# The Energiewende is running up against its limits

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By Jeffrey Michel 21.10.2016

*German transmission system operator Tennet recently announced an 80% increase in its transmission fees because of the high construction costs of new power lines to accommodate renewable energy. A study of the Düsseldorf Institute for Competition Economics found that by 2025 costs of the Energiewende could exceed €25,000 for an average four-person household. Jeffrey Michel concludes that the Energiewende is running up against its limits – but may be saved by imported by coal power from Central Europe.*

Prunerov coal power plant North Bohemia Czech Republic (photo Vaclav Vasku)

Germany's decision in 2011 to abandon nuclear power meant replacing 22% of the country's electricity supplies by the end of 2022. With nine reactors since retired, that figure has dropped to 14%. Five of the remaining eight plants with a combined net capacity of 6.7 GW are located in southern Germany. New centralized gas power stations could replace some of that generation. The remainder must be superseded by local combined heat-and-power (CHP) plants, reduced demand, imported electricity, and renewable energy technologies.

The conditions for non-fossil power generation in Germany's southern states are far from ideal, however. Solar power potential is limited with only 955 full-load hours of irradiation per year in Bavaria. The scarcity of historic windmills testifies to air currents too weak even to grind grain. Germany's premier industrial region must therefore be re-energized by other means.

Storage could be a solution, but battery banks for storing solar energy are only gradually being deployed, while hydroelectric pumped storage plants of up to 1,060 MW have become unprofitable due to depressed power trading prices. Cross-country transmission from large-scale photovoltaic and wind farms throughout Germany is therefore essential for filling the nuclear gap. However, the wide-ranging renewable power installations in north and eastern rural regions often generate excessive amounts of electricity simultaneously, necessitating expensive grid intervention measures.

## Overhead power lines

Protest against overhead power lines in Germany

Despite the impending need to supersede nuclear generation, transmission corridors from the North Sea to near Munich and Stuttgart are beset by planning delays. Overhead power lines are opposed by many for aesthetic and touristic reasons. Some people fear health detriments from electromagnetic radiation.

As a result, the German cabinet adopted a resolution in October 2015 to lay 1,000 km of long-distance cables underground. This was estimated at the time to cost €3 to €8 billion more than the overland option. TSO Tennet now expects total realization expenses of €4–5 billion for transmission from Saxony-Anhalt to Bavaria and €10 billion for the northern corridor to the southwest. These figures might be exceeded by the middle of the coming decade, however, if electricity usage in the transportation and building heating sectors rises beyond current estimates.

Underground power lines have other disadvantages. Although they carry direct current (DC) with radiation as

harmless as the Earth's magnetic field, and have no weight restrictions, repeated heating from power surges can lead to early failure. The rated service lifespan of 40 years is already only half that of overhead power lines.

## Growing costs

The retirement of each southern German nuclear reactor will reduce net generating capacities by an average of 1.3 GW, necessitating precautionary measures against power blackouts. One option would be simply to raise electricity rates for lowering consumer demand. That alternative is favored by the European Commission to stimulate energy-efficient technologies and influence usage.

But costs to the consumer are already increasing of their own accord. Minimum investment returns of 9.05% for new transmission construction and 7.14% for refurbishment are currently guaranteed by the German federal network agency under the Grid Expansion Acceleration Act. Tennet, which operates the north-southeast transmission system, has announced an 80% increase of long-distance power transmission fees beginning next year, raising the annual price of electricity by about €30 for a three-person household. According to CEO Urban Keussen, the added cost is due to ongoing political controversies, tedious licensing, and public protests. In result, he has said, the "construction of power lines has not proceeded as rapidly as renewables deployment. That should alarm us."

In a recent study of the Düsseldorf Institute for Competition Economics (DICE), overall expenses of €55.3 billion have been calculated for transmission and distribution by 2025. By that time, the average cumulative cost of the Energiewende could exceed €25,000 for an average four-person household, reports DICE.

