Connecting giant turbines to the grid

The Fraunhofer Institute for Wind Energy Systems is currently developing the world's largest grid simulator. Teams of scientists can use the simulator to identify the best way to feed electricity from ever more powerful wind turbines into the grid.
Weather conditions on the high seas are often difficult, particularly when there are strong winds. However, these conditions are perfect for giant wind turbines. That’s when they can really show what they’re made of. The turbines are feeding renewable electricity into the grid at an output of up to 20 megawatts. In light of the continued reorganisation of the grid and a rising share of renewables, ever more powerful offshore wind farms are being built. This helps generate more electricity, but also produces new challenges for grid connection. Because connecting giant turbines to the grid is not always an easy undertaking. The testbeds and grid simulators that are currently available to scientists are increasingly proving to be too small. They quickly reach the limit of their capacity and are therefore only of limited help when it comes to turbine optimisation.

A mobile grid simulator for field tests and analysis

It is against this backdrop that the Fraunhofer Institute for Wind Energy Systems has developed a mobile grid simulator as part of a research project to improve the compliance of new offshore installations with the grid. This simulator can be used to test and optimise even the largest of wind turbines. The mobile testing facility which allows for conducting on-site tests and analyses will have a capacity of 80 megavoltampere (MVA), making it the largest facility of this kind worldwide. Scientists can use the mobile testing facility for grid compliance checks to look at the electrical properties of offshore generation systems at different grid connection points. This will make it possible to simulate dynamic changes in frequency or the failure of a large wind turbine and therefore to develop realistic forecasts on the compliance of giant wind turbines with the grid – even those located far off land.

Surveying entire wind farms

The mobile testing facility for grid compliance checks is directly connected to the grid connection point at a particular test site. The 80 MVA grid simulator can test turbines with an output of up to 20 MW, allowing even to survey an entire wind farm or string. ‘In addition to this, the facility helps us actively detect disruptions in grid operation,’ Gesa Quistorf, project manager at Fraunhofer Institute for Wind Energy Systems (IWES), explains.

Mobile testing facility can be connected to hydrogen testbed

Professor Jan Wenske, deputy director of the Institute and technical director at Fraunhofer IWES adds that the new test bench could also be easily connected to existing test infrastructure and, additionally, to a hydrogen testbed which is currently being set up.

The launch of the grid simulator is scheduled for autumn 2022. The Federal Ministry for Economic Affairs and Energy is providing 12.7 million euros in funding for the project.

FURTHER INFORMATION

Information on the mobile testing facility for grid compliance checks provided by Fraunhofer Institute for Wind Energy Systems (IWES)
Information on the mobile testing facility for grid compliance checks provided on EnArgus – the Federal Ministry for Economic Affairs and Energy’s energy research website (in German only)
An action plan for cross-border trade in electricity

Europe's electricity markets are becoming increasingly more intertwined. This is why, by the end of 2025, 70 per cent of cross-border power lines are to be opened up for international electricity trading. Germany sets out how it will achieve these plans domestically in its Bidding Zone Action Plan.

Germany has long been a hub for European electricity trading. As our electricity markets become more intertwined, the need to transport electricity across the grid is also growing. According to the new EU Electricity Market Regulation, at least 70 per cent of cross-border power lines are now to be progressively opened up for cross-border electricity trading from 1 January 2020. This would mean a sharp increase in most of the limits for cross-border electricity flows between Germany and its neighboring countries. German transmission system operators say this will lead to considerable bottlenecks in Germany's domestic electricity grid, i.e. our electricity grid will become overloaded. Only about 20 per cent of capacity at Germany's borders with the Netherlands, France and Austria, for example, is currently open. The situation with other European neighbours is similar. According to the transmission system operators, the eastern European countries are 11.5 per cent open, while Sweden has already reached the 41 per cent mark. Some of Denmark's interconnectors already reach the required 70 per cent.

Action plans ensure a transition period up to the end of 2025

Given these challenges for the electricity grid, the EU Electricity Market Regulation grants each Member State a transitional period for expanding its electricity trade. To take advantage of this, the countries must each submit a national action plan setting out what specific measures will be taken to reduce domestic grid bottlenecks. Once an action plan has been submitted, the volume of cross-border trade must rise gradually from that point onwards. However, the target value of 70 per cent must be reached by 31 December 2025 at the latest. Countries including the Netherlands, Poland and Germany have opted to submit such an action plan. Germany submitted its Bidding Zone Action Plan.
Transmission grids to be fortified and expanded

The Action Plan is based around a series of measures designed to reduce grid congestion and improve the what is known as 'redispatch'. A key aim is to strengthen and increase the capacity utilisation of the transmission networks. This crucially involves not only accelerating network expansion, but also optimising existing networks. For example, so-called 'phase shifters' are to be used to better control the flow of electricity in the grid and thus increase its overall transport capacity.

