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briefing papers

Germany's 'Energiewende'

Redefining the Rules of the Energy Game

Rick Bosman¹, February 2012

German energy policy is increasingly being influenced by a diverse and growing group of renewable energy supporters. These forces have resulted in the recent adoption of a policy to transform the nuclear- and fossil-fuel-dominated energy system into one based predominantly on renewable energy sources by 2050. This transition has been coined the *Energiewende* (literally: "energy shift"). After the Fukushima nuclear disaster, proponents of renewable energy became dominant in Germany's energy policy arena. Consequently, the *Energiewende* has been taken up as a broad societal challenge, pursued by political parties across the political spectrum and actively supported by a large part of the German public.

Germany's nuclear sector has been the first victim of the recent developments, yet pressure is building up on the coal sector as well. Natural gas has so far remained below the radar, but its importance in the German electricity mix might actually increase in order to bridge the gap created by the nuclear phase-out.

The German renewables supporters will likely be able to continue to use their newfound clout to tilt their country's energy playing field in their favour. However, in order to maintain the momentum of the energy transition it will be beneficial for them to involve other European partners in future.

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Introduction

On 11 March 2011, an earthquake of 8.9 on the Richter scale occurred just off the coast of Japan, creating a devastating tsunami in its wake. The combination of the earthquake and the tsunami caused the Fukushima nuclear disaster. The fact that several old reactors were involved caused other governments to look critically at their own reactors. Within a week, seven of Germany's oldest nuclear plants were placed under moratorium, and in the course of the next three months the German government decided to exit from nuclear power as soon as possible and once and for all. The subsequent decision to exit from nuclear power raised eyebrows across the globe, due to the swiftness of the decision. Moreover, it means that Germany will become the first large industrial country to do without nuclear power.

Parallel to the decision to move away from nuclear energy (called *Atomausstieg*), another 'revolution' in Germany's energy sector is taking place – more gradually, but not less fundamental. This is namely the increasing share of renewable energy, most notably in the electricity sector. These sources have grown from a share of 3.1% in the German electricity mix in 1990 to 20.8% in mid-2011². Germany has formulated ambitious targets for its energy sectors, including electricity, and has implemented policies to achieve them.

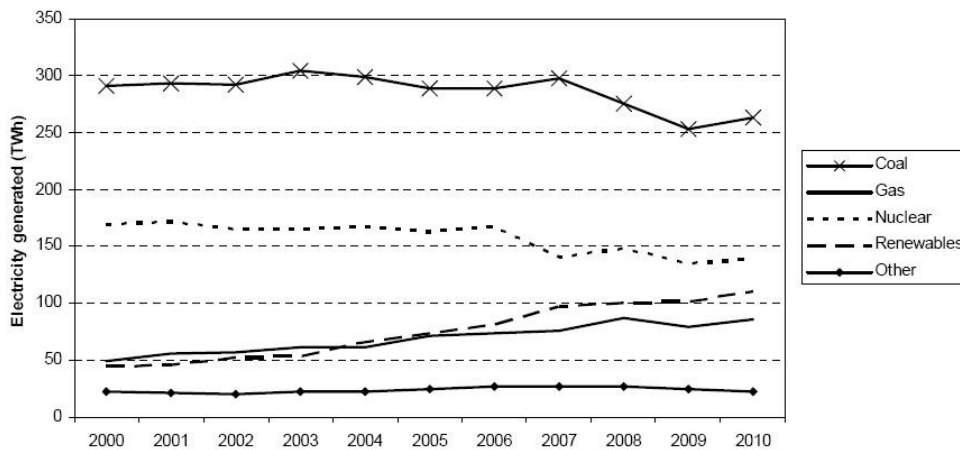
This briefing paper argues that the latest *Atomausstieg* decision should be seen in the context of the successful growth of the contribution of renewables and the growing influence of its supporters. Understanding the German context helps in making sense of the seemingly radical recent decisions and in being able to anticipate Germany's future energy policy, with its potentially large impact on neighbouring countries and the EU as a whole. The main underlying question here is: How did such energy policy change come about in Germany? The focus is on the electricity sector, as the course change in the country's energy policy is most visible and remarkable in this area. In answering this question, first an overview of the current direction in German energy policy is given. Next, the growing influence of supporters of renewable energy is explored, followed by a concise risk assessment. Finally, an outlook is provided on the development and consequences of the *Energiewende* for Germany and the EU.

² BMU, Röttgen: *20 Prozent Erneuerbare Energien sind ein großer Erfolg*, July 2011. Available online at: <http://www.erneuerbare-energien.de/inhalt/47718/4590/>

Germany's energy policy

While the share of renewables in Germany's electricity supply has been steadily increasing, the main contribution still comes from other sources, predominantly lignite (23%), hard coal (19%), nuclear (22%) and natural gas (13%)³, as illustrated by Figure 1 below.

Electricity generated by fuel type^a
Germany 2000–2010



^a 'Other' includes oil and other small-scale fuel sources.

Source: Frontier Economics (unpublished data).

Figure 1. Germany's electricity supply from 2000 through 2010. Source: Australian Government Productivity Commission, *Carbon Emission Policies in Key Economies – Appendix F Germany's Electricity Generation Sector*, June 2011.

In September 2010, a controversial agreement was reached to extend the lifetime of nuclear power plants by an average of twelve years. Chancellor Angela Merkel's centre-right government thereby effectively backtracked on a 2002 Red-Green⁴ coalition decision to phase out nuclear power⁵. The Fukushima disaster had a large impact on the ongoing energy discussions in Germany. Pressure on

³ These are 2010 numbers: renewables accounted for 17% in 2010; since then 8.5 GW of nuclear power has been removed from the grid. Source: AGEE-stat/AGEB, 2011.

⁴ Sozial-Demokratische Partei (SPD) and Bündnis '90/Die Grünen

⁵ In 2002 no specific end date was set. Instead a limited production volume was allotted to all nuclear power plants, which at continuous generation would lead to a nuclear exit by around 2022. Source: Süddeutsche, *Alles bleibt anders*, May 2011. Available online: <http://www.sueddeutsche.de/politik/atomausstieg-schwarz-gelb-vs-rot-gruen-alles-bleibt-anders-1.1103260>.

the German government to reverse its nuclear decision built up, not least by polls suggesting that Merkel's CDU was quickly losing ground to the Green party⁶, a long-time opponent of nuclear power.

