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Policy | brief

Energy Transition in Europe's Power House. *Alleingang*, avant-garde or blackout?

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The transformation of Germany's energy sector will further exacerbate current network fluctuations and intensify the need for modifications in Europe's power system. Cross-border power transfers will have to increase in order to overcome national limitations for absorbing large volumes of intermittent renewables like wind and solar power. In order to establish such an infrastructure on a European scale, the energy transition needs to be guided by an economic approach designed to prevent further fractures in the Internal Electricity Market. Moreover, constructive negotiations with neighbouring countries on market designs and price signals will be important preconditions for a successful energy transition in Europe.

The German government proclaimed its "revolution of Germany's energy sector" (Angela Merkel) without consulting its neighbours. The neglect of Europe's Internal Electricity Market is one of the most surprising aspects of the German *Energiewende* (energy transition) project, which aims at substantially increasing the share of renewables in the German energy mix while phasing out nuclear power. In Europe, national power systems do not function in isolation from one another; cross-border power flows are daily routine. In addition, the Internal Electricity Market helped with the first steps of Germany's energy transition: interconnections with neighbouring countries not only enabled wind energy surpluses to be exported, but also permitted electricity imports to bridge the supply gap after the rapid phase-out of nuclear plants in the wake of the Fukushima disaster. Increasing the input of renewables therefore not only subverts the hierarchical top-down logic of electricity distribution on the national level, but has implications for the supranational dimension as well. In this policy brief, I will place the German energy transition in the wider context of the European Internal Electricity Market.

The major blackout of November 2006 illustrated the transnational nature of Europe's power sector. Beginning in north-western Germany, the outage cascaded through Austria, Belgium, France, Italy, and Spain before finally crossing the Strait of Gibraltar to affect the Moroccan power system. Analogously, the repercussions of the *Energiewende* do not stop at Germany's borders and may turn out to be more far-reaching than originally intended. While the transition could stimulate the trend towards a more deeply integrated Internal Electricity Market and a more sustainable European power sector, the risk of disintegration of the European market and recourse to fossil fuels is equally present. Both trends would ultimately result from the growing share of intermittent renewable energy sources such as wind and solar power. Depending on natural forces which are difficult to forecast and impossible to control, these forms of electricity generation cause growing fluctuations in the system and make it difficult to match output and consumption. Compared to past decades where baseload power generation defined the system, with power plants adapting their output to (predictable) shifts in demand, renewables turn the logic of power generation and distribution upside down. Nowadays, grid management must match fluctuating generation to power consumption. Such a system is never far from blackout (overcharge) and brownout

(voltage drop), making network management a Sisyphean challenge.

With regard to Germany's role as the main transit country for electricity in the centre of Europe, interactions with neighbouring systems have to be taken into account: irrespective of whether it is indeed a revolution or rather an evolutionary process, the country's energy transition amplifies the 'ups' and 'downs' in the network as intermittent renewables largely replace the phased-out nuclear power stations. But transmission capacities are scarce and already heavily congested. Hence, the *Energiewende* creates the need to adapt the European power transmission system. Cross-border electricity swaps will have to increase to keep the networks stable, since only a truly integrated Internal Electricity Market could provide the capacity needed for synergetic interaction of diverse national power systems. One of the main tasks of energy policy therefore is to advocate a power system which is flexible enough to fulfil several tasks at once, and at different levels – local, national and supranational.

Best practice in the North: Denmark's *grønne omstilling*

The Nordic electricity market is a 'best practice' case of integrated electricity markets with high shares of renewables: a state-of-the-art transmission infrastructure densely interconnects the national systems, making electricity a commodity which is traded across borders. Moreover, with 64.9 per cent in Norway, 47.3 per cent in Sweden, and 30.3 in Finland, the share of renewables in gross electrical consumption is well above the EU average. Yet, with the exception of Denmark, these high numbers for renewables cannot be compared to other EU member states due to the widespread availability of hydroelectric power in the Nordic countries.

The Danish energy sector has otherwise been described as a microcosm of current major energy issues. And with 19.9 per cent, renewables in Denmark already exceed the German 18 per cent target set by European Directive 2009/28/EC for the year 2020 (and are set to rise to 100 percent according to the Danish government). These high numbers are primarily based on electricity generation (see below) and have to be seen against the backdrop of external shocks and a successful energy saving programme. In contrast to other European countries, Denmark never put its plans for a large nuclear sector into operation and phased out its world-leading nuclear research programme in the aftermath of the 1970s oil crisis. In the long run, the Danes gave high priority to energy efficiency and renewable energy.

