DISPOWER

Distributed Generation with **High Penetration** of **Renewable Energy Sources**

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Result realised by:

ISET

IT Power

Met Office

Wind Power Prediction Tool successfully adapted

Results:

> *improved calculation of energy bids*

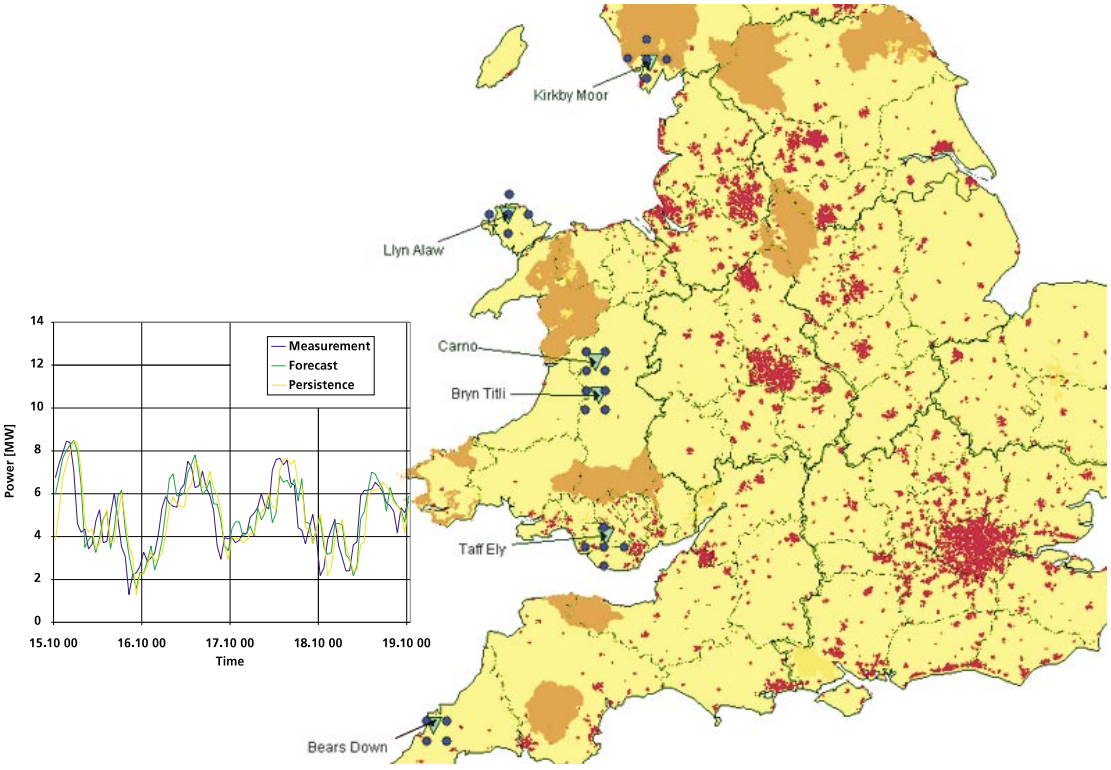
> *improved accuracy compared to persistence*

> *1420 MWh (2.7 %) avoided energy lack*

> *1750 MWh (3.3 %) avoided energy surplus*

Wind power prediction within the DISPOWER project

The objective of one subtask of the Dispower project is to improve the existing wind power prediction model, developed at ISET for a market-based electricity tradery system such as in the UK. The prediction model provides wind power forecasts for wind farms operated by National Wind Power, a large owner and operator of wind farms, and part of a major electricity company within the UK. IT Power collected all required data and information for the model improvement, i. e. wind farm power output time series, basic wind farm data and meteorological data. The Met Office provided the required meteorological forecasts.
ISET designed the layout and adapted the prediction tool for the calculation of the wind power forecasts.
Using artificial neural networks (ANN) the prediction tool provides the wind farm power output for the near future. Various ANN modules are trained to learn the relationship between variations in the meteorological data and the wind power output, using historical wind and power data. By the comparing of the results with observed power data, the optimal configuration of ANN modules was determined. The advantage over other approaches is the determination of the physical coherence by using observed data because the real relationship between meteorological data and wind farm power output can hardly be described sufficiently by physical models. Moreover the addition of further parameters does not require expensive modifications of the model.



Wind farm sites with surrounding grid points of the UK-Met-Office weather model.