Just one day after Fukushima, Chancellor Merkel announced safety checks for all German nuclear power plants; four days later she declared a moratorium on Germany's seven oldest plants. A broad discussion (re)started on the future of nuclear power in Germany and the country's energy future as a whole. To resolve the issue, the Ethics Commission 'Sichere Energieversorgung', a senior commission summoned by Chancellor Merkel, was asked to look into the ethical aspects of Germany's energy supply, focussing on the nuclear issue. They advised the government in May 2011 that within a decade a nuclear phase-out could be achieved.

After an election loss to the Green party in the populous state of Baden-Württemberg⁷ and the recommendation from the Ethics Commission to exit from nuclear power and to instead accelerate the entrance into the renewable era, the German parliament agreed on 30 June 2011 to the nuclear exit by 2022⁸. When comparing the latest *Atomausstieg* decision and the original *Atomausstieg* agreed upon in 2002, it is interesting to see that they are almost identical⁹. In this sense, the reversal of the nuclear plant lifetime extension was not as dramatic as sometimes claimed.

The "*Energiekonzept*" (Energy Concept), published in September 2010, sets out the direction for the *Energiewende*¹⁰. It was published before the recent *Atomausstieg* decision, but it remains the guideline for the German energy future up to 2050. The main goal is that: 'Germany should become one of the most energy efficient and environmentally friendly economies of the world'. Furthermore, 'with the *Energiekonzept* the federal government describes the way into the renewable energy era'¹¹.

⁶ Reuters, *Germany's Greens: From Unelectable to Unavoidable*, November 2011. Available online at: http://www.reuters.com/article/2011/11/07/us-germany-greens-idUSTRE7A61ZM20111107?feedType=RSS&feedName=environmentNews&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+reuters%2Fenvironment+%28News+%2F+US+%2F+Environment%29.

⁷ Baden-Württemberg used to be a CDU stronghold.

⁸ Deutscher Bundestag, *Namentliche Abstimmungen zu Atomausstieg und Energiewende am 30 Juni 2011*, June 2011. Available online at: http://www.bundestag.de/dokumente/textarchiv/2011/34867973_kw26_sp_energiewende/abstimmung.html.

⁹ Bundesamt für Strahlenschutz, 2011⁹ and Atomgesetz 2002, 2010 and 2011. The Atomgesetz is available online at: <http://www.gesetze-im-internet.de/bundesrecht/atg/gesamt.pdf>.

¹⁰ The *Energiewende* concept gained worldwide recognition following the *Atomausstieg* in early 2011. Actually, the term was already posed in 1980 as the title of a scientific publication regarding the possibility of organizing an energy system without the use of nuclear power and oil, by the Öko-institut, a German research institute.

¹¹ BMWi & BMU, *Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung*, September 2010.

This vision has been translated into *binding* goals for 2050:

- Cut back CO₂-emissions by 80-95% as compared to 1990 levels;
- 60% of primary energy supply should be renewable; and
- energy efficiency should improve by 2% each year.

Ambitious long-term goals are not very sensational, because it is easy for politicians to agree on targets for the distant future. However, Germany's approach differs from that of most other countries¹² because it has also set for itself *binding* intermediate targets that go beyond 2020, for example in relation to the electricity sector:

- at least 35% renewables by 2020;
- at least 50% renewables by 2030;
- at least 65% renewables by 2040; and
- at least 80% renewables by 2050.

Immediately after the recent *Atomausstieg* decision, the German government saw the need to accelerate the country's entry into the renewable era. Four new laws were passed regarding the acceleration of grid expansion, the adaptation of the energy market, the renovation of buildings and the climate-friendly development of communities. Another four have been changed, including the Nuclear Power Act, the Renewable Energy Sources Act (RESA), subsidies, and the energy and climate fund¹³. Implementing and adapting these policies should contribute to achieving the goals of the *Energiewende*.

In order to further develop its energy policy, the German Ministry of Economic Affairs endorsed a consortium of research institutes to make scenarios related to the *Energiekonzept* for Germany's future energy supply, which came out in August 2010¹⁴. They focussed on the economic effects of the *Energiewende*, including the lifetime extension of nuclear power plants as planned in 2010. In August 2011, the consortium updated the work to include the *Atomausstieg*. The scenarios drawn up before and after this decision are depicted in Figure 2 on the next page. Both¹⁵ project that the contribution of conventional power plants will decrease over time. Furthermore, it is presumed that renewables

¹² All EU countries have binding targets to increase their share of renewable energy supply under the Directive 2009/28/EC, which can be found here: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF>.

¹³ BMU, *Beschlüsse des Bundeskabinetts zur Energiewende vom 6. Juni 2011*, June 2011. Available online at: <http://www.erneuerbare-energien.de/inhalt/47467/4596/>.

¹⁴ Prognos, Energiewirtschaftliches Institut an der Universität zu Köln (EWI), Gesellschaft für Wirtschaftliche Strukturforchung mbH (GWS), *Energieszenarien für ein Energiekonzept der Bundesregierung*, August 2010.

¹⁵ Scenarios describe possible futures based on certain assumptions and goals; it is not implied that they are the most probable developments.

will gradually replace conventional sources and eventually become the dominant source of electricity. Existing conventional capacity is expected to be used more intensively in the short run, to fill the gap left in the wake of nuclear's exit. In the updated scenario¹⁶ more investment in coal-fired power plants than the capacity currently under construction is deemed unrealistic before 2020, while in the longer run coal with CCS could play a role, albeit perhaps a minor one. Currently, 11.5 GW of new conventional power plants are under construction, of which 2.9 GW is lignite, 8.7 GW is based on hard coal and 0.7 GW is natural gas. The German government is taking measures to expedite these power plants so that they can come online as soon as possible, as they are necessary to compensate for the nuclear phase-out. Contrary to coal, natural-gas-fired plants could see an increase from 2015 on, according to the most recent scenario. Hence, in this scenario it is presumed that natural gas will fill most of the gap left by the *Atomausstieg*. Nevertheless, Germany is expected to remain a net exporter of electricity until 2020.

