the reconfiguration of global energy supply security: the exploration of energy resources in the Arctic, the increasingly cost-effective (and thus increasingly large-scale) extraction of shale gas in the United States, rising oil prices, escalating tensions in oil-producing regions, and the expensive (and, in light of the environmental and macroeconomic costs, questionable) use of tar sands in Canada. However, rising energy demand has also prompted states across the globe to strategically embrace renewable energy sources – sources that emerging economies neither want nor can do without. Brazil, for instance, derives a large portion of its energy supplies from renewable sources (hydroelectric and biomass). This fact, however, should not disguise the country's intensive efforts to explore fossil fuel sources in the Atlantic. It should also be mentioned that, in absolute terms, the amount of renewable energy (wind, solar, and biomass) generated in newly industrialised economies exceeds that of Germany by now. The world's largest wind farms are located not in Germany but in China and in the United States.

Viewed from Europe, it is clear that Germany's phasing out of nuclear power is not an unusual process. On the contrary, it integrates sensibly into the European landscape, which is rather varied and unpredictable. Yet in comparison with non-EU countries, Germany occupies a special role, and not merely on account of its industrial importance. Outside of Europe, there is a pragmatism at work that assigns a strategic – though admittedly often small – role to renewable energy sources. Because the main focus outside Europe remains nuclear and fossil fuel power, the challenge for the architects of Germany's energy transition is to demonstrate convincingly that an industrialised country does not necessarily have to resort to uranium or hydrocarbons alone.

CLIMATE PROTECTION

The energy transition can advance international climate protection, but it must display greater consistency in Europe

One of the main goals of the energy transition is to reduce the emissions of climate-damaging greenhouse gases such as carbon dioxide (CO_2). Between 1990 and 2011, Germany succeeded in lowering CO_2 emissions by over 23 percent, thereby fulfilling its commitment under the Kyoto Protocol. Deindustrialisation in the new federal states was a major factor in Germany's success. The next milestone in the course of the energy transition has been set for 2020. By then, CO_2 emissions are to be reduced by 40 percent compared to 1990; this figure is to rise to over 80 percent by 2050. The reductions are designed to prevent (or, at a minimum, mitigate) further global warming. Present-day climate change can be ascribed in large part to the emission of greenhouse gases (such as CO_2) that began with the advent of industrialisation about 150 years ago. In contradistinction to earlier, natural shifts in the climate, present-day climate change is occurring very rapidly. The effects are particularly visible in developing countries, but also in Germany. The manifestations of climate change include, *inter alia*, more frequent droughts, rising sea levels, and extreme weather conditions. In Germany, the agricultural sector is grappling with the greatest impacts, but residential areas also suffer – through more frequent flooding, for instance.

German measures to curtail greenhouse gas emissions are part of global efforts to limit the global temperature increase to two degrees Celsius relative to a pre-industrial benchmark. International comparisons reveal that German energy-related CO_2 emissions comprise a mere three percent of worldwide emissions (emissions from the EU collectively comprise twelve percent). By these measures, the

largest drivers of greenhouse gas emissions are China (25 percent of global emissions) and the United States (18 percent). Germany's significance in the context of global climate protection efforts is based on its position as a leading economic power. If an industrialised country such as Germany were to succeed in uncoupling its growth-oriented economy from dependence on non-renewable energy sources, it would send an emphatic and positive signal to other rapidly growing economies. The argument for climate protection could be reinforced by an economic rationale, providing global efforts with greater incentives. In the wake of the energy transition, Germany itself has registered a gradual drop in energy intensity. In this way, a continuing increase in German GDP goes hand in hand with declining primary energy consumption. There has even been a decoupling of emissions levels from macroeconomic growth.

The initiative to launch a club of nations committed to energy transition, recently unveiled by the German environment minister, typifies the position Germany could occupy as a role model. The initiative envisions a community of nations that would aspire to greater sustainability through reorganizations of its member states' energy sectors. This community would also provide momentum for international negotiations aimed at curbing climate change. A preliminary meeting for prospective members of such a club was held earlier this year at a conference organized by the *International Renewable Energy Agency* in Abu Dhabi. It is hard to gauge whether the discussions lead to any measurable progress, as details of the meetings were not divulged.

