

OutSmart

Professionals in Wind



Wind Power Forecast system & Wind Power Trading Concept



Company Introduction

- ✓ OutSmart is an independent wind energy service provider, founded in 2008
- ✓ Member of the TÜV NORD Group, since 2013
- ✓ Company size: 55 Employees
- ✓ Our Services:



Project Management Services

Full project support for on- and offshore wind projects from development to maintenance.



Operations Services

Managing your assets (turbines), focusing on all technical and commercial aspects of onshore and offshore wind farms



Education & Training

Developing educational programs & trainings, for students and professionals in wind.



Concepts

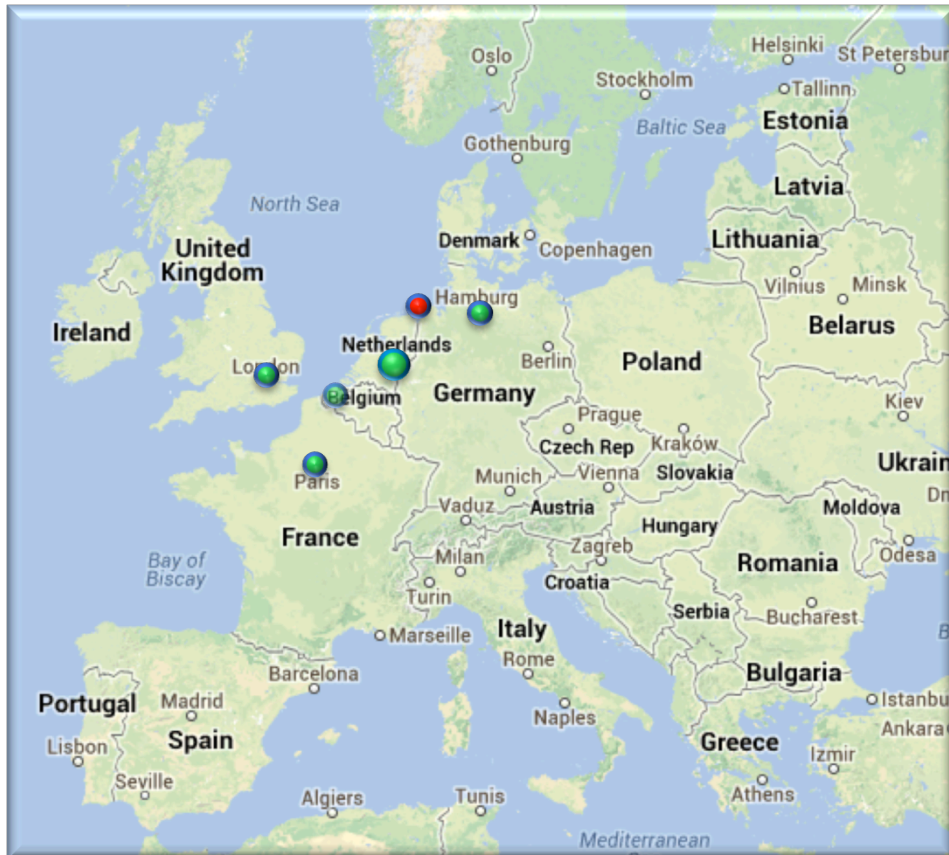
Developing innovative concepts for the on- and offshore wind industry, by thinking out of the box.



OutSmart Presence

Offices: Velp; Hamburg; Paris; London; Belgium

Operations Control Centre: Emden (DE)



Markets:

EU - Netherlands, Germany, UK, Belgium, Poland, France, Italy, Spain, Sweden, Finland, Norway, Denmark

World - US, Canada, China, Cape Verde, Dutch Antilles, Taiwan



OutSmart's goal

"Service the full lifecycle of a wind turbine or wind park and all aspects related"

Development, engineering, contracting,
construction, operation and decommissioning



Content

Introduction

Wind power forecast system

Trading scenarios

How to implement for your wind park?

Financial added value



Introduction

The wind power forecast services is a joined effort of BOC MetOcean and OutSmart.

