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More Accurate Wind Power Forecasts to Cut the Costs of Germany's Energy Transition

Federal government tasks ZSW and EWC to tackle a new research project

The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) in Stuttgart and Karlsruhe-based EWC Weather Consult GmbH intend to use multiple weather models' meteorological forecasts and machine learning techniques to calculate far more accurate projections for wind power generation. The aim is to drive down the costs of Germany's energy transition. The Federal Ministry of Economics is sponsoring this project called WindSage.

As Germany adds more fluctuating energy sources to the grid, sometimes weather conditions are such that these sources deliver less wind or solar power than predicted. Providers then have to draw on expensive balancing energy to compensate for shortages.

The WindSage project aims to remedy this situation. The Karlsruhebased weather experts from EWC will bring all their extensive expertise in forecasting and processing captured data to bear for this initiative, while ZSW's researchers will contribute insights into machine learning and meteorology gained over many years. With these assets at their disposal, the team will be able to combine as many as ten weather models to significantly improve wind power forecasts.

Rooted in cutting-edge in the latest advance in computer science, the machine learning techniques in guestion are used in much the same way in facial and voice recognition applications. Human learning provided the blueprint for these processes: Neural networks grasp the meaning of data like a toddler picks up the meaning of words and images. Learn-O-Matic, a software application developed at ZSW, enables scientists to evaluate mountains of data from weather models and select the best combination and weighting. "Deep neural networks with new methods of reinforcement learning are the means of choice. They are deployed on high-performance computers to find out which combination of forecasts and ground measurement data provides the best forecasts for wind power feeds," says Anton Kaifel, head of the Simulation and Optimization research group at ZSW. A great deal of prerequisites have to be met for system like this to truly learn. "At EWC, we will calculate forecasts for the last two to three years for each weather model. To this end, we have created a huge archive with historical forecasts," says Jon Meis, CEO of EWC.



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"These historical forecasts are very important because neural networks, like children, learn from example situations. The more historical data are available as examples, the better they learn," notes Anton Kaifel. Once trained, neural networks can be operated in an up-andrunning system that updates its wind forecasts hourly.

The point of creating this type of system is to furnish better forecasts than transmission and distribution network operators have been getting. "Balancing energy capacity can be reduced with more accurate forecasts. This means costs come down for everyone who buys electricity, corporations and households alike," says Jon Meis. But the system is also flexible enough to adapt to other requirements such as those of direct marketers and distribution network operators. What's more, initial applications in direct marketing have led project partners to believe that a similar system could also improve solar power forecasts.

The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) is one of the leading institutes for applied research in the fields of photovoltaic energy, renewable fuels, battery technology, fuel cells and energy systems analysis. The three ZSW sites at Stuttgart, Ulm and Widderstall are currently staffed with around 230 scientists, engineers and technicians supported by 120 research and student assistants.

An independent private provider of weather information, Weather Consult GmbH (EWC) furnishes time- and location-based weather data, historical weather databases, weather reports and forecasts, and lightning and climate statistics for businesses in the insurance and power industries, government agencies and the recreation sector. Founded in 1999, the company is currently developing markets at home and abroad.

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For pictures and a factsheet on ZSW, contact Solar Consulting GmbH or ZSW.





Wind turbine.

Photo: ZSW

Wind power forecasting using neural networks (red) is significantly more accurate than projections based on conventional weather models (blue).

Chart: ZSW



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