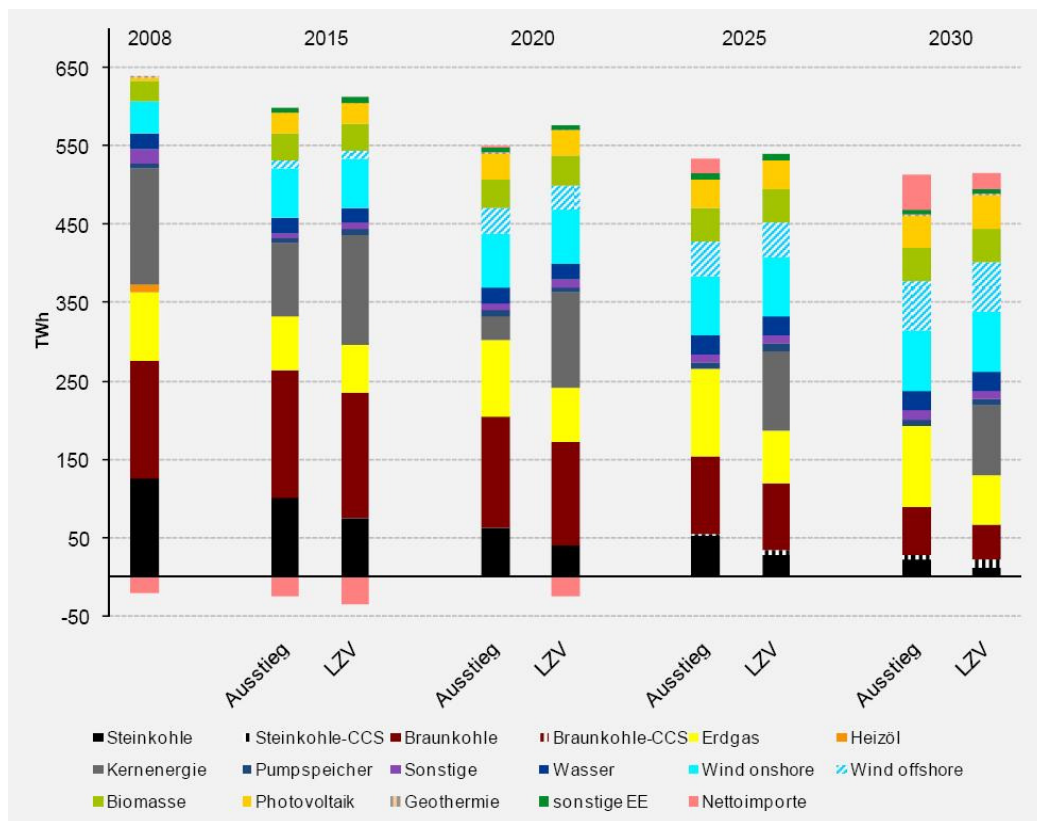


Figure 2. Development of German energy production, comparing scenarios before (LZV: *Laufzeitverlängerung*¹⁷) and after the nuclear exit (*Ausstieg*). Negative imports mean net exports. Source: Prognos, EWI, GWS, *Energieszenarien 2011*, August 2011.

¹⁶ Prognos, EWI, GWS, *Energieszenarien 2011* p. 4, August 2011.

¹⁷ Laufzeitverlängerung means "lifetime extension" (of nuclear power plants)

The Environmental Ministry, too, has endorsed research into possible energy scenarios: the *Leitstudie*¹⁸, taken up by a consortium of research institutes led by the German Aerospace Centre (DLR¹⁹). Their findings deviate from Prognos' scenarios primarily in that the share of renewables increases faster and is larger overall. Also, the *Leitstudie* shows the role of natural gas as increasing only marginally. Both studies formed important input to the formulation of the *Energiekonzept* and further policy supporting the *Energiewende*.

A Sustainable Coalition

Environmental interest groups were the first to argue that renewables offer an environmentally friendly alternative to conventional energy sources. More recently, they have also found economic reasons for their case, by arguing that the externalities of conventional energy sources should be included in the energy price. For example, Greenpeace Energy published a study in which they claim to show the real costs of electricity by including externalities and state support²⁰. After the environmental benefits of renewables were given a monetary value (e.g. through feed-in tariffs) the economics started working. This led to the development of a large clean energy industry²¹.

Industry associations such as the Bundesverband Solarwirtschaft, Bundesverband WindEnergie and the umbrella organization Bundesverband Erneuerbare Energien play an increasingly important role in the policy-making process. Also the *Verband Deutscher Maschinen- und Anlagenbau* (German Engineering Federation), originally not a 'green' outfit, joined the coalition in 1997 when it realized that developing renewables would mean a lot of work for its members. In September 2011, Siemens, the German engineering giant, joined as well. After the Fukushima nuclear disaster it announced that it would pull out of the nuclear energy business: 'the chapter is closed', Siemens CEO Peter Löscher said; the company will expand its renewable energy activities instead²². Industry associations argue that their sector employs a lot of people (370,000 in 2010²³) and has a large potential for growth. In

¹⁸ Deutsches Zentrum für Luft- und Raumfahrt (DLR), Fraunhofer Institut für Windenergie und Energiesystemtechnik (IWES), Ingenieurbüro für neue Energien (IFNE), *Leitstudie 2010: Langfristszenarien und Strategien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global*, December 2010.

¹⁹ The German Aerospace Centre (*Deutsches Zentrum für Luft- und Raumfahrt e.V.* - DLR) is the national centre for aerospace, energy and transportation research of the Federal Republic of Germany.

²⁰ Greenpeace Energy, *Was Strom wirklich kostet*, April 2011.

²¹ BMU, *Erneuerbar Beschäftigt! Kurz- und langfristige Wirkungen des Ausbaus erneuerbarer Energien auf den Deutschen Arbeitsmarkt*, July 2011.