Wind power trading:

- The influence of the wind power on the power market increases;
- Subsidy schemes creates partly coverage of market risks (SDE+ in Dutch market)
- Fixed PPAs in the market APX-11% unbalance discount or more;
- Development in the market: Technical Wind park Operations and power trading are being integrated more and more.

An accurate wind power forecast and effective power trading concept provides the needed answers on these developments.



Wind power forecast system



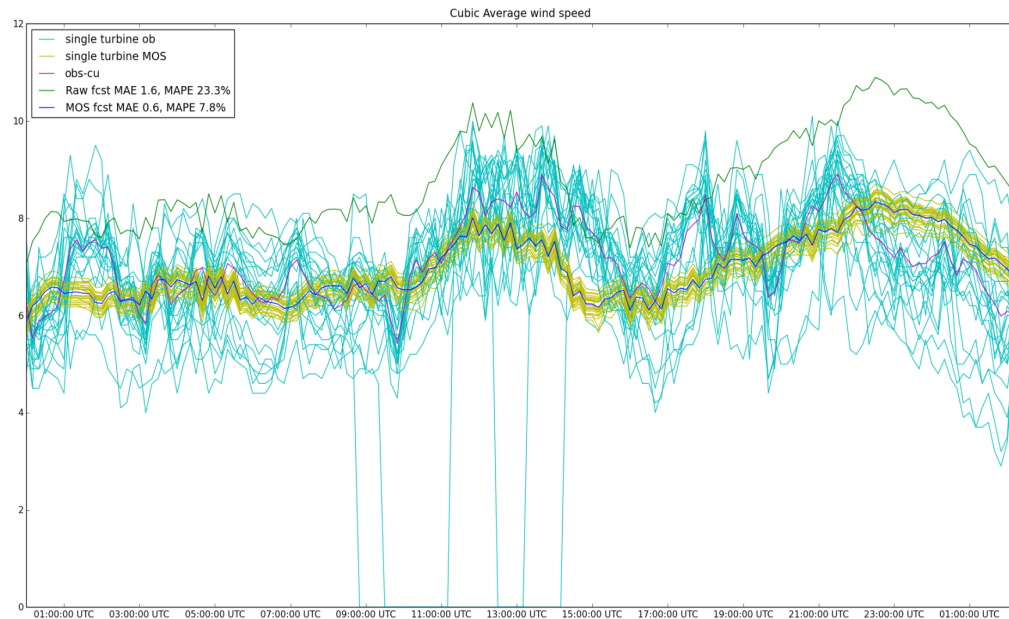
1. Wind forecast: MOS-model
2. Wind park characteristics
3. Availability of the wind turbines: Operations schedule
4. The trading strategy: Offset in forecast



Wind Forecast



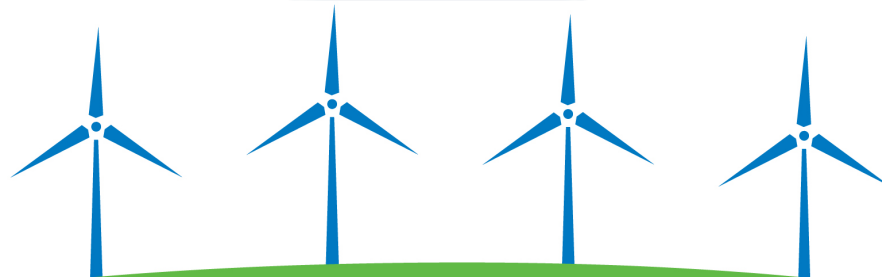
- Wind forecast: MOS-model, which is a self learning model, provides every day wind speed, direction and air density. The MOS-model gets every day a feed-back of the actual wind data (*first feed-back loop*).