Technial Details

Various ANNs were trained with the wind data of the surrounding points in combination with the measured wind power data to provide a two-hour forecast. The table shows the results of the test phase of the prediction models. The accuracy is compared to persistence, which is the easiest way of forecasting. Persistence assumes that the power does not change at all within the forecasting horizon. All evaluations are based on 142 days (568 forecasts). The root mean square error (RMSE) is based on the rated power and describes the deviation between the measured and predicted time series. The correlation describes the approximation of the curve progression, where 0 means independent and +1 means equal. The columns lack and surplus describe the difference between predicted and real wind energy production.

In general, the prediction model features a very good approximation of the wind power generation and shows a significant improvement over the persistence model on such a short prediction time. The table shows the accuracy of the forecasts compared to the persistence model. All forecasts feature an improvement of the accuracy opposite to the persistence model.

Farm	Nom. Power [MW]	RMSE	Correl.	Lack [MWh]	Surplus [MWh]
Forecast					
Bears Down	9.6	11.8%	0.921	845	802
Bryn Titli	9.9	13.1%	0.913	1650	1797
Carno	33.6	9.8%	0.922	4594	4592
Kirkby Moor	4.8	12.9%	0.913	836	899
Llyn Alaw	20.4	9.7%	0.947	2966	2801
Taff Ely	9	13.9%	0.909	1643	1241
Persistence					
Bears Down	9.6	13.7%	0.899	964	899
Bryn Titli	9.9	14.6%	0.887	1926	1921
Carno	33.6	10.2%	0.898	5150	5041
Kirkby Moor	4.8	15.0%	0.881	965	986
Llyn Alaw	20.4	11.6%	0.916	3426	3490
Taff Ely	9	14.7%	0.882	1518	1540

Table: Statistics for the two-hour forecast of all wind farms.

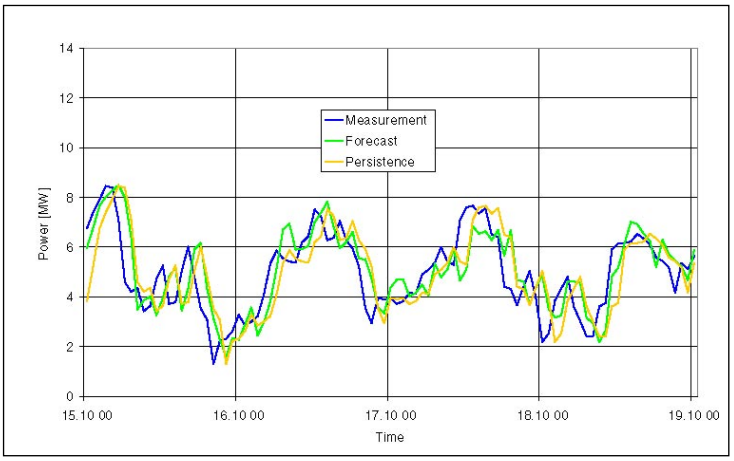


Figure: Measured and predicted power output of wind farm Bears down

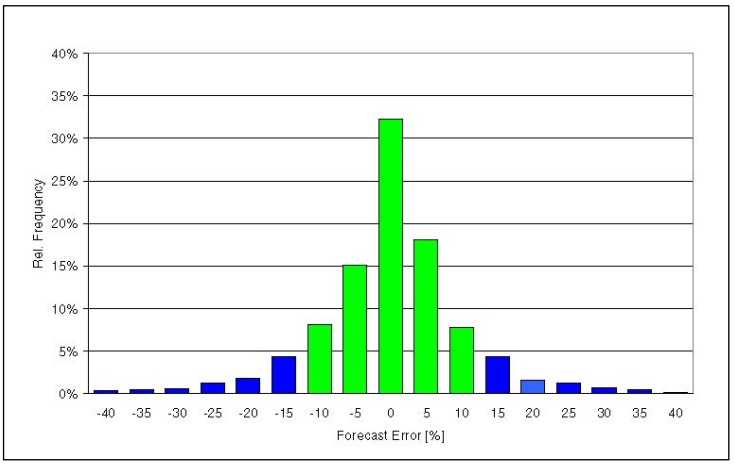


Figure: Frequency distribution of frorecast error of Bears Down – 82 % of the error ranges from –10 % to + 10 %

MASTHEAD

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