²² Der Spiegel, *Siemens to Exit Nuclear Energy Business*, September 2011. Available online at: <http://www.spiegel.de/international/business/0,1518,787020,00.html>.

²³ Idem footnote 21.

2010 investments in renewables in Germany amounted to €26.6 billion²⁴. The associations therefore represent an increasingly important pillar of the German economy.

In addition to universities and research institutes, new agencies affiliated with the German government have been founded which support further development of renewable energy. For example, the Renewable Energies Agency, which is funded by the Ministries of the Environment and Agriculture and the renewables industry argues that renewables lead to value creation for local communities, mostly because of avoided expenditures on fossil fuels imports²⁵. The *UmweltBundesAmt*, the executive branch of the German government regarding environmental law, also provides the government with advice regarding energy issues. It provides scientific support for an energy supply fully based on renewables²⁶. In addition to this, they are critical of environmentally damaging policies, such as ongoing subsidies for the coal sector²⁷.

Together, these actors span a broad range of German society and their arguments are increasingly influential in the country's energy policy, as is shown in the next section.

Institutionalizing sustainability

Under the Red-Green government, important decisions were made which boosted the institutionalization of the sustainable coalition's public engagements, such as introducing the RESA, Germany's renowned feed-in policy in 2000 and the decision to exit from nuclear power in 2002 (see Box 1 for an overview on the support of renewables in Germany before 2000). However, at the same time, subsidies for hard coal mining in Germany continued, totalling around €35 billion between 1997 and 2005. In 2003, a decision was made to continue support for the mining sector up to 2012²⁸, although the amount was slimmed down. It is believed that coal subsidies remained in place so that ranks of the SPD, with strong support in coal mining areas, would agree to the RESA²⁹.

²⁴ AGEE-Stat, *Development of Renewable Energy Sources in Germany in 2010 - Graphics and Tables*, July 2011.

²⁵ Renewable Energies Agency, *Value Creation for Local Communities through Renewable Energies*, December 2010.

²⁶ Umwelt Bundes Amt, *Energy Target 2050: 100% Renewable Electricity Supply*, July 2010.

²⁷ See, for example, Umwelt Bundes Amt, *Braunkohle – ein subventionsfreier Energieträger?*, 2004 and Zeit, *Kohlesubvention: Kritik*, 2003. Available online: http://www.zeit.de/2003/28/Kohlesubvention_Kritik.

²⁸ IEA, *Energy Policies of IEA Countries: Germany 2007 Review*, June 2007.

²⁹ Bechberger, *Das Erneuerbare-Energien- Gesetz (EEG): Eine Analyse des Politikformulierungsprozesses*, 2000.

Box 1. Historical support of renewable electricity in Germany

In 1979 experiments started with tariffs to support renewables. The tariffs were intended to reward environmental benefits of renewables compared to conventional energy sources. In 1989, after some years of experimentation and technology development, the '100 MW' wind and '1000 Roofs' solar programme were initiated at the federal level. These programmes were aimed at strengthening the industrial base and building up a local market for renewable technology. A year later the first nation-wide feed-in policy supporting renewable sources of electricity (Strom-Einspeisegesetz, StrEG) was born. This law required utilities to connect generators of renewable electricity to the grid and to buy their electricity at a set rate. The StrEG was passed in an unusual cooperation of mainly conservative hydropower producers and a progressive alliance supporting wind and solar interests, without much political effort and supported by all political parties. The StrEG led to a gradual increase of renewables: in particular wind energy, the capacity of which grew from 55 MW in 1990 to over 1 GW in 1995. By this time the large utilities took note and they put pressure on the federal government to lower feed-in rates. This led to strong public opposition and an unexpected mix of metal workers, farmers, environmental and church groups took to the streets to demonstrate.

In 1998 the Green Party took office in coalition with the labour party, resulting in the so-called Red-Green government. This government gave a further boost to renewable energy: first with the 100,000 roofs programme, which built on the 1000 roofs programme of the previous decade, in order to stimulate further activity in the solar sector; and second, the replacement in 2000 of the StrEG with the Renewable Energy Sources Act (RESA) or *Erneuerbare Energien Gesetz (EEG)* in German. The RESA is based on three principles. First, renewable sourced energy has grid priority. Second, grid operators are obliged to buy all renewable electricity at a favourable price per unit. This is paid for by (almost) all end users through a premium on their energy bills. And third, this price is guaranteed over a long time period, usually around 20 years. The Act strengthened the position of renewable sources of electricity and has led to a steady increase of their share in the German electricity supply and consistent steady growth of the renewables sector.

Under the grand coalition (SPD and CDU/CSU³⁰) between 2005 and 2009, a sort of status quo regarding energy policy was reached. The SPD would not allow changes to the earlier achievements in (renewable) energy policy, such as the RESA and the nuclear exit. However, some progress was made toward phasing out coal subsidies. In 2007 the government reached an agreement to phase out all these subsidies by 2018³¹.

³⁰ Christlich Demokratische Union / Christlich-Soziale Union, together known as "the Union".

³¹ IEA, Energy Policies of IEA Countries: *Germany 2007 Review*, June 2007.

By the end of 2009 the conservative CDU/CSU took office, together with the pro-business FDP. Their beliefs were less pro-renewables than former governments and proposals to water down the country's progressive energy path followed, predominantly: revising the basic principles of the RESA, averting pressure from the EU to phase out coal subsidies by 2014 instead of 2018³² and, most controversially, reversing the 2002 *Atomausstieg* decision by extending the lifetime of nuclear power plants. This line of the new government formed a great set-back for the supporters of renewable energy.

Fukushima as turning point

The Fukushima disaster gave great impetus to the federal government to continue institutionalizing the pro-renewable arguments in government institutions and policies. Telling are the recommendations of the Ethics Commission. This body finds that 'the *Ausstieg* is necessary and recommended in order to rule out the risks of nuclear power in Germany for the future'. Furthermore, 'the withdrawal from nuclear energy can be completed within one decade' and 'Germany has alternatives available: electricity production from wind, the sun, water, geothermal energy, biomass, more efficient use and increased productivity of energy, as well as the climate-compatible use of fossil fuels.' Upon presentation of the Commission's report, Chancellor Merkel stated: 'We will take the recommendations of the Ethics Commission as the guideline for action'³³.