Another way of leveraging the energy transition for climate protection might entail the development of a global regulatory framework. Such a framework could, for instance, put a price on harmful greenhouse gas emissions (in the form of mandatory certificates) to create incentives to avoid emissions in the first place. Europe has implemented a similar system for various industries that affect the climate, but it is constantly running up against technical and political limitations. For example, when the EU aviation industry was recently integrated into the existing EU emissions trading system, dozens of non-EU industrialised and emerging economies (including the United States, Russia, China, and India) protested vociferously – and even threatened sanctions – on account of the new mandatory certificates for flights to and from Europe. There has been talk of a looming trade war in the press. Moreover, the actual effectiveness of an emissions trade regime that does not regulate CO_2 emissions worldwide is highly dubious – emissions curbed in Europe might be cancelled out by increasing emissions elsewhere as a result of industrial relocation (carbon leakage). Furthermore, climate protection pursued merely at the national level, as is the case with the German energy transition, could end up blunting the efficacy of European-wide instruments such as the EU emissions trading system. The CO_2 reductions achieved in Germany in the course of the energy transition are leading to a falling demand for emissions certificates elsewhere in Europe, causing their price to fall correspondingly. In this way, CO_2 emitters in other EU countries may find it cheaper to continue emitting CO_2 instead of investing in technologies that reduce such emissions, undermining any incentives for climate protection in the process. The decline in the price of emissions certificates from fourteen to eight euros per tonne of last year cannot be definitively attributed to the CO_2 German energy transition, but it does indicate that there are problems concerning the compatibility and coherence of national and European climate protection instruments, at least in terms of regulatory policy. Even the German energy transition was not immune to effects of the drop in price because the revenues intended to cover the costs of transitioning to renewable energies fell in consequence.

In its current form, the EU emissions trade also debunks the popular argument that harnessing fossil fuels as a bridging element in the German energy transition will lead to an increase in global CO_2 emissions. That's because the European climate targets set limits on CO_2 emissions, which are issued as allowances to emit. As a result, the short-term increase in fossil fuel use cannot lead to any absolute increase in climate-damaging emissions within the EU. At most, the recourse to fossil fuels as interim sources of energy would merely have the effect of driving up the price of emissions certificates.

In the bigger picture, Germany's energy transition focuses primarily on the domestic landscape. This creates problems for the wider European regulatory framework. History suggests that a comprehensive regulatory architecture for climate protection would be difficult to enforce. The signals sent by the German energy policy in the areas of economic and climate policy may provide the necessary impetus for further initiatives at the international level. In the long term, a global regulatory framework is indispensable. In an economic sense, fossil fuels such as oil and gas are much too attractive to give renewable energy sources a chance to compete on a global scale.

AFFORDABILITY

The energy transition is an investment in Germany's economic sustainability

Currently, renewable forms of energy in Germany are not competitive vis-à-vis fossil fuels, and likely wouldn't be in the immediate future absent state subsidies. There have been promising developments recently, especially with re-

spect to wind energy; costs have fallen so much that competitiveness is within range. Nonetheless, in order to introduce renewable energy sources despite market conditions, Germany is relying on a feed-in-tarif (Renewable Energy Sources Act, *Erneuerbare-Energien-Gesetz [EEG]*), which guarantees the purchase of electricity from renewable sources at minimum prices (on a scale that diminishes over time). Because these minimum purchase prices lie above the price of fossil fuels at the market equilibrium, the difference represents the direct costs of the price floor. These costs are partially offset by revenues raised by the sale of electricity on the market; the residual costs are distributed among end consumers in the form of the EEG levy. Because German industries with high levels of power consumption would otherwise be disadvantaged in international competition, they are subject to a reduced EEG levy.