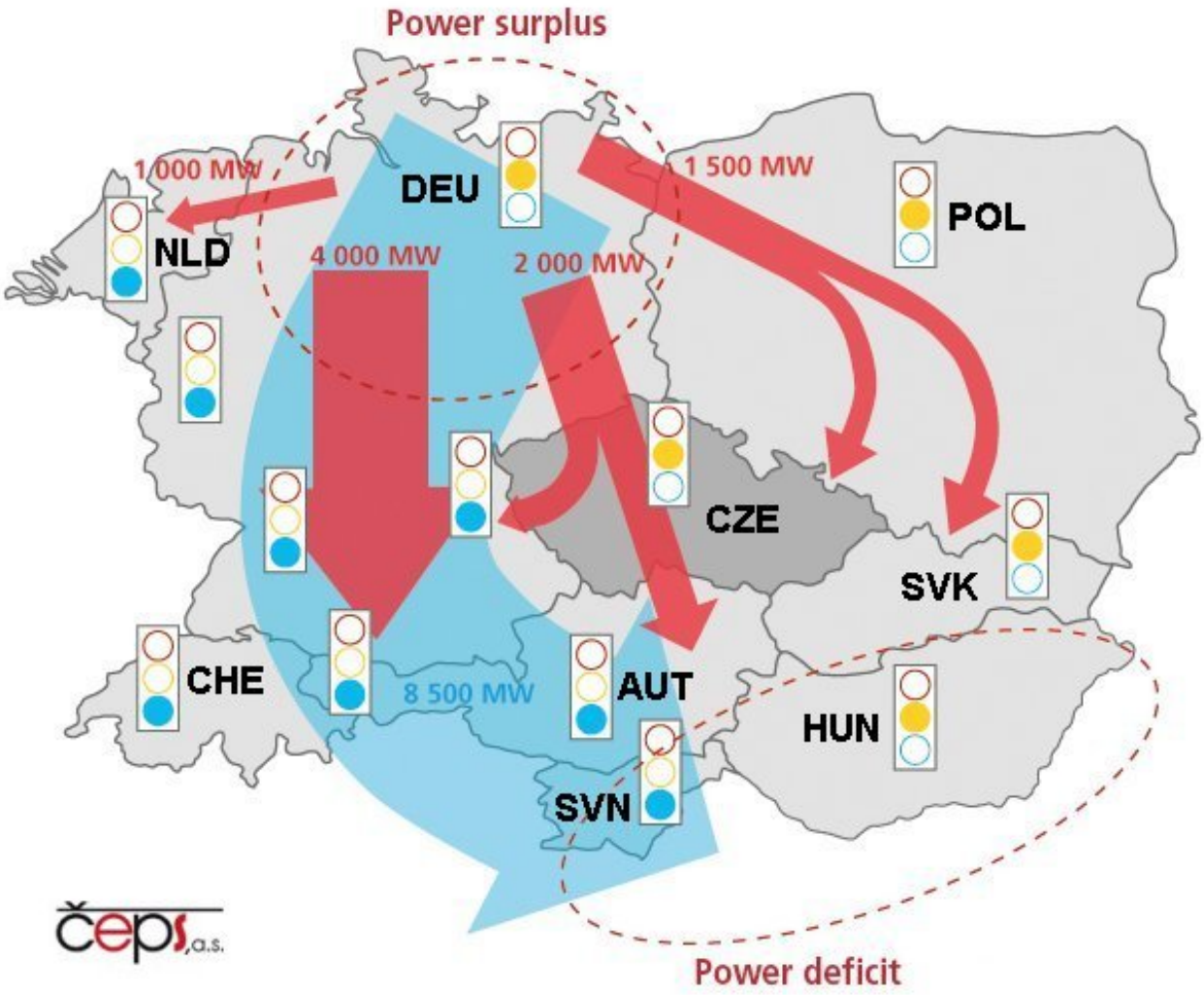
The green power surcharge for households and small businesses has been raised by Germany's network agency from 6.35 cents this year to 6.88 cents/kWh in 2017, mainly to compensate for falling wholesale power prices.