The process of institutionalizing pro-renewable policies is most visible in the communications of the Ministry for the Environment, which is responsible for the development of renewable energy and therefore plays a leading role in the *Energiewende*. Environment Minister Röttgen (CDU), for example, said: 'Due to the *Energiewende*, the conflict between ecology and economy has finally been resolved'³⁴. Also: 'In future, energy supply will become more decentralized, structured around the middle class, and technologically more challenging than today. It will be better tuned towards the end user, more efficient and based on local value creation.'³⁵ The Ministry of Economic Affairs and Technology, responsible for energy efficiency, energy markets and infrastructure and headed by Minister Rösler (FDP), is reluctantly following, as can be seen from the ambitious goals of the *Energiekonzept*, which it formulated together with the Ministry of the Environment. The agreement

³² This was successfully achieved in December 2010. See Financial Times, *Germany Wins Extension of Coal Subsidies*, December 2010. Available online: <http://www.ft.com/intl/cms/s/0/5f1fa75e-047c-11e0-a99c-00144feabdc0.html#axzz1cM8O5I5S>.

³³ Ethikkommission, *Germany's Energy Transition – A Collective Project for the Future*, May 2011. Available online: <http://www.bundesregierung.de/Content/DE/Artikel/2011/05/2011-05-30-bericht-ethikkommission.html>.

³⁴ Welt, 'Ich bin kein Missionär', August 2011. Available online: <http://www.welt.de/print/wams/politik/article13569626/Ich-bin-kein-Missionar.html>.

³⁵ Röttgen, *Energiewende in Deutschland*, July 2011. Available online: https://www.bmu.de/reden/norbert_roettgen/doc/47601.php.

to extend the lifetime for nuclear power, which was reached at the same moment, can be seen as its trade-off for the Ministry of Economic Affairs' agreeing to such ambitious renewables targets.

Influence on energy supply

In the previous section we saw that the argumentation of renewable energy supporters has entered the political arena and is increasingly being taken over by policy-makers. However, a discrepancy often exists between political rhetoric and what is actually happening; therefore, we will discuss some events that illustrate the actual influence of these arguments.

The first example concerns the ongoing debate surrounding support for photovoltaics and the RESA in general. A compromise was reached at the beginning of 2011 favouring the solar industry's solution. Over the past several years, the costs of photovoltaics have been rapidly decreasing. At the same time, German feed-in tariffs didn't come down accordingly. This led to over-support of the solar sector and, consequently a boom in installed solar capacity: 3,800 MW in 2009, 7,400 MW in 2010 and 7,500 MW in 2011 compared to 42 MW in 2000³⁶. Together with generous tariffs for small-scale biomass, this put pressure on the *RESA-Umlage*, the premium end users pay on their energy bills to cover the costs of developing renewables. As a consequence, the *RESA-Umlage* has been steadily rising over the last years, from 0.2 ct/kWh in 2000 to 3.530 ct/kWh in 2011, which comes down to around €10 per month for an average household³⁷. This increase led to fears over public support for the RESA. Therefore, at the end of 2009, the newly installed Merkel government announced plans to revise support for solar energy, possibly introducing a cap on the total installed capacity.

Furthermore, revision of the RESA instrument as a whole was put on the agenda. In response, the German solar industry set up a massive campaign. Solar firms went on strike and advertisements were placed across the country to raise awareness for the planned cut-backs. Telling is the posting of an ad by the German solar industry association on one of the most prominent streets in Berlin (see Figure 3 on the next page).

³⁶ BMU, *Erneuerbare Energien in Zahlen*, July 2011. Available online: http://www.erneuerbare-energien.de/files/pdfs/allgemein/application/pdf/broschuere_ee_zahlen_bf.pdf.

³⁷ Assuming an average German household uses 3500 kWh/y.



Figure 3. Advertisement against cutting feed-in tariffs for solar power by the Bundesverband Solarwirtschaft³⁸ on the Staatsoper, Unter-den-Linden, Berlin. Source: Bundesverband Solarwirtschaft, 2010.

Reductions to the tariffs were agreed upon, and even actors from within the renewables advocacy pledged to reduce the tariffs for solar-PV in order to retain public support³⁹. However, a solid cap on installed capacity, as the government had intended, was averted through a compromise with the industry, which is elaborated on in Box 2 below.

³⁸ The text on the advertisement reads: 'Wer die Solarenergie beschneidet, beschneidet unsere Zukunft' - 'Who cuts solar energy, cuts our future'.

³⁹ Süddeutsche, *Angst vor dem Kollaps*, December 2010. Available online: <http://www.sueddeutsche.de/wirtschaft/oekostrom-angst-vor-dem-kollaps-1.1036299> .

Box 2. Breathing cap for Solar-PV

For most renewables, the EEG prescribes a yearly reduction in feed-in tariffs, the so-called digression rate. For solar-PV this used to be a set percentage of around 9% each year. However, because the costs of solar-PV were decreasing faster than the annual digression rate, extra adaptation was needed. In May 2010 the government agreed to an extra 11-16% decrease of the remuneration, depending on the type of installation, by the 1st of July the same year. This decision was delayed due to pressure from the *Bundesrat*, the German senate, and in the end a digression of 8-13% per 01 July 2010 and another 3% per 01 October 2010 was agreed upon. Even with these extra interim tariff decreases, 2010 became an absolute record year for solar-PV, with 7.4 GW installed capacity.

This showed that feed-in tariffs for solar-PV were still too generous. Therefore, by the end of February 2011 the solar industry struck a deal with the government to stave off the introduction of a straightforward cap and instead compromised for a 'breathing cap'. This means that new solar-PV capacity of 3.5 GW is aimed for and that the feed-in tariffs will be decreased faster or slower, according to the newly installed capacity. An extra digression will be carried out by mid-year, in addition to the regular digression at the beginning of each year.

