

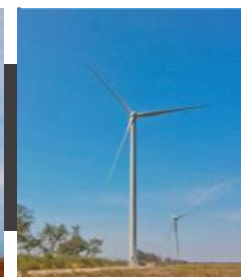
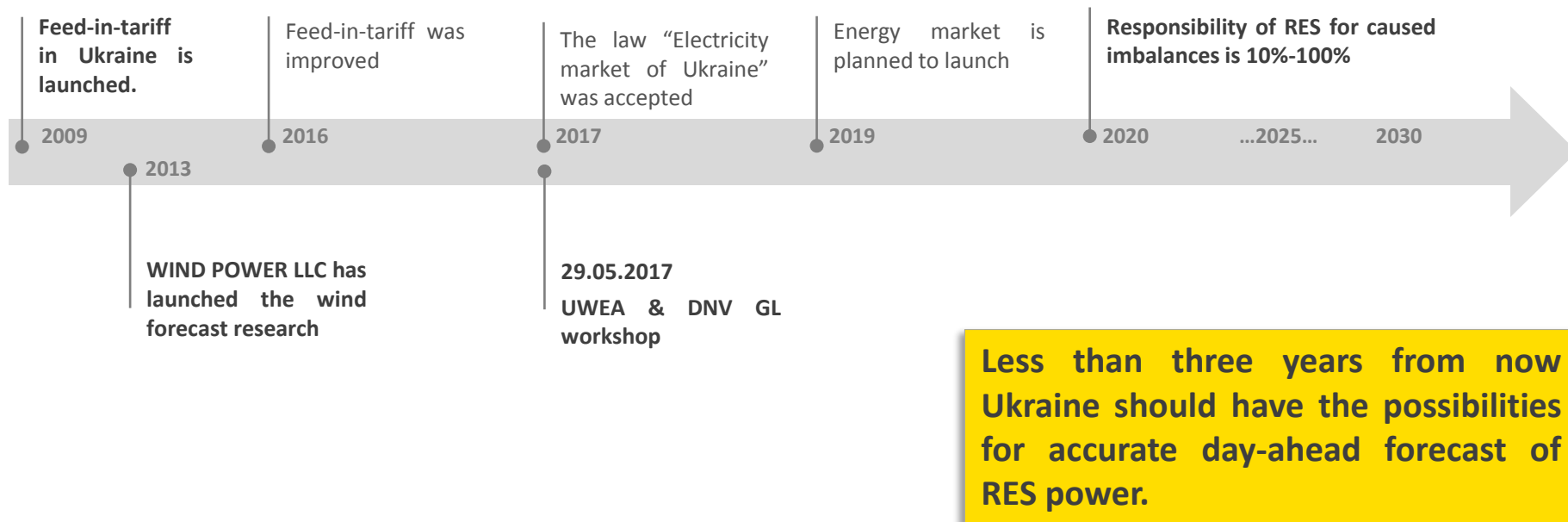


PROBLEMS OF SHORT-TERM ENERGY FORECAST IN UKRAINE. CASE: BOTIEVO WIND FARM

VYACHESLAV MOLIBOG



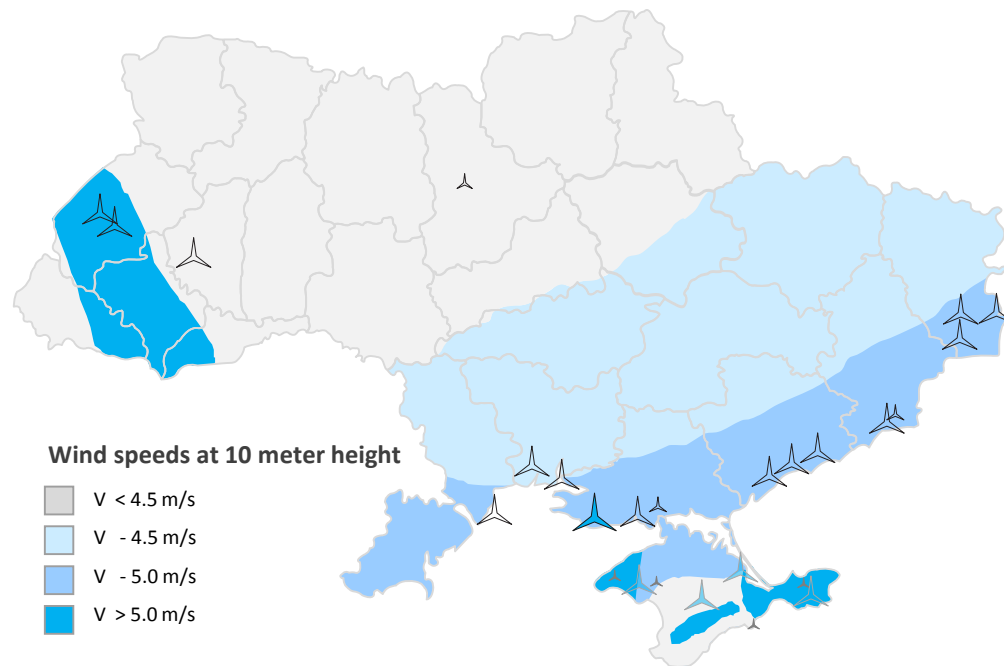
MILESTONES OF WIND ENERGY FORECAST RELATED ISSUES



WHY IS IT IMPORTANT TO FORECAST WIND ENERGY ACCURATE

1. Poor forecast brings increased requirements for spinning reserves
2. No imbalances charges and penalties
3. More efficient project construction, operation and maintenance planning