An estimated nine billion euros were levied on German electricity consumers in 2010. In light of the targets of the energy transition and the accelerated post-Fukushima timetable, this number is expected to increase. However, in the foreseeable future, costs will fall because opportunities for the expansion of renewable energy facilities are limited and because the guaranteed purchase prices are scheduled to decrease over time. But any cost projections are by nature uncertain. The fluctuating prices of items such as fossil fuels, emissions certificates, and foreign currencies will directly affect electricity prices and, indirectly, the sales volume of electricity derived from renewable energy. In addition to the direct costs, there are several indirect and virtually unquantifiable costs that are ultimately passed on to the consumer, such as those arising from inefficient utilisation of conventional power stations, those associated with grid modernizations, and those associated with enforcing the EEG levy.

Currently, there is a contentious debate surrounding the costs of the energy transition, the focal point of which is the EEG levy. In the short term, the costs of the levy are expected to rise, which could jeopardize public acceptance of the measure. What became clear during the debate is that the EEG is only useful as a vehicle to catalyze the development of renewable energy sources; once renewable energies comprise a sizeable share of the market, the costs of the EEG will become prohibitive. As a result, comprehensive reforms will be imperative after the federal election. For the short-term time period leading up the elections, other approaches to curb an increase in costs of the EEG are being entertained. One idea called for a restriction on further renewable energy facilities. The environment minister proposed a "brake" on energy prices ("Strompreisbremse"). It would consist of several measures to attenuate additional EEG cost increases: The EEG exceptions granted to certain industrial energy consumers would be rolled back; and newly opened facilities would have to wait longer before they could take advantage of the EEG-specified minimum prices for renewable energy. The federal states, however, rejected the "brake" on energy prices. Some states preferred instead to achieve savings by lowering the value added tax on electricity. It remains unclear whether some form of agreement will be reached before the elections.

The energy transition also entails a number of benefits: increased employment opportunities, revitalised local economies, reduced of greenhouse gas emissions, a phased reduction of subsidies, and the long-term increase in the price of fossil fuel. Positive effects in the labour market have been observable for some time. Jobs are created directly in the manufacturing industry, and indirectly in tertiary industries via an economic ripple effect. In 2006, over 160,000 jobs were created in this way; this figure climbed to 360,000 by 2010. Areas with the highest rates of growth included the wind, biomass, and solar industries. Because the industries are by nature rooted in mainly rural areas, smaller communities in particular have benefited from new value-added chains that generate additional corporate profits and local revenues. Moreover, the development and the utilisation of renewable and energy-efficiency technologies are increasingly becoming part of the German export industry. This reinforces the notion that Germany's competitive advantage in international markets is predicated on its innovative prowess. The country's solar industry – recent slumps notwithstanding – is an excellent case in point.

Because the expansion of renewable energy is increasingly displacing non-renewable sources of energy, there has been a corresponding decrease in the financial value of subsidies doled out for these non-renewable sources (these subsidies are discussed all too rarely in Germany). The case of the nuclear industry is illustrative because the state implicitly subsidises it by shouldering the lion's share of the risk (the industry itself is only exposed to limited liability for nuclear accidents). Once nuclear energy has been phased out, there will be no nuclear waste for the state to dispose of. Furthermore, the industry benefited for decades from exemptions from common energy taxes. Beyond the nuclear industry, there are also direct and indirect subsidies for bituminous and brown coal, such as sales subsidies, tax relief measures, and sundry other advantages to boost coal's competitiveness. It must be noted, however, that subsidies for coal have been systematically scaled back in recent years.

A complete analysis must also consider the salutary ecological effects. The displacement of fossil fuels lowers the volume of climate-damaging greenhouse gases and minimises the types of activities that can lead to environmental damage such as coal mining or risky deep sea explorations

(as the case of the Deepwater Horizon spill in the Gulf of Mexico made tragically clear). Ultimately, rising global energy demand will continue to drive up the price of fossil fuel – even as new sources of fossil fuel are discovered. As a result, current studies indicate that Germany will enjoy lower energy costs compared to fossil-fuel dependent economies as soon as 2030, in no small part because of its transition to renewable energies and its rigorous pursuit of energy efficiency.