Concretely, this means that the capacity installed between March and May 2011, for example, was multiplied by four to come to an estimate of the total capacity to be installed over the whole year. If this would have been higher than 3.5 GW an extra digression of between 3 and 15% would have taken place. However, installations between March and May were around 0.7 GW, resulting in 2.8 GW for 2011 as a whole, so no extra digression by 01 July 2011 took place. Between 1 October 2010 and 30 September 2011, the base period for the digression at the beginning of each year, new PV installation with a capacity of about 5,200 MWp was registered with the Federal Network Agency; therefore, a digression of 15% took effect on 01 January 2012.

The outlook of this high digression led to another solar rush by the end of 2011. In 2011 7.5 GW of solar-PV was installed, of which approximately 3 GW in December alone. This led Economics Minister Rösler to criticize the RESA-scheme and propose a 1000 MW cap on installed solar-PV capacity. Environmental Minister Röttgen, in charge of renewable energy policy, replied that Rösler's criticism had led to unnecessary uncertainty in the sector and subsequently started negotiations with solar industry representatives to find a solution. The industry proposed to introduce a more dynamic digression, which could take place quarterly or monthly. This should prevent another end-of-year solar rush. Röttgen expressed his preference for this solution over Rösler's and the exact implementation is currently under consideration by the Ministry of the Environment.

Moreover, the scheduled revision of the RESA, in which fundamental changes in the principles of the support scheme were feared, such as cancelling the preference of renewable electricity over conventional power, did not come through. Actually, with the draft RESA for 2012⁴⁰, which notably was agreed upon after the Fukushima disaster, the Merkel government reaffirmed the basic principles of German feed-in policy, namely a continued preference for renewables in the grid, and an obligation to connect all renewable electricity producers to the grid and pay them a favourable price per unit of electricity for a long time period, mostly around 20 years. At the same time, initiatives were included which should lead to renewables responding better to price signals in the electricity market and taking more responsibility in stabilizing the electricity grid.

Furthermore, at the beginning of 2011, renewed plans for European harmonization of support schemes for renewables circulated. The renewables advocacy coalition feared that EU-harmonization would mean the end of their beloved RESA. Therefore, pressure was put on the German government, which then rejected such harmonization⁴¹: 'EU-harmonization would be the end of our *Energiekonzept*, we could throw it in the paper bin', according to Environment Minister Röttgen. That was the end of the EU-harmonization debate.

These examples show that the influence of renewables supporters is considerably and initially oriented at cementing the RESA, the policy that led to strong development of the sector. The following examples show the pressure that is put on the current German energy supply system as a whole.

Firstly, pressure on coal-fired power is also building up. Most vocal on this front is BUND (Friends of the Earth Germany), which leads a campaign against construction of new coal-fired power plants under the slogan 'climate killer coal'. They claim to have prohibited the construction of sixteen coal fired power plants, of which eleven in the last three years⁴². This trend seems to be confirmed by the Prognos scenario studies mentioned earlier. The first scenario study was made in August 2010 and formed the basis for the decision in September 2010 to extend the lifetime of nuclear power plants. In this study, new coal-fired power plants with a total capacity of around 14 GW were planned and/or under construction. At that time, the estimate was conservative according to the

⁴⁰ The preliminary text for the EEG 2012 can be found here:
http://www.bmu.de/files/pdfs/allgemein/application/pdf/eeg_2012_bf.pdf .

⁴¹ Handelsblatt, *Europäische Energiepolitik braucht noch Zeit*, January 2011. Available online:
<http://www.handelsblatt.com/politik/international/europaeische-energiepolitik-braucht-noch-zeit/3820146.html?p3820146=all> .

⁴² BUND, *Geplante und im Bau befindliche Kohlekraftwerke*, July 2011. Available online:
http://www.bund.net/fileadmin/bundnet/pdfs/klima_und_energie/20110707_klima_liste_kokw_verfahrensstand.pdf .

researchers⁴³. However, in the updated scenario which was published only one year later, they decreased their estimate for new coal fired power plants to less than 11 GW. Also, they believe investment in more coal-fired power plants than the capacity currently under construction to be unrealistic before 2020. The reasons for lowering their estimate are not made explicit in the study, but it seems likely that opposition to this energy source plays a role.

Also, the issue of Germany's coal subsidies is raised regularly. Most pressure on this topic, however, does not come from German proponents of renewable energy but from international organizations such as the IEA⁴⁴ and the EU⁴⁵. It is understandable that renewables supporters do not open a frontal attack on these subsidies, as the renewables sector itself is still dependent on support.

It is interesting to see that the role of natural gas, which ultimately is also a fossil fuel, is less disputed, although the Prognos Energy Scenarios project its contribution to increase substantially in Germany's future energy mix. It is probably not challenged by the supporters of renewable energy as much as nuclear and coal power, due to its better CO₂ profile compared to coal and compatibility with variable renewables.

The clearest example of actual implementation of the policy goals of the renewables advocacy and their dominance in drafting energy policy can be found in the *Energiekonzept*, which provides clear and binding goals and intermediate milestones along the way to gradually make the German energy supply sustainable. At the time of its publication in September 2010, it could still be seen as lip-service to renewables supporters, while at the same time the life-time extension of nuclear plants was agreed upon. Yet since the nuclear exit the goals set out in the *Energiekonzept* have been reaffirmed, written into law and their pursuit accelerated. Notably, this has been done by a conservative government, while the opposition is even more progressive on this topic. This means that within German society and politics, consensus exists on the general direction of the *Energiewende* and things are being set in motion to accelerate it. Minister of Economic Affairs Rösler (FDP) confirms this: 'Our goal now is to exit from nuclear power faster than previously planned. The pace is crucially dependent on how fast we can develop alternative sources of energy. The decision

⁴³ Prognos, EWI, GWS, *Energieszenarien für ein Energiekonzept der Bundesregierung* p. 54, August 2010.

