Why Germany's *Energiewende* Reminds Us of the Virtues of Cooperation

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Given that 25 per cent of Germany's electricity is now coming from renewable sources, the country's energy transition (*Energiewende*) has entered its adolescence. Like most teenagers it sometimes behaves very impolitely towards its neighbours, it annoys its grandparents and prompts its parents to discuss how to raise this child to become an agreeable member of society. On the other hand, teenagers are easily misunderstood, and, in fact, if one is prepared to listen, one can learn a lot.

The flexibility challenge

Let us first take a step back and ask: what characterises Germany's *Energiewende*? What makes it so intriguing, fascinating and scary to other countries? It is the fact that Germany has ruled out two of three possible ways to decarbonise the energy system – nuclear (after decades of political struggle) and carbon capture and sequestration (CCS) (rather by default) – and thus implicitly claims to reach its climate targets almost entirely on the basis of renewable energy sources. Even more disturbingly, among the different renewable technologies it is the two most intermittent sources – wind and photovoltaic (PV) – that will provide by far the biggest share of the energy supply for the world's fourth largest economy. The reason is simply that these will be the cheapest technologies and have the greatest resource potential.

A system that fundamentally relies on variable generation sources implies a paradigm shift: hitherto, power systems in Europe and elsewhere have been dominated by central baseload plants optimised for permanent operation. With wind and PV as the dominating generation technologies, intermittent electricity generation will be the norm because the two technologies produce electricity depending on the weather conditions. In the future, we will see more and more hours when wind and PV produce more electricity than needed and other hours – without wind and sun – when demand has to be met almost entirely by other resources. The rest of the system will have to react very flexibly to this situation. Ramping rates of several gigawatts within minutes and the requirement for power plants to reduce output to zero and come back within very short timeframes will be very challenging. Nuclear and coal plants are not able to provide this service to the system.

Although Germany might be one of the first countries entering into the new energy world, it will not be the last. In fact, the European Commission expects that wind and PV will provide large shares of future power systems almost everywhere in Europe (European Commission, 2011). In its Energy Roadmap 2050, the Commission foresees a share of between 25 and 67 per cent of wind and PV in total generation depending on different scenarios. Many experts argue that they will form an even higher share because the costs of wind and PV have been overestimated and will decrease much faster than the Commission expects. And we can certainly agree with the International Energy Agency that other regions and countries will find themselves in similar situations – the wind and sunshine are not restricted to Europe (International Energy Agency, 2014).

Germany is already in the transition phase. The old system is still there and conventional energy generators are desperately seeking more time (and money) to manage the transition to the new world. With the conventional plants still running, and the new renewable capacity entering the market, Germany is producing an enormous excess supply. The effects are bearish prices at the wholesale market that drive more and more plants out of profit. In order to prevent blackouts, the regulator prohibits utilities to decommission their plants without permission. In the meantime the effects are spreading all over Europe: driving down market prices, pushing plants out of the market and creating stress for unstable transmission grids. Everyone blames the pubescent youth for its erratic behaviour.

How wind and sun force Europe to cooperate

However, once we stop complaining about the unpleasant characteristics of a wind- and PV-dominated power system, we can start cherishing its beauty (which might still be hidden beneath some pimples on its face): an abundant, clean and cheap energy supply. And we could think about how to face the challenge of the new world, namely making the power system flexible.

Generally speaking, four flexibility options exist: demand response, storage, flexible generation by firm capacity and buffering through the grid. The potential of these options varies according to geography, resources and the structure of the economy. Very few regions possess enough cheap potential to provide the amount of flexibility that is needed. Therefore it will be prohibitively expensive if balancing takes place at a local or national level because new and expensive technologies would be needed. In contrast, sharing existing flexibility resources among regions and countries can help to buffer variable renewable electricity generation in a cost-efficient manner. Hence, as a general rule, cooperation makes the energy transition easier and cheaper.

The cheapest way to cope with variable renewable generation is to balance the intermittency over larger geographical areas. Weather patterns are not the same all over Europe. When wind blows at the Atlantic coast, it might be calm in Hungary; when the sun is shining in the South, it might be cloudy in the North. Expanding the transmission grid is thus critical. The ability to trade electricity between regions allows us to mobilise and better use the resources in all parts of Europe. Tapping into the Eastern European biomass potential, for instance, or shifting loads in industrial centres in order to reduce peak demand can be efficient measures to stabilise the system. The abundant hydro capacity in Scandinavia and the Alps could play an important role in balancing continental European power supply.

Furthermore, the total amount of capacity needed to ensure system reliability can be reduced by cooperation. Because people in Spain, Poland and The Netherlands sleep, work and cook at different times and because power systems function under different conditions, load curves vary between regions. Therefore, cumulated peak demand is lower than the sum of national peak demands, which means that ensuring the secure supply of electricity at any time becomes easier and cheaper when countries cooperate.

Even for those few countries that are blessed with sufficient flexible resources to fully balance their system, cooperation can be an advantage because it provides a business case. Norway, a country with 95 per cent hydro capacity and thus great flexibility in its system, could, for instance, trade power with Germany. When Germany is short of electricity and prices are high, Norway could make money by selling power. And when wind and sun produce more electricity than Germany needs, prices fall and Norway could buy cheap electricity, thus leaving its own hydro resources untouched.

Next steps of European power market integration

More cooperation among, and deeper integration of, national power systems is a prerequisite for energy transition in Germany and all over Europe to proceed in a secure and cost-effective manner. Thus, implementing the *Energiewende* in Germany also requires a political strategy to support it on a European level. From a systems and a national economic perspective, the benefits of cross-border cooperation are obvious – actually, they were recognised long before the EU was created. Yet politically it is not easy to achieve – particularly in times when the 'European project' suffers from dwindling trust and weak ambition – because it would mean relying on others to provide energy when it is needed and being tolerant about the way it is produced in neighbouring countries. In addition, energy policy has always had significant geopolitical implications, which makes the mélange of interests even more complex.

Still, since the 1990s Europe has aimed at a single energy-only market as well as the integration of balancing markets. While this is progressing, Europe is already entering the next phase of power market integration, which will be about system reliability and support for renewable energy sources.

Because the energy-only market does not suffice to ensure system reliability in the long term (due to the lack of incentives to invest in new flexible resources), countries have started debating the implementation of capacity mechanisms. But in a partially integrated European energy market, implementing capacity mechanisms on the national level will bring about huge inefficiencies. As history tells us, market integration with 28 countries is a time-consuming and difficult process. Thus, it might be advisable to develop a joint mechanism on a sub-level first, test it and scale it up to the European level at a later stage.

Finally, more cooperation at the European level on support schemes for renewable technologies could leverage efficiency gains and help to optimise the use of resources. However, this leaves us with the million dollar question: how do we design a power market based on wind and PV with marginal costs of zero? Nearly the entire expenditures for wind and PV installations are capital costs that accrue before a single kilowatt hour is produced. But once they are installed, they produce electricity almost for free – yet another feature of our adolescent child that gives us a headache.

References

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