Map of wind potential and existing/planned wind farms



Structure



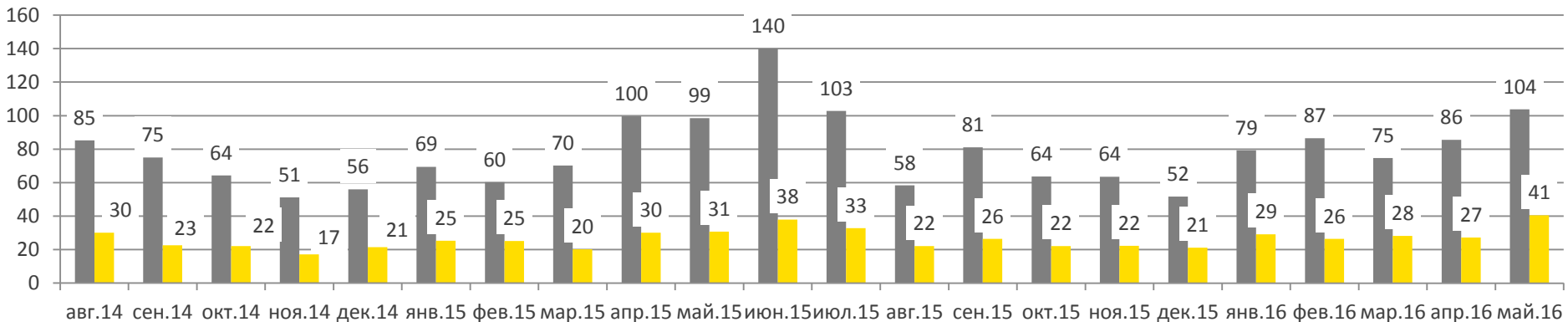
Results

$MAE (Wind\ speed) = 26\%$

$MAE (Energy\ forecast) = 77\%$

$$Forecast\ error_i = \frac{Actual_i - Forecast_i}{Actual_i} \times 100\%$$

■ Средняя за месяц погрешность прогнозирования выработки, % ■ Средняя за месяц погрешность прогнозирования скорости ветра, %



RESULTS ANALYSIS AND IMPROVEMENTS

Meteo forecast

1. Start-up train of the model on the base of wind measurement campaign

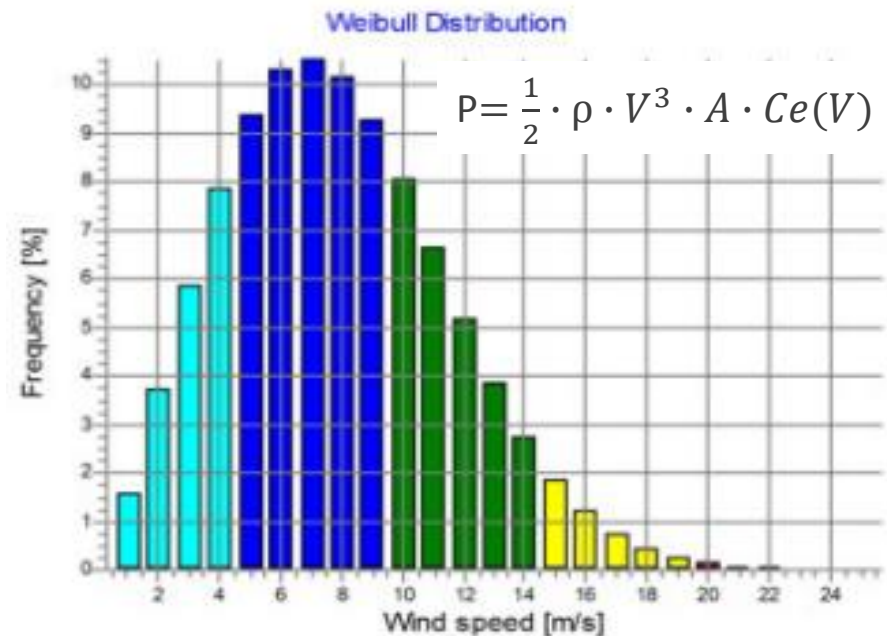
Energy forecast

1. Model re-train every 2 month
2. Maintenance schedule
3. Curtailments and long-term downtimes

1% of final energy forecast is a result of multiplying energy forecast error and meteo forecast error in proportion 1/9.