Wind forecasting - models

- WRF** - The Weather Research and Forecasting (WRF) Model
- next-generation mesoscale numerical weather prediction system
 - both operational forecasting and atmospheric research needs
 - a 3-dimensional variational (3DVAR) data assimilation system

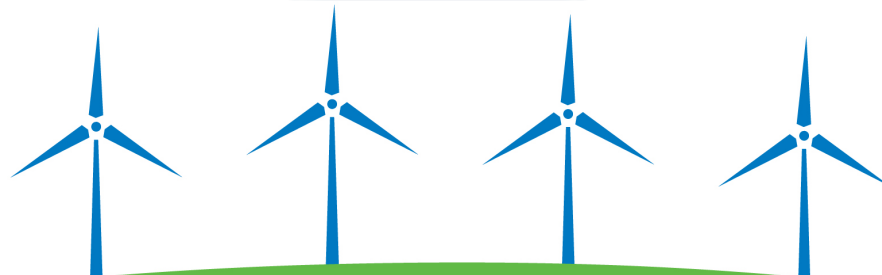
WRF is suitable for a broad spectrum of applications across scales ranging from tens of meters to thousands of kilometres.



Wind forecasting - models

MOS – Model Output Statistics

- Before each model run the MOS system compares a history of the model gridded data over the wind farm (predictors) and observations (predictands)
- Each iteration of the system separates this data into a training set and a verification set.
- The system then selects the most useful predictors, by running either a multiple linear regression or Kalman Filter over the training set and verifying this over the verification set.
- The algorithm results in the simplest set of equations which do the best job.
- These equations are then applied to the raw model forecast.

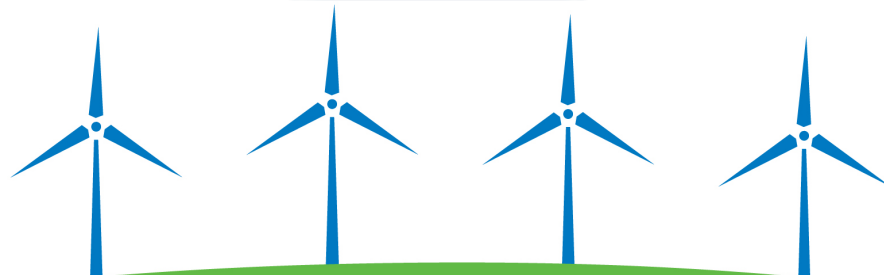


Wind output

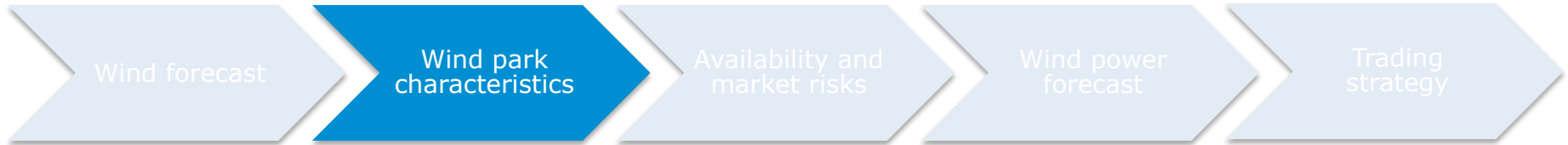
The following information is currently provided for a wind farm

- 1) Wind speed and direction at hub height
- 2) Air density
- 3) Pressure
- 4) Temperature
- 5) Relative humidity

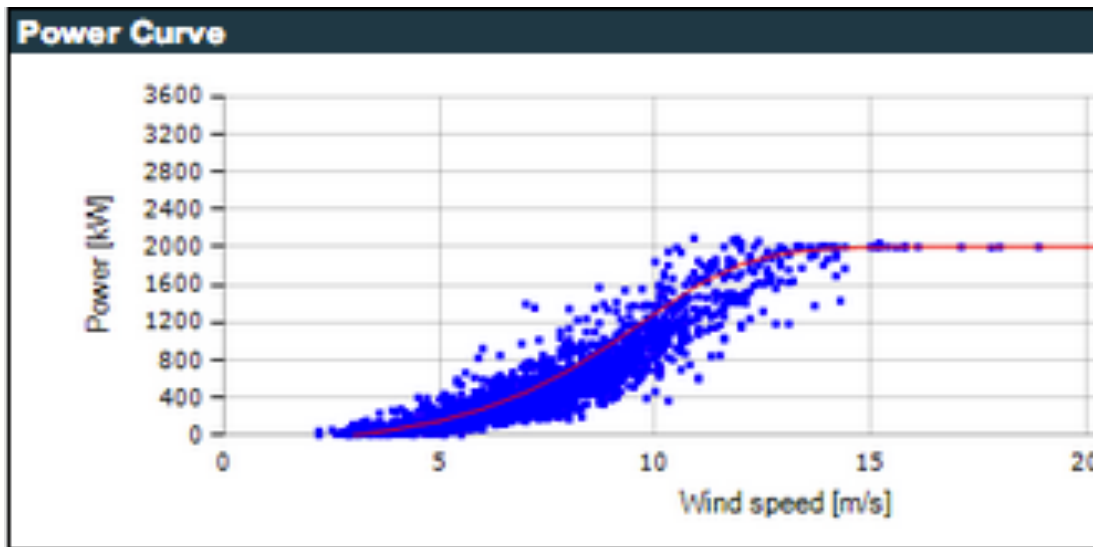
Other atmospheric parameters / phenomena like vertical wind shear, temperature inversions, ramping events, etc can be provided as well