⁴⁴ See for example IEA, Energy Policies of IEA Countries: *Germany 2007 Review*, June 2007 available online: <http://www.iea.org/textbase/nppdf/free/2007/germany2007.pdf> and Euractiv, IEA top economist calls for bonfire of the fossil fuel subsidies, October 2011. Available online: <http://www.euractiv.com/specialreport-solarpower/iea-chief-calls-bonfire-fossil-fuel-subsidies-news-508497>.

⁴⁵ European Environment Agency, *Energy Subsidies in the European Union: A Brief Overview, 2004* and European Commission on Energy, *External Dimension: G8 and G20, 2009-2010*. Available online: http://ec.europa.eu/energy/international/organisations/g8_and_g20_en.htm.

to exit from nuclear power was not satisfying in itself; we therefore initiated or changed 16 laws in order to also safeguard our entrance into renewable energies and ensure a reliable energy supply⁴⁶.

These examples show that the influence of the renewables advocacy on Germany's energy policy was already substantial before Fukushima and has only increased since. It seems that in the time since Fukushima, this group has become the dominant force in energy policy, as even a conservative government is actively pursuing the transformation of the current energy system towards renewable energy.

Public support

One crucial factor for the gradual increase of the influence of the renewables advocacy which has only been touched upon so far is the German public. The public shows strong sentiment against conventional energy sources, most strongly nuclear power. It is even willing to take to the streets to prevent nuclear waste transports or the lowering of feed-in tariffs. This topic is so pressing for part of the German public that it influences their voting behaviour. Extending the lifetimes of nuclear plants proved detrimental to the federal government's approval rates and especially after Fukushima led to defeats in state elections. Most noticeably, the populous and economically important state of Baden-Württemberg, which used to be a CDU stronghold, was lost to the Greens. Furthermore, renewable energy policy, predominantly the RESA, has enabled an increasing number of private persons to play an active role in the *Energiewende* by becoming energy producers. This makes the contribution of the public tangible and visible. Over 50% of the current installed renewable capacity is owned by private citizens or farmers, compared to less than 10% by the four largest utilities⁴⁷. Also, initiatives of regions wanting to become energy autonomous⁴⁸ underline this trend. A recent poll by TNS-Infratest shows that the German public broadly supports the *Energiewende* and is even willing to pay for it: 94% is in favour of an accelerated development of renewable energy and 80% thinks the costs, which currently amount to around €10 per household per month⁴⁹, are 'adequate' or even 'too low'⁵⁰.

⁴⁶ Deutschland Radio, *Rösler fördert 'Ausbau erneuerbarer Energien und Ausbau der Netze'*, June 2011. Available online: <http://www.dradio.de/dkultur/sendungen/interview/1474312/>.

⁴⁷ BMU, *Entwurf Erfahrungsbericht 2011 zum Erneuerbare Energien Gesetz*, May 2011. Available online: http://www.bmu.de/files/pdfs/allgemein/application/pdf/eeg_erfahrungsbericht_2011_entwurf.pdf.

⁴⁸ deENet, *100ee-Map*, 2011. Available online: <http://www.100-ee.de/index.php?id=100eemap>.

⁴⁹ This refers to the EEG-Umlage, the premium end-users pay over their electricity bill to finance the feed-in tariffs. This premium has been steadily rising over the last years, from 0.2 ct/kWh in 2000 to 3.530 ct/kWh in 2011. Assuming that an average household uses 3500 kWh/y.

⁵⁰ Agentur für Erneuerbare Energien, *Umfrage: Bürger befürworten Energiewende und sind bereit, die Kosten dafür zu tragen*, August 2011. Available online: <http://www.unendlich-viel-energie.de/de/detailansicht/article/4/umfrage-buerger-befuerworten-energiewende-und-sind-bereit-die-kosten-dafuer-zu-tragen.html>.

Risks

Pursuing the *Energiewende* too rigorously could lead to problems. Change creates new possibilities, but it could also prove painful for people and organizations that are not able or willing to adapt to the changes. If it is not possible to get these actors on board, there could be fierce resistance. Also, if the transition does not provide timely delivery on its promises, it could lose its public backing.

Hit hardest by the *Atomausstieg* and the concurrent *Energiewende* are the four large utilities operating in Germany, namely E.ON, RWE, Vattenfall and EnBW, as they are still heavily dependent on nuclear and coal power. It will require huge effort and investments by these companies, which serve close to 90% of the German market, to change their business models and become active (or more active) in the *Energiewende*. The problem is that the *Atomausstieg* has dampened their assets and thus greatly decreased their ability to invest in renewable energy. If the big four won't invest, who will? Probably, private investors will fund part of the *Energiewende* by investing in decentralized energy production. However, these private investors will probably not be able to fund offshore wind parks, which require billions of euros to get rolling.

Energy-intensive industries are also concerned. They depend largely on cheap and reliable nuclear power and will have to find an alternative. Predictions are that energy prices will rise because of the *Atomausstieg* by as much as 20% by 2030⁵¹, and that this will mostly affect energy-intensive industries since a large part of their energy comes from bilateral contracts with nuclear power plant operators. Effort should be devoted to getting these important sectors of German economy on board as well. The announcement by Siemens to exit from the nuclear business and increase its focus on renewables is encouraging in this sense.

Furthermore, the *Atomausstieg* and *Energiewende* pose technical risks to the energy system, as it is not completely clear how Germany's future energy supply will be secured. Most prominent and pressing is the danger of a black-out. The coming two winters have been marked as critical by grid operators and the *Bundesnetzagentur*, the German Federal Network Agency. Idle capacity has been made available, and Austria has been found willing to provide reserve capacity, if necessary, to stabilize the German grid. With these measures in place and great effort by the Transmission System Operators (TSOs), the situation is 'manageable' according to the *Bundesnetzagentur*⁵². The European Network of TSOs for Electricity (ENTSO-E) is more concerned. In a preliminary statement it says:

⁵¹ Prognos, EWI, GWS, *Energieszenarien 2011* p. 19, August 2011.