The Bidding Zone Action Plan also focuses on ensuring that overhead lines can operate regardless of what the weather conditions are. This is an issue, as the conductor cable has a maximum operating temperature – imposing a limit on the transmission capacity of the overhead lines. This maximum temperature depends mainly on how high the volume of electricity flow and the air temperature are. By precisely recording the ambient temperatures of and the onflow of wind onto individual lines, the idea is to help determine the maximum permissible current flow and thus increase the overall load on the lines. The use of high-temperature conductor cables also makes it possible to increase the load on the existing network.

Creating a better balance between consumption and production

In order to improve congestion management, the redispatch of electricity must be made more efficient. Power generation and grids need to be better aligned with one another. This is why, as part of the future expansion of renewables, wind power plants are to be increasingly be built in southern Germany, for example. As coal-fired power plants are shut down, the impact on transport capacity needs for electricity will also be considered. Coal-fired power plants that are important for the electricity grid will therefore be excluded from the first call for shutdowns. If there is any doubt as to the impact of a particular shutdown, the power plant is not allowed to stay shut down completely but must remain available to serve as a reserve power plant.

In the second part of the Bidding Zone Action Plan, the principles for calculating the starting values for the Germany's 'minimum trading capacity' are explained. These principles form the basis for the gradual increase to 70 per cent. The Bundesnetzagentur [Federal Network Agency] undertakes comprehensive monitoring to ensure that the transmission system operators also fully implement the requirements for allocating capacities for cross-border electricity transmission.

A uniform bidding zone is to be maintained

The overall objective of the Bidding Zone Action Plan is to maintain a uniform national bidding zone and strengthen cross-border electricity trading. Europe is already divided into several electricity market areas, known as 'price zones' or 'bidding zones'. In each of these zones, a uniform electricity price applies to all. Having uniform bidding zones makes it possible to harness balancing effects in
generation and consumption across a geographical area. They also provide easy access to the electricity market not only for large suppliers, but also for small innovative providers as well. Analyses conducted by the transmission system operators also show that the bottlenecks within Germany are distributed across the entire transmission system and therefore – unlike in other countries – do not provide clear geographical boundaries for establishing different bidding zones.

FURTHER INFORMATION

[⇒ Federal Ministry of Economic Affairs and Energy download: 'Bidding Zone Action Plan' (PDF, 1 MB)]
[⇒ Federal Ministry of Economic Affairs and Energy dossier: 'Electricity market of the future']
[⇒ Federal Ministry of Economic Affairs and Energy article: 'What exactly is 'grid congestion'?]

Quote of the week

'By implementing the measures set out in the Climate Action Programme, we can achieve 95 per cent of the emissions reduction target we have set ourselves for 1990 to 2030. With an estimated emissions reduction of 52 per cent compared to 1990 levels, we are in the top group in an international comparison.'

Peter Altmaier, Federal Minister for Economic Affairs and Energy, speaking mid March about the results of the export report of the Climate Action Programme.

Climate Action Programme brings Germany within reach of its climate target for 2030 (in German only)

A recent expert report has concluded that by following its Climate Action Programme 2030, Germany will reduce its greenhouse gas emissions by 52 per cent by 2030 compared to 1990 levels. The report, which examined the effects of the measures in Germany's climate package on climate change mitigation, was conducted by Prognos AG on behalf of the Federal Ministry for Economic Affairs
and Energy. According to the findings, without its Climate Action Programme, Germany would only be able to reduce its greenhouse gas emissions by 41 per cent by 2030. All of this means that the measures adopted to date will already enable Germany to come very close to meeting its climate target reducing greenhouse gas emissions by at least 55 per cent by 2030. According to the estimates, the energy industry will make a particularly large contribution to reducing emissions. Prognos expects emissions from the energy industry to fall to 183 million tonnes by 2030. This would be a reduction of 61 per cent compared to 1990 levels.

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**Berlin Energy Transition Dialogue cancelled**

Due to the current restrictions linked to the new coronavirus (COVID-19), many events on relating to the energy transition have been cancelled throughout Germany and internationally. Among them is the Berlin Energy Transition Dialogue (BETD) mentioned in the February issue. Further information can be found on the BETD website.

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