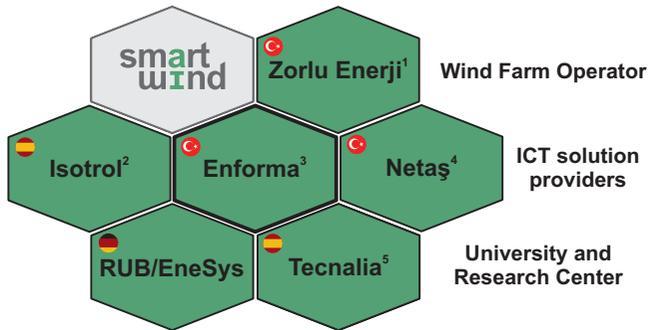


Cooperation Partners of the Joint Project



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smart wind

**Advanced Tools to Optimize
Operation and Maintenance
Activities in Wind Farms**

Conceptualization and Implementation
of AI-supported Wind Farm Operation
and Active Wake Control

Project Support and Funding

Supported by:



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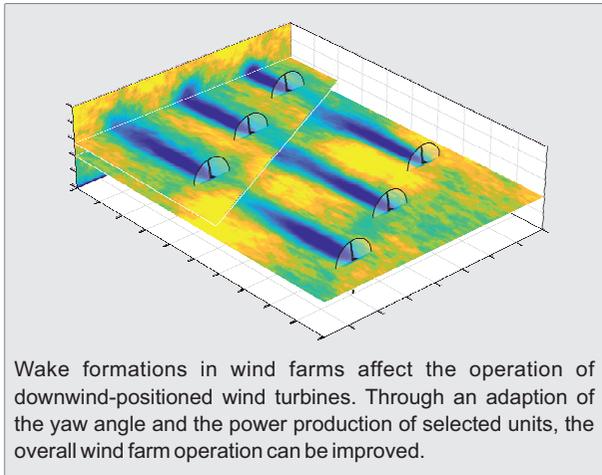
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Challenges in Wind Farms

The construction of wind turbines in wind farms is encouraged due to economic advantages and a higher utilization factor of available areas. During operation, the stochastic wind field in the wind farm is superimposed with the wakes of the wind turbines. Depending on the wind direction, these wakes result in a reduced energy yield and because of the higher turbulence intensity also in increased mechanical stress of the support structure and drive train. A decreased overall energy yield, increased failure probabilities of stressed components and a deteriorated profitability of the wind farm are the main consequences.

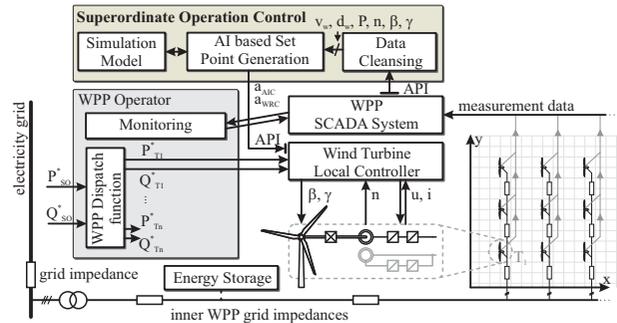


Wake formations in wind farms affect the operation of downwind-positioned wind turbines. Through an adaption of the yaw angle and the power production of selected units, the overall wind farm operation can be improved.

What are the Goals of the Project?

The main objectives of the project SmartWind are enhancements of the reliability and the profitability of wind farms. This comprises an predictive failure identification of relevant components to implement an optimized operation and maintenance management. The German subproject focusses on the development of an active wake control, which helps to diminish energy losses and structural loads that are caused by the wake turbulences of upwind-positioned wind turbines.

Concept of the Multi-Criteria Decision Support System



The action recommendations of the maintenance management as well as the set points calculated by the active wake control are bundled in the multi-criteria decision support system (MCDSS).

Measurement data are collected in real-time and fed into the AI-based algorithms of the active wake control. Algorithms such as feed-forward neural networks use the input values to calculate appropriate set points for the yaw angle and power limitation of individual wind turbines to achieve an overall wind farm operation optimization. These set points are transmitted to the central wind farm control, which forwards them in accordance with the safety management to the local turbine controllers.

For the validation of the MCDSS, firstly the SWiPLab is used, a laboratory infrastructure that emulates wind farms of up to 30 wind turbines. Afterwards, it is tested at the Gökçedağ WPP, a wind farm of 54 turbines and an installed capacity of 135 MW that is positioned and operated in Turkey by Zorlu Enerji.