Wind park characteristics



- Wind park characteristics: Each month the PV-curve will be optimized automatically by the actual data (*second feed-back loop*).



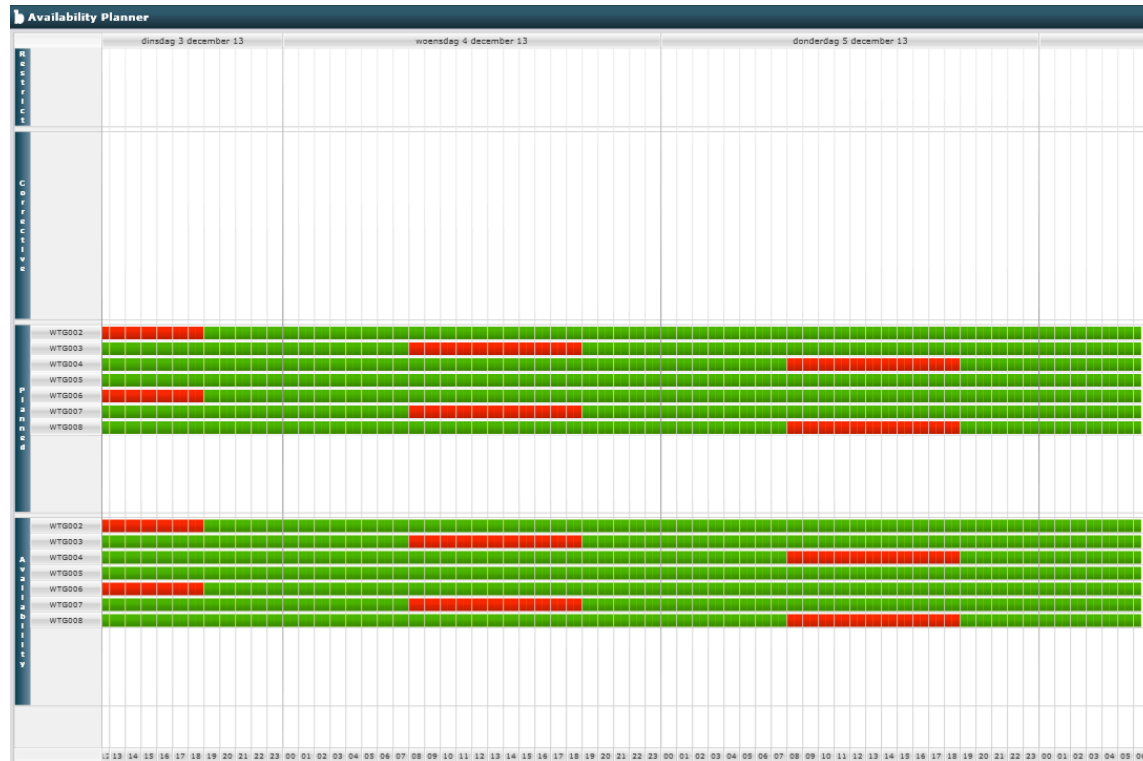
- The PV curve is based on actual data from the monitoring system.