Starting from a very low level of 1.8 per cent in 1973, renewables grew steadily to today's 29.1 per cent of Denmark's gross electricity consumption, despite GNP growth of about 50 per cent since 1980. Because Denmark became the EU member state with the lowest energy intensity and world leader in energy efficiency, the country's energy consumption remained stable over this period. Hence the transformation of Denmark's energy system did not have to keep pace with economic growth. Wind power plays a role similar to the *Energiewende* concept, with wind turbines generating about 20 per cent of the country's electricity demand (Germany: 6 per cent as of 2010). Given the absence of major storage capabilities due to geological conditions in Denmark, the success of Danish energy policy is striking.

Germany's *Energiewende*: Avant-garde of a European energy transition?

For 2020, the government in Copenhagen is seeking to cover 50 per cent of electricity consumption using wind power, and this share is supposed to increase further until 2035. However, the example of Denmark's *grønne omstilling* shows that such developments do not take place in a vacuum, but encounter and interact with the European context. Integrating large volumes of intermittent renewables into the Danish energy system would not work without interdependent electricity markets. Accordingly, Denmark's *grønne omstilling* and world leadership in the manufacturing of wind turbines has led to greater, rather than less, interdependency with countries to the north over the years. Two elements are decisive: the availability of suitable technical infrastructure and a legal framework that allows (short-term) trading in liberal transnational electricity markets. Being a member of the Nordic electricity market, which integrates Norway, Sweden, Finland and Denmark (with the Netherlands and Germany in its orbit), Denmark offered excellent energy policy conditions. Likewise, the German energy transition has a transnational dimension, but compared to the Nordic market it encounters a less developed European framework. Whereas the Nordic power market is fully integrated and based on an appropriate infrastructure,

power systems and energy markets in the rest of Europe remain largely nationally defined. German surplus wind energy therefore flows randomly to neighbouring countries, causing technical, economic and political difficulties.

In the coming years this option will no longer be available since Germany's neighbours consider limiting such imports. Moreover, they themselves will be producing power surpluses from renewables according to national action plans and projections. Europeans will therefore be compelled to distribute electricity more efficiently since network balance is considered to be in jeopardy if intermittent renewables exceed 5 per cent in the power system. Yet in 2010 they already amounted to 5.6 per cent of electricity consumed in the EU-27 (compared to 2.6 per cent in 2005) and will rise to 17.1 per cent by 2020, according to national renewable energy action plans. The latest initiative of the European Commission to overcome deficits in the European power grid therefore includes not only trans-border power transmission and distribution networks, (cross-border transport of electricity to consumers on high-, medium- and low-voltage systems) but also high- and extra-high-voltage transmission ('electrical highways'; see regulation proposal COM (2011) 658 final).

Member states are slow to adopt European legislation to deepen the integration of electricity markets. Yet Germany's energy transition appears to be the avant-garde of a developing European energy policy: with an overall target of 34.5 per cent renewables in the EU's gross final electricity consumption in 2020, EU policy corresponds almost exactly to German policy, which aims for 35 per cent. In the light of the Danish experience, the German targets could end up being exceeded, since the integration of large volumes of intermittent renewables requires large-scale electricity markets to absorb the 'ups' and 'downs' in the energy system. The *Energiewende* could therefore force Germany to support a policy of deeper integration of electricity markets in the EU and beyond.

Operating load and biomass from a European perspective

The deployment of large volumes of intermittent renewables increases the urgency of creating new power transmission infrastructure in Europe. But in a complete Internal Electricity Market where an adequate capacity for transmission of generated current exists, which side of the border these power plants are located is irrelevant; it can be expected that electricity will be generated in those plants that have the lowest marginal costs. In the course of its energy transition Germany resorted to its 'cold reserve' of fossil fuel plants to provide a stable electricity supply. Hence, the *Energiewende* might lead not only to growth in renewables, but oddly enough might also augment the current trend in Europe, since 2009, of using (cheap) coal.

