Winds not Harnessed: How a slowdown in Germany's wind power development perpetuated dependence on Russia

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Germany's wind power capacity additions stalled and contracted after 2015, falling far behind the rest of Europe. This was a lost opportunity to reduce reliance on fossil fuels. Had the country followed the same trajectory of growth in annual installations as the rest of Europe, installed wind power capacity would have been 32 GW greater at the end of 2021. This additional wind power would have generated more electricity than Germany's six remaining nuclear power plants in 2021, and replaced more gas than was imported through the Nord Stream 1 pipeline in July before the cut-off in late August. Germany would thereby have avoided the consumption of gas with a price tag of 23 billion EUR for the full year of 2022, and reduced its emissions with an amount equivalent to the total CO2 emissions of Switzerland (in 2021). Instead, Germany is entering the first wartime winter in Europe in over 70 years less energy secure than it had reason to be. This political failure requires political action to ensure that energy security in Germany and in Europe will be stronger in the future.

Germany fell behind in wind power installations after 2015

After being a clear leader in European wind power expansion, Germany started to fall behind in 2016 after a slow-down became apparent in the onshore sector already in 2015. In 2014, Germany installed 1766 new onshore wind turbines with 4.75 GW capacity, and this number fell to 1368 new turbines in 2015, and down to as few as 325 in 2019, with a capacity of 1.08 GW. A drop in capacity installation of more than 75% in five years forces Germany to now play catch up in order to meet their new goals of 80% renewable electricity by 2030. This plan requires substantial increases in wind power generation both on land and sea, and a decisive turn of the negative trend in wind power capacity installation and power generation from the last years.

Between 2018-2021, net wind power capacity additions in Germany averaged just above 2 GW annually; slightly more than a fifth of the 10 GW capacity that the Scholz government currently proposes to install annually towards 2030 — on land alone. 2021 thus became the year where the consequences of lacking investments in new wind capacity, combined with unusually poor wind conditions, caused wind power generation to have its sharpest drop in this millennium: a drop of 7%, cutting German power supply by almost 10 TWh. Figure 1 displays the stagnating and subsequently falling investment in German wind power capacity which stands in sharp contrast to the expansion seen elsewhere on the continent.