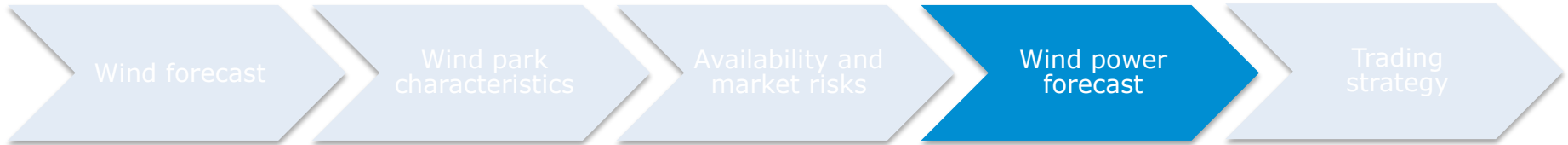
Availability and market risks



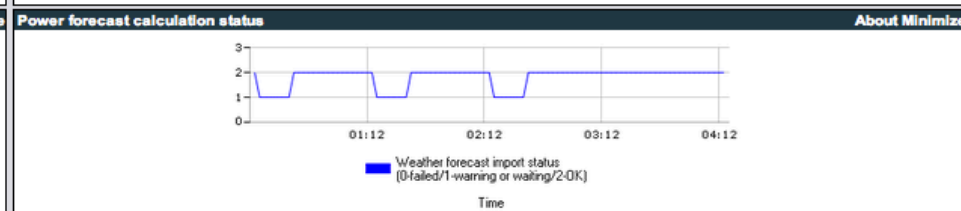
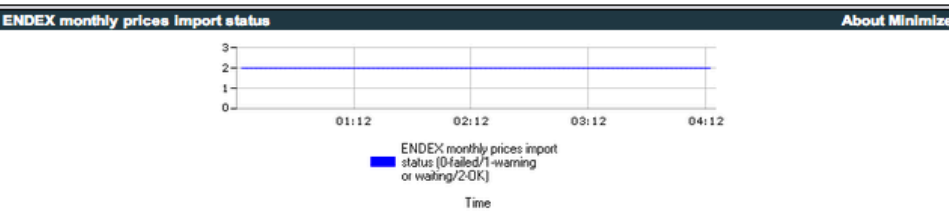
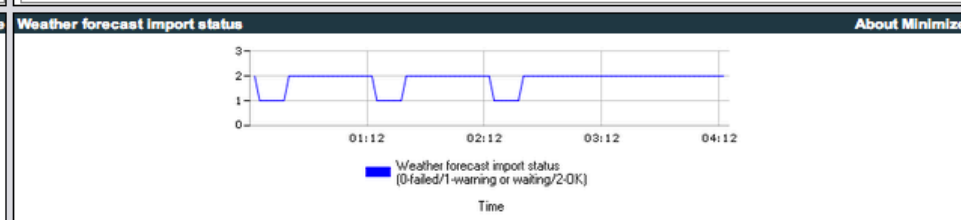
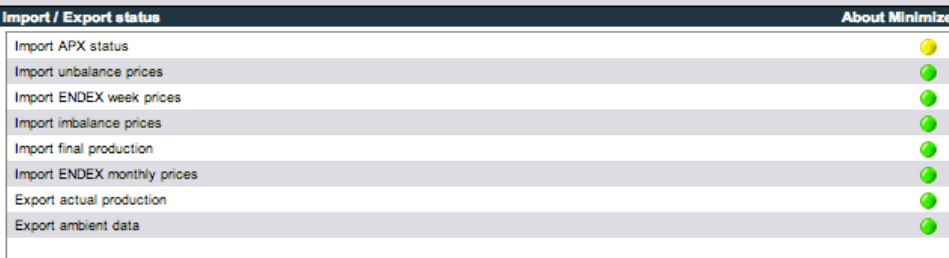
- Availability of the wind turbines: The wind power forecast will be adjusted in case of planned maintenance. The operator has a log-in at the schedule module of the system.