⁵² Bundesnetzagentur, *Report on the Impact of the Nuclear Power Exit on Transmission Networks and on Security of Supply*, August 2011. Available online: http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/PressSection/ReportsPublications/2011/110831NuclearPowerExitSummaryReport.pdf?__blob=publicationFile.

'Whereas TSOs presently expect that generation adequacy can be maintained in Europe under average weather conditions, the security of supply for key areas in Europe cannot be ensured under extreme conditions.'⁵³

The paradox of Germany's unilateral *Atomausstieg* is that it has made the need for European coordination regarding energy issues even clearer. Exactly because this decision has such impact on its neighbouring countries, pressure is building up to put stricter coordination measures in place⁵⁴. Therefore, Germany and France recently called for the formation of an EU electricity coordination group, intended to monitor and report on projects that significantly impact the European electricity mix⁵⁵. However, it is questionable as to whether discussing these matters with all 27 member states will deliver concrete results, as more elaborately argued in the CIEP Energy Paper 'Harvesting Transition?'⁵⁶.

Furthermore, critics say importing nuclear power after the 'Atomausstieg' is hypocritical. A dogmatic focus on the energy island Germany is outdated, as much for critics as for supporters of renewable energy. Germany buys France's nuclear power when there is little wind and France buys solar power from Germany when this is cheaper on the electricity exchange than its nuclear power. This is a consequence of the internal market and lowers prices for all end users.

Moreover, it is argued that Germany will not be able to meet its CO₂-reduction targets because of the nuclear exit. Prognos expects that the emissions of the German electricity mix will go up by 30 to 50 Mt CO₂ as a result of the *Atomausstieg*. However, it also argues that these emissions will be accounted for under the European emission trading scheme (EU-ETS) and that higher emissions in Germany will lead to higher CO₂-prices (around €1 to 2 increase⁵⁷), which will then improve conditions for new investments in low-carbon technology. Therefore, it comes to the conclusion that the *Atomausstieg* will not lead to higher CO₂ emissions EU-wide. However, this argumentation is a bit simplistic, as the ETS does not yet function properly. Therefore, it remains to be seen what the *Atomausstieg* will actually mean for CO₂ emissions.

⁵³ ENTSO-e, *European TSOs Concerned About System Adequacy for This Winter*, October 2011. Available online: [https://www.entsoe.eu/media/news/newssingleview/article/european-tsos-concerned-about-system-adequacy-for-this-winter/?tx_ttnews\[backPid\]=28&cHash=e2130853167037699123e7ac5e9d7988](https://www.entsoe.eu/media/news/newssingleview/article/european-tsos-concerned-about-system-adequacy-for-this-winter/?tx_ttnews[backPid]=28&cHash=e2130853167037699123e7ac5e9d7988).

⁵⁴ See also: Leonie Meulman et. al., *Harvesting Transition?*, January 2011, Energy Paper, Clingendael International Energy Programme, The Hague, Netherlands.

⁵⁵ Robin Sayles, Platts, *France, Germany Call for European Group to Monitor Power Decisions*, September 2011.

⁵⁶ Idem.

⁵⁷ In 2008 Euros. Prognos, EWI, GWS, *Energieszenarien 2011*, August 2011.

Outlook

Together with continuous development of renewable energy in Germany over the last twenty years, an ever-growing growing group of renewable energy supporters has developed. It is now a broad and diverse set of actors from research, politics, public administration, industry, interest groups and civil society who support the transition towards an energy supply based predominantly on renewable sources.

The Fukushima nuclear disaster was the last straw for Germany's nuclear sector. Renewable energy is perceived as a compelling and credible alternative. Consequently, Chancellor Merkel was forced to abandon the controversial September 2010 decision to extend the lifetime of the country's nuclear power plants, under pressure of the German public and renewable energy advocates. Now, broad consensus has been reached on the direction of the country's energy future, as even this conservative government is setting clear and binding targets towards 2050 and introducing laws to accelerate the pace of the *Energiewende*. Politically, there seems no way back, as a switch in government would only mean an acceleration of the chosen path.

For now, the renewables advocacy has aimed its clout at cementing its position, predominantly the RESA feed-in policy which spurred its growth. As renewables move away from their role as niche player toward becoming mainstream, they increasingly will have to adapt to market conditions. At this moment, the market is configured in a way that favours conventional sources of energy. Therefore, supporters of renewable energy are using the momentum to redefine the rules of the energy game to tilt the playing field in favour of renewables. Pressure is being exercised to introduce legislation to correct market failures of the current energy system. One option would be to increasingly price pollution, e.g. by reinforcing the EU-ETS but also through introducing taxes on other pollutants emitted by conventional power sources. Favourable planning procedures for renewable generation capacity and the necessary (grid) infrastructure are being pushed as well. These adaptations will lead to favouring renewables over conventional sources of energy, with public support as the renewables' trump card.

However, risks to the success of the *Energiewende* remain. Firstly, the planned changes are painful for incumbents of the energy sector which still rely largely on conventional energy sources. Effort should therefore be devoted to getting these on board, however difficult this is; otherwise it could result in fierce resistance. Moreover, technical risks exist, predominantly in the form of black-outs. A major black-out could jeopardize public backing of the *Energiewende*. Moreover, the *Energiewende* will require a lot of time, investments and effort. If it does not deliver timely and tangible results, it could also lose public backing.

Furthermore, it seems that the international dimension of the energy system receives too little attention. Up to now, most of the bargaining power of the German renewables advocacy has been aimed at adapting and introducing domestic policies. An inward-turning trend can be observed regarding energy policy, with regions becoming energy autonomous and individuals becoming energy producers. This tangible development, most notably in rural areas, has been pivotal in building up public support for the *Energiewende*. Nonetheless, shifting focus to the European dimension could in fact be a vehicle with which to accelerate the transition.

In future, instead of alienating its neighbouring countries with unilateral decisions to exit from nuclear energy and prohibiting harmonization of support schemes, Germany and its powerful renewables advocacy should channel this power towards aligning its European partners in the energy transition. Strengthening cross-border interconnections of the electricity grid could reduce the costs of the transition. Moreover, increased efforts at the EU level will result in the opening up of markets for Germany's leading clean tech firms.