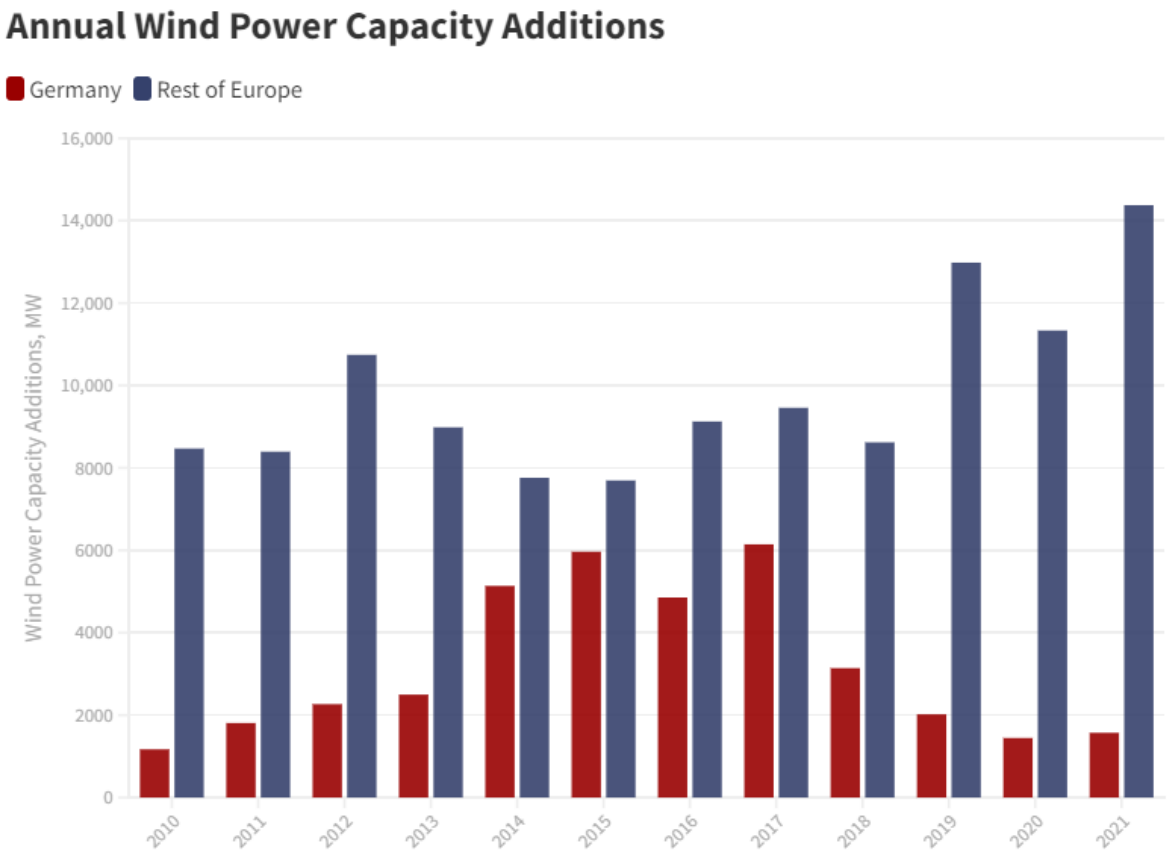

Figure 1. Installation of German wind power capacity accelerated till 2015 before a period of stagnation turned into a clear fall in annual installations after 2017. Source: BP Statistical Review of World Energy 2022.

The trend in German wind power capacity additions over the last seven years represents a political failure to uphold the long-term energy security of Germany in the face of short-term pressures. Cumbersome permitting, legal disputes and an uncertain investment environment slowed down wind power development. Licensing authorities became understaffed, the permitting process slowed down, and financial incentives for wind power development were reduced. In the words of professor in renewable energy systems at the Berlin University of Applied Sciences, Volker Quaschning, "in Germany, it is easier to build an ammunition factory than a new wind turbine". With requirements like the 10H rule in the federal state of Bavaria, requiring wind turbines to be built as far as 2,5 kilometres away from residential areas, politicians have caused Germany to get off track.

In 2019, one of Germany's largest producers of wind turbines, Enercon, cut 3,000 jobs. According to a study by VDMA Power Systems, this number was less than a tenth of the jobs assumed to be lost in the German wind power industry by the end of 2019 due to stagnating numbers of wind turbine installations. In 2022, we see the energy security consequences of past political mistakes: an energy crisis which is more severe than would have been the case if Germany had simply kept up its investments in wind power.