A cost-benefit analysis of the German energy transition reveals it to be a long-term investment that will not necessarily yield immediate benefits. But it could start to pay dividends within one generation. Painstaking care must be taken to avoid the kinds of insolvencies and subsidy disputes that plagued the solar industry; instruments such as the EEG must be carefully calibrated within a regulatory framework to ensure success.

ENERGY SECURITY

Renewable energies can make contributions to energy security, but fossil fuels are crucial for the transition

Germany's energy security is contingent on a number of factors, some of which are domestic in nature, others of which are conditioned by European or global developments. In the context of energy security, fuel imports and electricity supply are the two most important factors relating to the energy transition. Nuclear power plays a comparatively marginal role in the energy mix in Germany. But its unique advantage in comparison to other energy sources is that it can be put to use at any time, and cost-effectively at that. For this reason, there was a particularly heated debate about the merits of nuclear energy imports once the decision had been made to phase out Germany's nuclear power plants. Some attacked the premise of achieving energy security with the help of nuclear power imports. Such concerns were dismissed, however, because Germany already imports power derived from other energy sources such as natural gas, coal, and – as it turns out – uranium. Moreover, the *sine qua non* of energy security consists more broadly of a healthy domestic energy market and suitable infrastructure. The intriguing question remains: How long will Germany continue to allow imports of nuclear energy for political reasons? It's conceivable that nuclear energy imports will come under closer scrutiny once the last nuclear power plant is decommissioned in Germany in 2022. At this point, the question of how to distinguish between different forms of energy would become pertinent: If Germany procures hydroelectric electricity from dam reservoirs that were created in part with the aid of nuclear-powered pumps, how would that energy be categorized? It remains to be seen.

One central argument advanced in favour of the energy transition relates to reduced dependence on imports generated from uranium and hydrocarbons. Today, oil, natural gas, and coal – over 70 percent of which is imported – satisfy more than 50 percent Germany's primary energy demand. By 2050, this share could be reduced to below 30 percent because of the switch to renewable energies and because of energy efficiency measures prescribed in the energy transition. This would lower the dependence on energy imports considerably. The share of energy derived from imports is anticipated to fall to below 50 percent by then. Of course, this assumes that energy from renewable sources will actually be imported, even if in small volumes. In the future, regions such as North Africa (where renewable energy use will be realised on a large scale, under the DESERTEC Initiative, for instance) will play an important role. It should be noted that this option has not yet been tested in terms of its economic, technological, and political viability. As the use of renewable energies expands, new energy supply corridors will eventually be created in order to increase the number of different sources of energy, strengthening energy security through greater diversification. Such diversification also applies to renewable energy sources within Germany, as well; the importance of individual regions for overall energy security will diminish as production becomes decentralized.

In the context of the accelerated energy transition, fossil fuels will occupy the bridging function that nuclear power initially played. That will elevate the quantitative and qualitative importance of fossil fuels for German energy security in the immediate future. Germany's dependence on gas imports from Russia is consistently cited as a risk factor. But while Russia plays an important role as an energy supplier for Europe as a whole, direct dependence is rather limited. As a result of earlier energy crises, Germany has been pursuing a policy of import diversification. Today, the volume of gas imports from Norway nearly match those from Russia, and Germany's third-largest foreign gas supplier is the Netherlands. The risk, then, is not that the spigots will be turned off (not least because Germany is linked directly to Russia via the *North Stream Pipeline*) but rather that Germany will find itself in weaker negotiating positions. Russia is thwarting European ambitions to craft a unified energy policy by strategically supplying each European country directly. Current developments in the case of the Nabucco Pipeline corroborate this observation. Russia is now in a position to negotiate with each European country on an individual basis, thereby increasing its odds of securing higher sales prices.