Wind power forecast



- Each morning at 9:00 am a day-ahead production profile is being sent to the Trader.
- Fixed xml-format via Web-services
- Integrated alarms if the files have been delivered and received by Trader



Trading strategy



- The trading strategy based on experiences of the behaviour of the market. Historical power prices show that for wind power a unbalance long position is preferable (trading situations).
- Depending of the number of turbines in the wind park and the reliability of the wind turbine technology (number of unexpected failures), the offset of power forecast is -10% till -30%.
- To manage unbalance long prices a “Power Regulation Module” have to be implemented.



Trading situations

Four different trading situations are applicable:

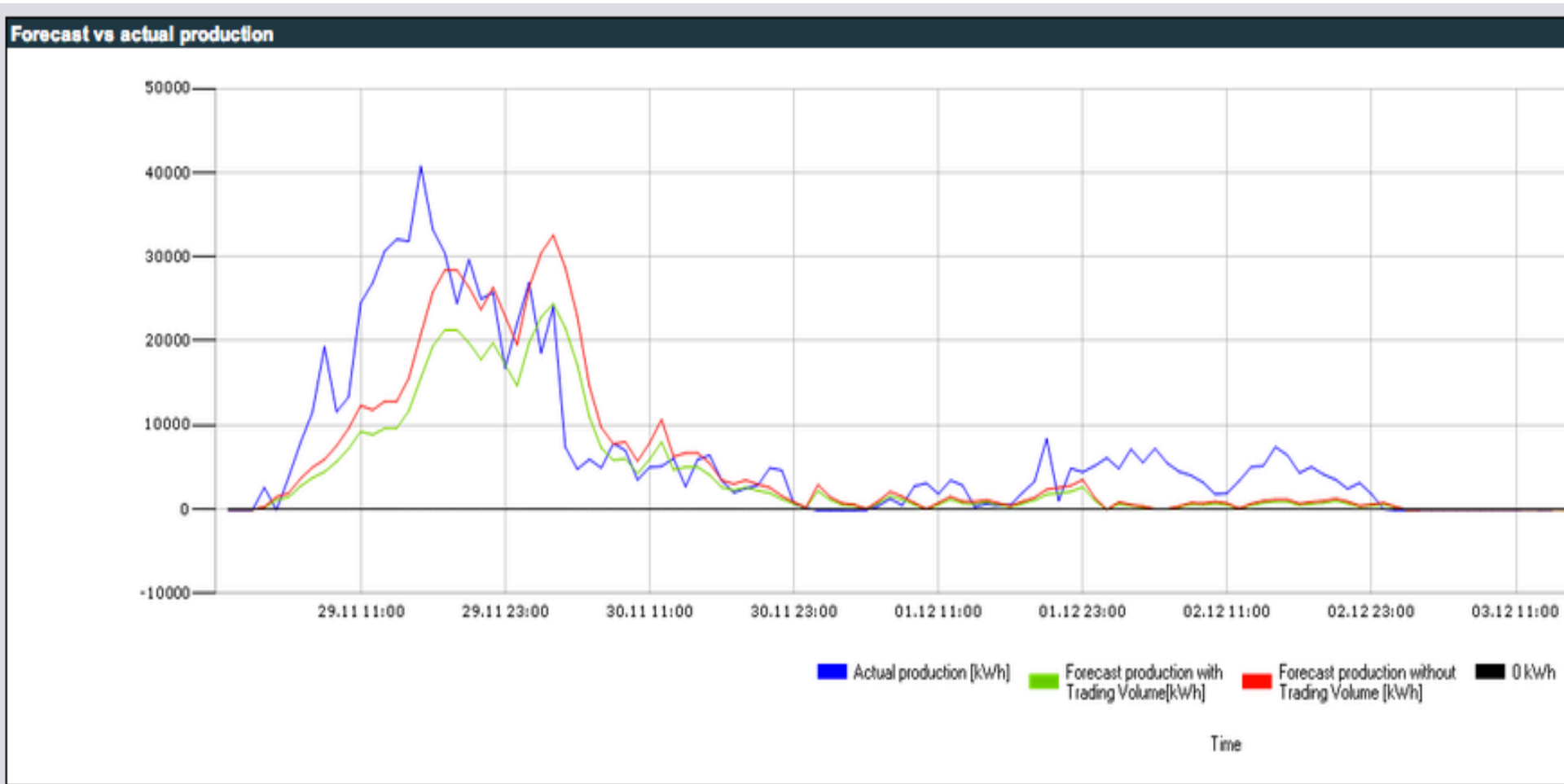
- Unbalance long, with positive long price
- Unbalance long, with negative long price (occurs at the morning and evening peak)
- Unbalance short, with positive short price
- Unbalance short, with negative short price (occurs at the morning and evening peak)