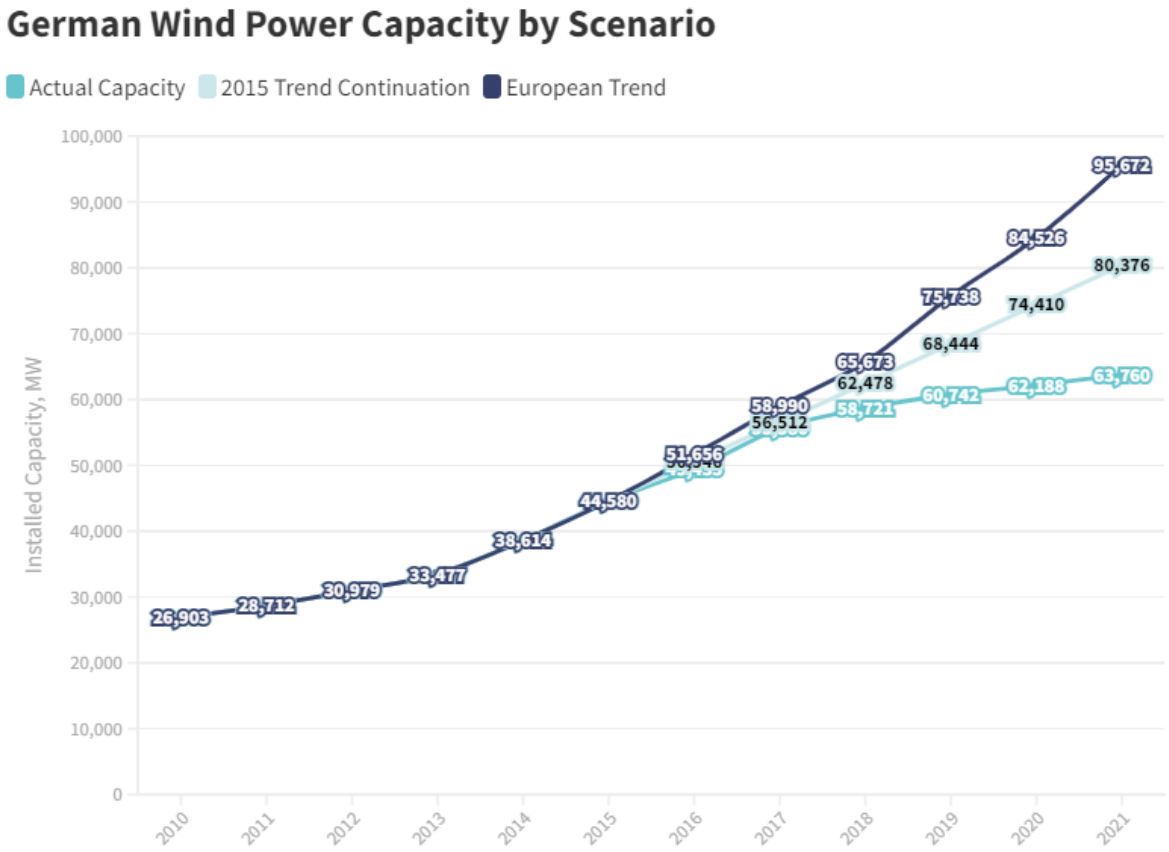

Figure 2. Following the European trend, Germany would have had almost 32 GW more installed wind power capacity in 2021. Source: BP Statistical Review of World Energy 2022 and CREA.

Figure 2 shows the consequence of the failure to sustain the pre-2015 trend or follow the trend in European wind power installation. In the former case, Germany would have had 16.4 GW of additional capacity, and in the latter case, the number would be almost 32 GW.

Can wind power substitute for gas?

Gas and wind power have different uses in the energy system, so they are far from perfect substitutes. However, in the power sector, where about one third of all gas is used in Europe, increased wind power generation will replace gas and coal, in a ratio that depends on fuel prices and a host of other factors — this is a simple consequence of the merit order in which the generation sources with the highest marginal cost are used last. In the extreme situation of a physical gas shortage, gas prices rise so high that the fuel being replaced becomes almost always gas. In the northern European power system of which Germany is a part, there remains more than enough gas-fired generation to be replaced by increased wind power generation.

If fully replacing gas-fired power generation, the additional wind generation in place by the end of 2021, had Germany followed the wind power growth trajectory of the rest of Europe, would have avoided 23 billion EUR worth of gas consumption and 34 million tonnes of CO2, 5% of the CO2 emissions from Germany's energy sector, or equal to the total emissions of Switzerland in 2021. If the wind power generation was replacing a mix of coal and gas, the CO_2 savings would have been greater.

Historical and future trends suggest that more wind power capacity would have replaced generation from gas and coal, helping alleviate the impact of Russia's gas blackmail.

Germany's generation of wind and solar power increased from 11 TWh in 2001 to 116 TWh in 2021 and contributed to replacing coal power generation which fell from 294 TWh to 134 TWh over the same period. Fossil gas plants had more favourable economics than coal, at least until the current fossil fuel price spike, due to high CO2 prices, low gas prices, and lower costs for ramping production up and down in response to variation in renewable power output. As a result, gas-fired generation increased from 58 TWh in 2001 to 91 TWh in 2021, a period in which total power demand declined by only 4% (Ember, 2022). This trend is unlikely to continue as Europe redoubles its investments in renewable energy and energy efficiency, as displayed in a recent study focused on the UK, which confines gas to a marginal role in a fully decarbonized power grid, by 2030.