The unreliability of renewable energies represents a formidable challenge for energy security. Sunlight and wind are not continuously available and cannot yet be stored adequately. Furthermore, the upgrading of distribution and transmissions networks in Germany and in the EU cannot keep pace with the expansion of renewable energy sources. In consequence, Germany regularly confronts critical situations in which its energy supply is in jeopardy. There are current plans to construct new power lines to transmit renewable energy from northern Germany to the country's energy-intensive southern regions; sweeping changes to Germany's planning laws have been made to expedite the construction. Germany's energy security faces another challenge: the limited political appetite and technical capabilities of Germany's neighbours to purchase large quantities of electricity generated from renewable sources, particularly where Eastern Europe is concerned. As a result, European energy policy will become a crucial factor for German energy security in the context of the energy transition. Cross-border grids are needed in order to match supply and demand within Europe and to facilitate energy imports from outside the EU to Germany. This will demand a functioning single market with a clear regulatory framework.

It would be conceivable to use biomass to smooth over fluctuations arising from the increasing reliance on renewable energy sources. But in view of Germany's agricultural landscape, biomass cultivation is limited and has some negative effects on local ecologies (such as those associated with monocropping techniques using rapeseed or corn). Furthermore, biomass raises the ethical quandary as to whether arable land should be used to generate energy. The use of woody biomass is less controversial, as the space requirements do not rival arable land to the same extent. Other alternative methods of compensating for the fluctuations of renewable energies consist of upgrading power grids, employing innovative storage concepts such as *Power to Gas* (whereby wind and solar energy is converted into gas), or relying on storage capacities outside of Germany (in dam reservoirs in Norway, for instance).

The relevance of fossil fuels will increase in the short term because they can be stored more easily. The widely debated question in Germany right now is how to create the means of storing fossil fuel energy – the answer to this question will be key to the energy transition. The major problem is that it doesn't make economic sense for energy suppliers to invest in fossil fuel power plants; this situation is exacerbated by the preferences for renewable energy sources. It is incumbent on the government to devise a regulatory framework that will create sufficient capacities to guarantee energy security. The crucial task at hand is to find a mechanism that will prevent a market failure that could result in energy supply insecurity. From a regulatory perspective, the approach should be as market-compatible as possible; it should inject a price mechanism and facilitate later exits from fossil fuel energies without major disputes about subsidies.

In this context, the question concerning the use of shale gas is becoming more important. There are indigenous sources that could be tapped using "fracking" techniques. However, public misgivings about the environmental repercussions in Germany are significant, so large-scale extractions are probably unlikely. Gas is nevertheless becoming one of the most important – if not the most important – transitional forms of energy that will facilitate Germany's transition to renewable energies. Global developments in this area may yet contribute to the success of Germany's energy transition.

On balance, Germany's energy security is not threatened by the increasing utilisation of domestic renewable energy sources and may even improve. Nevertheless, the use of fossil fuels such as gas and coal and the modernization of German and European power grids will be of great importance. The looming challenge remains: How can Germany craft a regulatory policy to secure the energy supply with the aid of commercially viable fossil fuel power during the period of transition?

CONCLUSION

Germany is embarking on a reorganisation of its energy supply system at a time when changing market conditions are making fossil fuels cost-prohibitive vis-à-vis substitutes such as natural gas, coal, uranium, and renewable energy sources. At the same time, the energy demand stemming from rapidly developing economies – as well as from developed economies recovering from the financial crisis – is nearly unprecedented. Germany's recently launched transformation of its energy supply system encompasses both risks and opportunities – some of which are economic, others of which are ecological, and still others that are related to supply security. An analysis demonstrates the potential for success, the extent of which will hinge in large part on the regulatory framework advanced by the government. Herein lies one of the greatest challenges to the implementation and public perception of the energy transition: When regulatory parameters are broached, there are too many parochial interests voiced by federal states and lobbying groups that impede progress towards energy independence. Only if Germany manages to make renewable energy sources competitive with fossil fuels without compromising energy security will the energy transition meet with national and international success.

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