Analyses show that if the wind park will be reduced in power at the following trading situation additional turnover (reduction on lost turnover) can be created:

- Unbalance long, with negative prices. Price should be lower than -78 Euro/MWh due to Subsidy fee (MEP)
- Unbalance short, with negative prices (- x - = +). Price should be lower than -78 Euro/MWh.

		Prijzen			Koegorspolder																											
		Onbalans			Volume											Opbrengst																
Datum	Tijd	APX	short	long	Forecast	Productie	Afname	Realisatie	LT Verkoop	LT Koop	Hedge	APX Verkoop	APX Koop	APX	Onb. (P) Inv.	Onb. (P) Afr.	Onb. (A)	Tot. Onb. abs.	LT Verkoop	LT Koop	Hedge	APX Verkoop	APX Koop	APX	Onb. (P) Inv.	Onb. (P) Afr.	Onb. (A)	Onbalans	Totaal			
Scenario Unbalance long - Positive unbalance long price																																
28-02-12	11:00	61,19	55,55	55,55	763	1.210	0	1.210	1.250	0	1.250	0	-471	-471	431	0	0	431	98,00	0,00	60,88	0,00	-28,84	-28,84	23,96	0,00	0,00	23,96	56,00			
Scenario Unbalance long - Negative unbalance long price																																
27-02-12	05:45	35,29	-63,55	-63,55	641	2.160	0	2.160	1.250	0	1.250	0	-674	-674	1.584	0	0	1.584	-24,45	0,00	60,88	0,00	-23,79	-23,79	-100,68	0,00	0,00	-100,68	-63,60			
Scenario Unbalance short - Positive unbalance short price																																
23-02-12	14:30	52,85	55,09	55,09	1.637	450	0	450	1.250	0	1.250	346	0	346	0	-1.146	0	1.146	-39,36	0,00	60,88	18,30	0,00	18,30	0,00	-63,15	0,00	-63,15	16,03			
Scenario Unbalance short - Negative unbalance short price																																
15-02-12	00:00	33,51	-65,55	-65,55	6.326	5.890	0	5.890	1.250	0	1.250	5.289	0	5.289	0	-649	0	649	239,92	0,00	60,88	177,23	0,00	177,23	0,00	42,54	0,00	42,54	280,65			

Actuals



How to implement this?

- Project specific Wind Power Forecast Module
- Installation of communication module near the SCADA server on site
- Implement the power reduction module from Wind turbine manufacture
- Get a data feed for Tennet with real time unbalance prices



Financial added value

Park Specific Wind Power Forecasting feasible > 10 MW

- The higher accuracy of the power forecast creates an additional turnover
- The power reduction by the two scenarios (unbalance long, with negative price and unbalance short, with negative price) creates an additional turnover. After subsidy period the added value will increase significantly!
- Planned maintenance has been scheduled in the wind power forecast.

By continuous improvement (the two feed back loops) the accuracy of the wind power forecast will be increased.

At a wind park of 25 MW: (50 Euro/MWh (APX price) x 3% improvement x 25 MW x 2000 FLH= **66.000 Euro per year** (Payback time: 6 - 9 months)

Wind Power Forecasting is a proven alternative for a fixed PPA.



Summary

- Wind power forecasting on park level makes it possible to optimize (two feedback loops)
- Metrologic, Technical Operations and Power trading synergies give the optimum result
- Park Specific Wind Power Forecasting feasible > 10 MW
- Improvement of the wind park business case
- Wind Power Forecast is a proven alternative for a fixed PPA.



Thank you for your attention!

Questions/remarks?

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OutSmart

Professionals in Wind

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Dennis Schiricke

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Albert Winnemuller

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Jacco Witteveen

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