The energy forecast error could be easily minimized by updating the transfer function and including maintenance schedule.

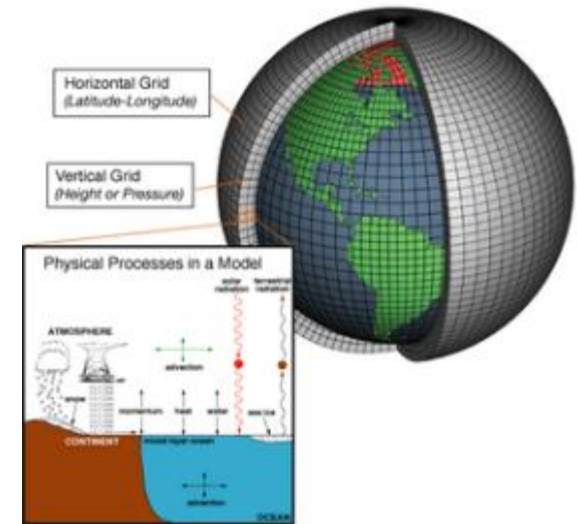
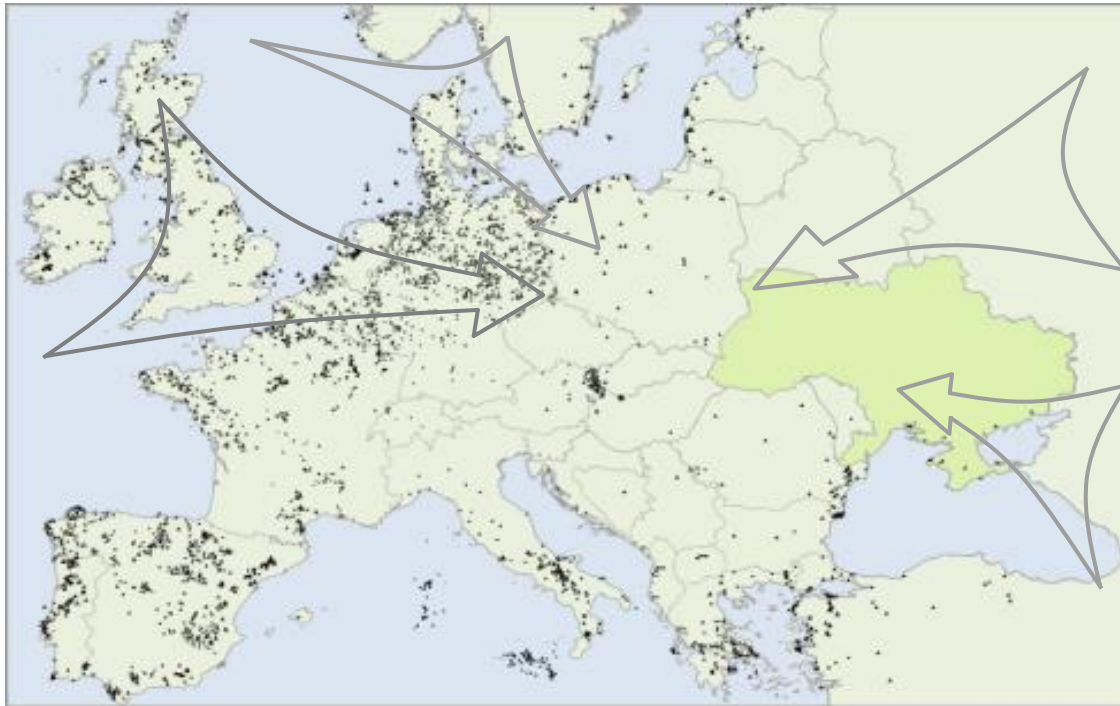
The reason of meteo forecast influence is the non-linear behavior of WTG power curve. Since the dependence of power to wind speed is cubic the error of forecast in 0,01 m/s could bring significant error of energy forecast.



METEO FORECAST MODEL DETAILS



PARAMETER	Europe	Botievo Wind Farm
Type	Regional	Global
Resolution	4x4 km	17x17 km
Inputs	Global model, Meteo stations, Wind farms	Global model



The key issue in poor weather forecast is absence of detailed weather model for Ukraine territory, taking into account the terrain, local weather factors, the nature of wind.

1. Regional weather forecast model for Ukraine

At the moment, usually forecast is made upon the global meteo model with 17x17km resolution or higher and maximum 3 h. update. The local model has following parameters (4x4 km and 1h update)

2. Weather forecast model include the on-line metering of installed in Ukraine meteorological masts

Having a lot of data sources would improve the weather forecast

3. Power forecast model should include the on-line power metering of wind farms in Ukraine

Having the real-time power on hand, the power forecast model would have a possibility to tune the forecast for the most recent actual power

4. Power forecast model should have the possibility to correct the forecast on actual availability of wind turbines

The forecast model should have a possibility to tune the forecast on the basis of most recent wind turbine availability, curtailments etc.

THANK YOU FOR ATTENTION!