Wind power producers are also hurting from the lack of transmission capability. Last year, 4.1 TWh of wind energy could not be delivered because of grid congestion. In consequence, the federal government now intends to restrict annual wind turbine construction from the 2.5 GW earlier anticipated to only 902 MW in the northern German states – Schleswig-Holstein and Mecklenburg-Vorpommern, Bremen and Hamburg, and adjacent regions of Lower Saxony. The regulation will be terminated automatically at the end of 2020.

## Filling the power vacuum

As domestic electricity availability is reduced due to nuclear plant retirements and wind power cutbacks, grid operators in neighbouring countries could increase power deliveries to Germany as a means of alleviating their own overcapacities.

In the past, surplus electricity has been exported from Germany to Eastern Europe in response to prevailing supply deficits. However, new generating capacities that include lignite power plants in North Bohemia, Poland, and the south-eastern EU are increasing local energy autonomy.




In southern Germany, by contrast, Bavaria and Baden-Württemberg must eliminate nuclear generation on a rigid timetable. Whenever the necessary substitute capacity is unavailable regionally, it must be found elsewhere. Tennet has emphasized the uncertainties of future electricity transactions, but persistent supply deficiencies were already predicted in 2014 by a study of the German Aerospace Center (DLR) for the government of Baden-Württemberg.

### Czech lignite potential

Certainly the Czech Republic has recently enhanced its power export potential. After an advanced 660 MW coal power plant at Ledvice was proposed without enough lignite available for long-term operation, the mining limits for the Bílina surface mine established in 1991 were lifted by parliamentary resolution. An additional 100 million metric tons of lignite can now be excavated, allowing power generation at Ledvice to at least mid-century.

Extended operation until 2030 is also foreseen at the 820 MW Chvaletice lignite power plant owned by Severní energetická. In addition, the semi-state power producer ČEZ has already dedicated €3.65 billion to reconditioning 11 hard coal and lignite power plants.

An existing transmission line between Vyskov in North Bohemia and Prague was recently enhanced by a parallel corridor purportedly to accommodate wind-generated electricity flowing across the border from Saxony.

By coincidence, the Czech consortium EPH/PPF has also taken over four lignite power stations with adjacent surface mines from Vattenfall in Saxony and Brandenburg to form the Lausitz Energie AG (LEAG). The combined generation capacity after the scheduled retirement of two 500 MW blocks at Jänschwalde by 2019 will be 7.1 GW.

Some of the electricity generated may be destined for North Bohemia, where four phase-shifting transformers are currently being installed at Vyskov as a barrier against excess German wind power. Lusatian electricity from lignite might instead be dispatched along the same route during low-wind periods.

Expanded power transfers from the Czech Republic to Bavaria and Austria could prove particularly cost-effective under these circumstances. The new transmission line between Vyskov and Prague has cost only €102 million, less than €1.1 million per kilometer despite the 270 pylons required along the route. Further grid expansions would likely be achievable at lower risk than the construction of gas power plants with uncertain long-term investment returns.

## Outdated blueprints

Austria is another potential exporter of electricity to Germany. Statistically around one-quarter of the electricity exported by Austria to Germany results from hydroelectric storage, with domestic and imported power used for pumping. Austria has recently dedicated Europe's most modern pumped storage hydroelectric plant in Reißeck. The 430 MW cavern plant will help absorb excess power received from Germany for later redistribution.

When nuclear phase-out in Germany is culminated at the end of 2022, annual power generation will have been reduced by an additional 90 TWh. It is hoped that Germany will ultimately have a wide variety of domestic and international options at its disposal. Its grid architecture would likely be aligned toward achieving predictable revenues, and will include a profusion of underground cables. But Germany may also have to be saved by the flexibility and resourcefulness of the Central European electrical power industry, based mainly on coal power. Whatever the final outcome, the obsolescence of many original blueprints for the Energiewende is already apparent.

**Editor's Note**

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