Better forecasting for solar and wind power generation

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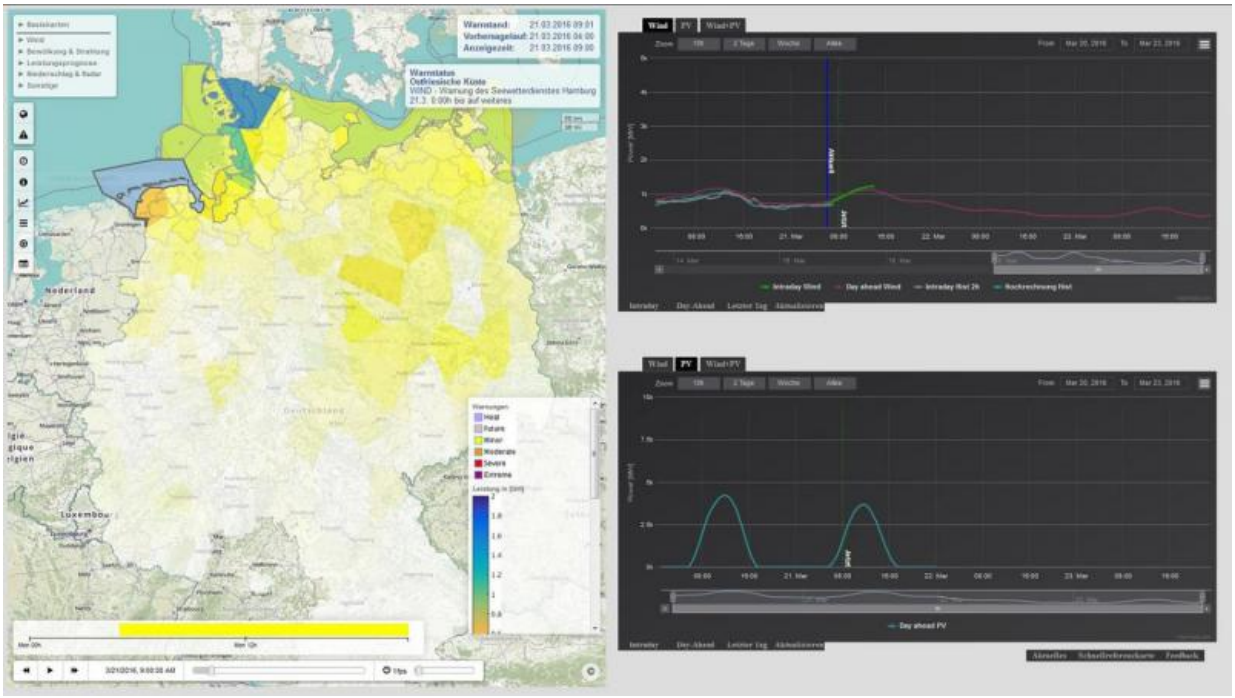

The new demonstration platform „EnergyForecaster“ depicts forecasts for the feed of renewable energies in general (left) and for photovoltaics and wind energy in particular (right). Over all, more than 20 different warnings and forecasts can be displayed. Credit: Fraunhofer IWES

The sun does not shine and the wind does not blow with constant intensity. This is a problem for the power grid, where the power supply must always match the power demand. In the EWeLiNE project,

Fraunhofer and the German Weather Service have been working to develop better models for forecasting the generation of renewable electricity. Now they have launched a platform for transmission system operators to test the new models live.

In the EWeLiNE project, the Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) in Kassel is working together with Germany's National Meteorological Service in Offenbach. The partners develop mathematical models that produce improved forecasts accurate for each quarter-hour, which show how much electricity Germany's installed photovoltaic and wind-farm facilities will generate over the next few hours and days. "It's crucial for us to interconnect both worlds – forecasts of weather and power – more closely than before, tailoring them better to the requirements of the transmission system operators," says project manager Dr. Malte Siefert of IWES, describing the added value of the new models. These companies operate the major power lines in Germany that make up the 380- and 220-kV high-voltage grid. Transmission system operators are responsible for bringing electricity to consumers, maintaining the power grid, and expanding it as needed.

EnergyForecaster: Testing forecast models live

The project began at the end of 2012. Now the partners are releasing a demonstration platform called the EnergyForecaster, where transmission system operators can try out new forecasting tools live in their control centers. The companies know nearly precisely when and how much electricity consumers need over the course of the day – but they know only approximately how much photovoltaic systems and wind farms will feed into the grid. "It's important to forecast how much renewable power will be generated, because that tells us how much conventional generation capacity – whether nuclear, gas, or coal – needs to be brought online. At the same time, the forecast is necessary for calculations to keep the power grid stable and for trading electricity," explains Siefert.

New kinds of forecasts available in the demonstration platform help transmission system operators calculate precisely how much wind and solar power will be fed into which grid nodes. Other new tools feature information on the reliability of the forecasts. "The transmission system operators also have to be aware of any critical weather conditions – for example, patches of low stratus or low-pressure zones – so they can better analyze and estimate the forecast results," says Siefert. The researchers also benefit from the EnergyForecaster, as it shows them how their innovations perform in the real world. "We believe that more potential for optimization, as yet unrecognized, will result," says Siefert.

1.9 million units included

"It's crucial to calculate precisely how the 1.9 million photovoltaic facilities and wind farms operating in Germany will convert the weather into electricity," says Siefert. The problem is that data are not available for all of the systems. "In some cases, data privacy laws prevent us from gaining access, while in others we simply lack the technology to continuously record how much power the unit feeds in," explains Siefert.

IWES is designing mathematical models to improve the forecasts of all PV systems and wind farms in Germany. Researchers reconcile the results with existing data and optimize them for various applications. The scientists separate the more than 40 forecasts that transmission system operators currently use into 16 groups, then systematically improved them. "Our objective is to combine several different methods for each application to take advantage of their various strengths," says Siefert.

Meanwhile, the DWD is adapting its weather forecasts to meet the requirements of power forecasting. "We performed detailed meteorological analyses of the occasions when forecasts of power feed-ins to the grid proved most inaccurate. From these analyses we then

derived improvements to our weather models," explains the DWD's Dr. Renate Hagedorn. "With the systematic adaptation of our weather forecasts as a basis for wind and photovoltaic power forecasts for the electric grid, the German weather service has taken on a new and supplementary role," explains Hagedorn.

Functioning of the power grid

If supply and demand for electricity do not match, the power voltage and frequency on the grid change. Transmission system operators observe these variables and manage supply to match demand. The need to adjust power generation or activate reserve power to avoid power outages has become more frequent. This risk grows in proportion to the percentage of weather dependent energy sources like sun or wind. Renewables already account for 22 percent of the electricity generated in Germany. The federal government's energy plan calls for an increase to 35 percent over the next eight years.

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