But not every technology based on renewable energy exhibits large fluctuations in output. On the contrary, biomass, hydro and geothermal energy is stable in its electricity output and capable of providing the necessary operating load to counterbalance wind and solar power. But since continental Europe lacks sufficient hydro potential, only the combustion of carbon can fulfil the task of counterbalancing the fluctuations caused by wind and solar power. If recourse to large-scale use of coal in the Internal Electricity Market is to be avoided, alternatives must be found that can compete with its price levels. In this respect, it is noteworthy that the first signs of an international biomass market are emerging. Based on new technologies such as pelletization, briquetting and torrefaction, wood biomass such as forest residues becomes a cost-effective alternative for co-firing in coal power plants.

Prospects

With growing feed-in from decentralized and intermittent sources like wind and photovoltaic, the risks of grid outage increase, therefore making the construction of new power lines imperative. A limit of approximately 5 per cent on intermittent renewables in the system is regarded as critical for network stability. Their share in the EU exceeded that margin in 2010 and, according to the Energy Roadmap 2050, will increase further. Depending on the underlying scenario, between 25 and 65 per cent of the EU's electricity consumption will be supplied by this form of energy by 2050. Germany's energy transition will accelerate this process since the nuclear phase-out increases the need for new generation capacity. Renewables, especially wind power, will have to take the place of decommissioned plants. This energy transition therefore increases the pressure on Europe's electricity networks and makes the inclusion of neighbouring countries in planning an imperative. The European electricity market could be the missing cornerstone in the German transition process, offering untapped potential for conversion of the energy system.

Denmark's green energy transition, or *grønne omstilling*, began in the aftermath of the 1970s oil crisis and shows that 'green transition' is a long-term project. But successful energy-saving policies to decouple economic growth and electricity consumption can help to speed up the process: with stable energy consumption the deployment of renewables does not have to keep pace with movements in the gross domestic product. Binding targets for energy saving could yet be decided on the European level. In growing economies this will certainly limit the proportion of renewables that can be achieved in the short term. In particular, rapidly growing countries like Poland will face difficulties reaching their targets. Denmark's green transition also reveals the limitations of national systems for absorbing large volumes of intermittent renewables and the need for transnational infrastructure and markets to ease the pressure on the grid by cross-border power transfers. Yet transmission capacity is still scarce and heavily congested in Europe; different electricity tariffs and market models in different EU member states make market opening a delicate task. All the more in the case of the *Energiewende*, since deeper integration could lead to increasing imports of fossil-based or even nuclear electricity.

A successful transformation of Germany's energy sector therefore depends on competitiveness: in order to set up an infrastructure which allows a comfortable matching of power production and consumption in Europe, the *Energiewende* should be guided by an economic approach designed to overcome the fractures in the Internal Electricity Market. Yet electricity tariffs in Germany are already way above the European average, both for private households and for industrial consumers. Limiting tariffs is therefore the crux of Germany's energy transition. Backup power generation using coal and second-generation biomass in combined combustion to counterbalance wind and solar power could keep costs down and allow further market opening. Moreover, constructive negotiations with neighbouring countries to match market designs and price levels and develop common infrastructure projects are important elements for making Germany's energy transition work.

Selected references

Faaij, André P.C. (2006). Emerging international bio-energy markets and opportunities for socio-economic development. *Energy for Sustainable Development* 10 (1): 7-19.

Center for Politiske Studier (2009). *Wind energy. The case of Denmark*. Copenhagen: CEPOS.

Schleicher-Tappeser, Ruggero (2012). How renewables will change electricity markets in the next five years. *Energy Policy* 48: 64-75.

Energy Research Centre of the Netherlands/European Environment Agency (2011). Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States. Covering all 27 EU Member States with updates for 20 Member States.

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Thomas Sattich joined the Environment and Sustainable Development Cluster at the IES as a Visiting Researcher in April 2011. Since July 2011 he has also been a Visiting Fellow at the Brussels office of Stiftung Wissenschaft und Politik (SWP). He graduated from the Ludwig-Maximilians-Universität Munich (political science, law, modern history), has studied in France and Hungary and is carrying out his PhD at the University of Bremen, Germany. Research visits at the Instytut Spraw Publicznych and the German Historical Institute Warsaw roused his interest in the (not so) new EU member states. His current focus lies on energy-related topics, infrastructure and Trans-European Networks.

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