Germany would be more resilient against Russia's gas blackmail with more wind power

Following a more ambitious trajectory and investing in more wind power could have significantly reduced Germany's reliance on fossil fuel imports, thereby lessening the ability of Putin to blackmail the Bundesrepublik by cutting gas supplies. Figure 3 shows that had the Merkel government followed the European growth trend in wind capacity installations after 2015, the energy security situation would have been substantially better.

Germany would have had an additional wind power supply by the end of 2021 exceeding the output from the six nuclear plants remaining in Germany in 2021, or enough power to replace as much gas in power generation as was carried through Nord Stream 1 when it was operating at 25% capacity, before Gazprom stopped the flow completely in September 2022 (see the next section for more detailed discussion). Consequently, Germany would have been less affected by Russia's weaponization of trade in energy products, and fluctuations of fossil fuel prices on the global market. This would clearly have benefited the German consumers and firms now paying the price for political short-sightedness.

Our estimates show that, following the European trend, Germany would have sufficient additional wind capacity to substitute gas worth 23 billion EUR and reduce emissions by 34 million tonnes of CO_2 in 2022 alone. Most importantly, it would have reduced Germany's dependence on gas supplies that suddenly became inaccessible.

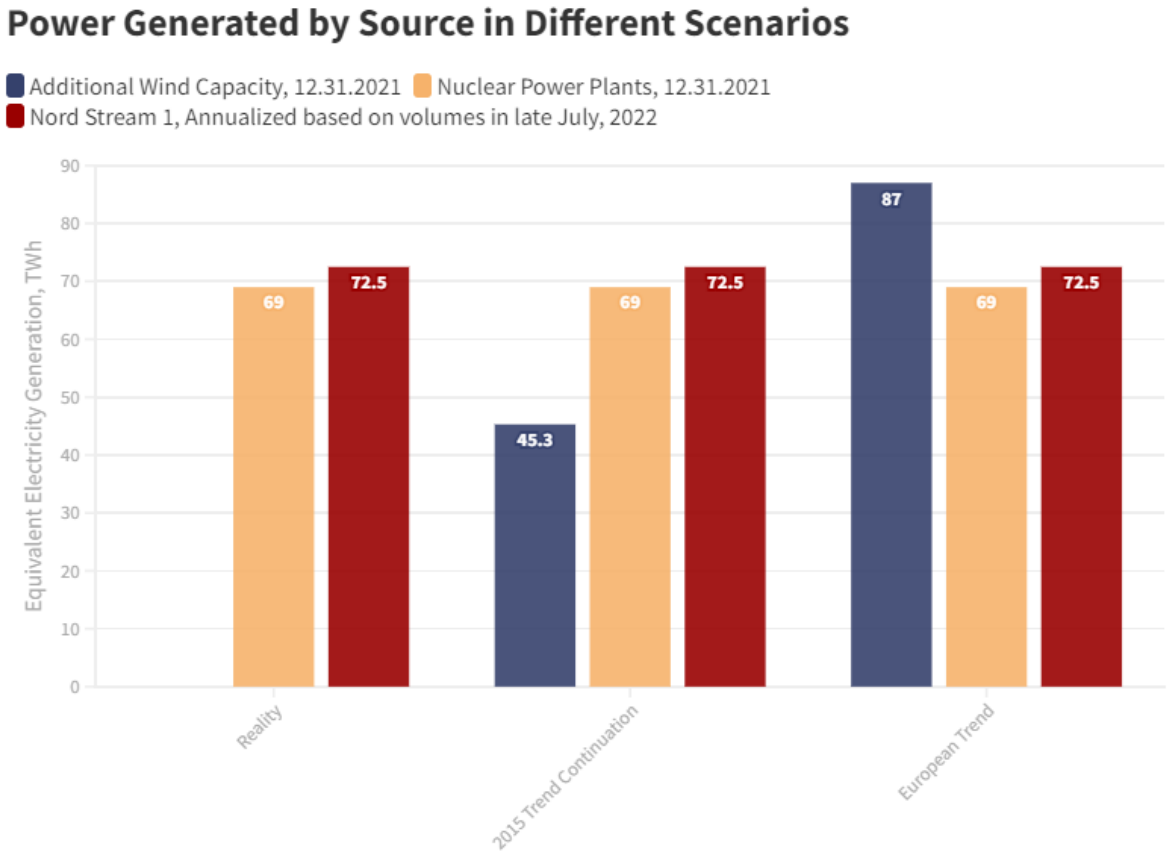

Figure 3. Following more ambitious trajectories, Germany could have had additional wind power generation equivalent to more than Germany's total nuclear power generation and 25% of Nord Stream 1's full capacity. Source: Bruegel, BP, and CREA.

More wind power in Germany would reduce the European energy bill

More wind power capacity would not only have insulated Germany from the current energy insecurity. It would additionally have driven down energy prices both in Germany and across the Energy Union, in two different ways.

Firstly, more domestic wind power capacity would have lessened the need for fossil fuels now that supply is heavily restricted and prices are sky-high. Europe is essentially in a situation where the continent is buying all available gas and coal that the global market can deliver, and prices are set at a level that forces demand down to match the restricted supply. Any additional clean energy capacity on the continent would therefore alleviate the situation by increasing the accessible energy supply and reducing the demand for

fossil fuels on the global market. The consequence would be lower energy prices for consumers across Germany, Europe, and indeed the entire world. Not only would this be sensible from the perspective of European energy security, but also from a solidarity perspective. The current situation creates energy shortages and blackouts in the Global South that used to rely on the energy supplies that Europe now scrambles for.

Secondly, due to the zero marginal cost of wind power generation, a larger fleet of German wind turbines would drive down energy costs in the highly interconnected European power grid. A 2016 study by Neon and the Mercator Research Institute looking at the massive drop of power prices in Germany and Sweden concluded that the expansion of renewables contributed the most to this phenomenon. In Germany, prices fell from a high of 76 EUR/MWh in 2008 to 32 EUR/MWh in 2015, while in Sweden they fell from 60 to 22 EUR/MWh over the same time period. This fall in power prices as a consequence of expansion of renewable energy is logical, given that solar and wind have zero marginal costs and depress power prices in the short to medium term when they are producing at a high rate. During parts of the year when wind and solar assets are most productive, power prices may even be negative, thereby contributing to substantially reducing the average cost of energy.

As Europe is extremely interconnected, these prices feed into neighbouring geographies through interconnection. The reverse holds true as well and is seen today with low production rates in the French nuclear fleet lifting price curves in neighbouring countries, exacerbating the effects of Russian gas cuts. Conclusively, more wind power generation will contribute both to depressing energy prices across Europe and to insulating the Union from external energy price shocks.

Policy recommendations

Germany needs large investments in clean energy to reach its climate and renewable electricity targets, ensure low energy prices for consumers and industry, and protect the Bundesrepublik against geopolitical crises as the one Europe is currently experiencing. The Russian invasion of Ukraine has demonstrated clearly that domestic renewable power production is key to reliably keeping the lights on in European households, as the true price of reliance on Russian fossil fuels has proven to be extreme energy costs and a situation where Europe funds Putin's war.

However, the German government now wants to change this by increasing Germany's energy production from renewable sources from 244 TWh in 2021 to between 544 TWh and 600 TWh in 2030. To realise this goal, it's essential to

- accelerate and streamline the permitting processes for new wind farms and transmission lines by simplifying the legal framework for wind power development, implementing strict deadlines, and providing sufficient resources for licensing authorities to fasten their pace;
- ensure sufficient availability of land, e.g. by setting time-bound targets for land licensing; and
- promote the upgrading of old wind farms to increase their capacity.

The German government has proposed a new Renewable Energy Act (EEG 2023), a Wind-on-Land-Act dedicating 2% of Germany's land area to wind power development, and raised its target for offshore wind power capacity. CREA supports the revival of German wind power ambitions as it will contribute to energy security in Germany and across the globe, reduce emissions, and shorten the road to peace in Ukraine.