



Energy research Centre of the Netherlands

Short-term output prediction OWEZ

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NoordzeeWind



Abstract

NoordzeeWind carries out an extensive monitoring and evaluation programme (NSW-MEP) as part of the project Offshore Wind Farm Egmond aan Zee (OWEZ). Task 1.7.2 of this programme is "short-term output prediction".

This report describes for the period between 1st January 2007 and 30th June 2007:

- Day-ahead forecasts of the power output of the OWEZ, day-ahead energy prices from the APX, and settlement prices from TenneT; as stored in the NSW-MEP database maintained by ECN.
- Overviews of measured and forecasted energy, the corresponding programme imbalance plus the associated fictitious payments and fees, as well as information on exceedances and extremes; also stored in the database.
- An assessment of
 - (i) the value of wind power forecasting and
 - (ii) the use of such forecasts at events like storms.

As to the value of the applied wind power forecasting for the OWEZ after six months of experience it is premature to draw conclusions because the imbalance payment primarily depends on which type of wind speed forecasts is used. If not-optimized forecasts would have been used over the six month period, the OWEZ would have been better off with the imbalance fee. If, on the other hand, the optimized forecasts would have been available as a-priori knowledge, the OWEZ would have been better off with the imbalance payments.

The main conclusion on the use of wind power forecasts at events like storms is that the predictability of exceedances and extremes is poor. As to the ability to serve as an early warning for high-speed cut-out events the information is inconclusive.

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List of symbols

a	[-]	Slope in forecast versus measurement correlation
b	[m/s][kW]	Offset in forecast versus measurement correlation
c	[h]	Conversion factor from power to energy
E	[kWh]	Energy
p	[EUR/MWh]	Energy price
P	[kW]	Power
W	[m/s]	Wind speed
α	[-]	Slope in measurement versus forecast correlation
β	[m/s][kW]	Offset in measurement versus forecast correlation
ΔE	[kWh]	Energy imbalance, energy forecasting error
ΔP	[kW]	Power forecasting error
ΔW	[m/s]	Wind speed forecasting error
$\langle x \rangle$		Bulk average of quantity x

List of abbreviations

ext	Extraction
fin	Feed-in
frc	Forecasted
imb	Imbalance
mea	Measured
opt	Optimized
sho	Shortage
sur	Surplus
sys	Systematic

1. Introduction

NoordzeeWind carries out an extensive monitoring and evaluation programme (NSW-MEP) as part of the project Offshore Wind farm Egmond aan Zee (OWEZ). The objective of Task 1.7.2 "short-term output prediction" of this programme is:

- To create day-ahead forecasts of the power output of the wind farm, and to store these in the NSW-MEP database maintained by ECN,
- To acquire imbalance prices (APX and TenneT), and store these in the database,
- To produce daily overviews of measured and forecasted power, as well as imbalance energy- and imbalance cost with and without forecasting, and
- To assess
 - (i) the value of wind power forecasting on project basis, and
 - (ii) the use of such forecasts at events like storms.

The measured data employed in this task comprise wind power and turbine state retrieved from the SCADA system of the turbines, plus wind speed, wind direction and air density retrieved from the 116 m high meteo mast.

The offtake agreement or PPA between NoordzeeWind and Nuon is confidential. Electricity prices used in this task include prices on the day-ahead market and settlement prices for programme imbalance which are available in the public domain. The day-ahead prices originate from APX under an end user licence agreement with ECN. The public prices for feed-into or extract-from the electricity system originate from TenneT [TenneT].

The forecasted data were made by ECN. Wind power, wind speed, wind direction and air density for the day of delivery originate from the wind power forecasting method AVDE [Brand & Kok, 2003][Brand, 2006b]. Turbine state for the day of delivery, on the other hand, is based on the turbine state on the day before delivery.

This report describes for the period between 1st January 2007 and 30th June 2007:

- Day-ahead forecasts of the power output of the OWEZ, day-ahead energy prices from the APX, and settlement prices from TenneT; as stored in the NSW-MEP database maintained by ECN.
- Overviews of measured and forecasted energy, the corresponding programme imbalance plus the associated fictitious payments and fees, as well as exceedances and extremes; also stored in the database.
- An assessment of the value of wind power forecasting and the use of such forecasts at events like storms.

First, the forecasting and evaluation methodologies are described in chapter 2. Next, in chapter 3 the experience with and an evaluation of output prediction in the given period are presented. And finally, chapter 4 summarizes and concludes the outcome.

2. Methodology

2.1 Measurements

The measured data were obtained from the OWEZ database and comprise wind power and turbine state for each of the 36 wind turbines in the OWEZ, plus wind speed, wind direction and air density at 70 meter above mean sea level at Meteo Mast 1 near the OWEZ. (Wind data from the meteo mast was preferred over wind data from the turbines because the wind power forecasting method AVDE employs a power curve which requires the wind speed to be measured upstream of the wind turbine, and to allow for a comparison with the preceding period [Brand, 2006b].) If the power of an individual turbine is greater than zero and it has been in operation for at least 597.6 seconds in a ten-minute period, individual power and state are accumulated into the power and the state of the wind farm; otherwise power and state of the wind farm are flagged with an error value.

The measured data were linearly interpolated from averages over 10-minute periods into averages over 15-minute periods [Brand, 2006a]. The reason is that 15-minutes are the basic averaging period in the electricity sector (Programme Time Unit).

The 15-minute averaged wind power P (in MW) is transformed into the energy E (in MWh) which is produced during that 15-minute period:

$$E = c P \text{ with } c = 0.25 \text{ h;}$$

for example if the average wind power in the period between 0:00 and 0:15 h is 4 MW then in that period 1 MWh of energy is produced.

2.2 Forecasts

Day-ahead forecasts¹ were made with the ECN wind power forecasting method AVDE. These forecasts comprise the 15-minute averaged wind power of the OWEZ, plus the 15-minute averaged wind speed, wind direction and air density at 70 meter above mean sea level in the location of the OWEZ. Out of the 4 different day-ahead forecasts issued per day the +24 hour forecast² (run00) was selected because it is the only forecast that is available before market closure.

The wind power forecasts from AVDE are compensated for the expected availability of the OWEZ. To this end the wind farm state at 6:00 UT of the day before delivery is employed as the expected wind farm state during the day of delivery.

The forecast of the 15-minute averaged wind power is transformed into the forecast of the energy produced in that 15-minute period.

¹ One day lacks forecasts because the underlying HiRLAM file was not delivered to ECN: 6th January 2007 in run00

² Here +hh hour indicates the lead-time to the first 15-minute period of the next day in Universal Time

2.3 Imbalance, surplus and shortage with respect to programme

In the context of the electricity market a wind energy forecast that is issued before market closure on the day before delivery is the programme for the energy to be produced in 15-minute intervals during the day of delivery. In this report it is assumed that all forecasted energy is put into the programme³.

In addition it is assumed that any deviation from the programme, the so-called programme imbalance, is settled on the day after delivery. Such a deviation comes in two types: surplus or shortage. In the case of surplus with respect to the programme (measured energy greater than forecasted energy) energy is fed into the electricity system so that energy is sold to the system operator TenneT. On the other hand, in the case of shortage with respect to the programme (measurement less than forecast) energy is extracted from the electricity system so that energy is bought from TenneT.

The production normalized imbalance, defined as the ratio of the imbalance energy (sum of surplus energy and shortage energy) and the measured energy, is the major indicator for the impact of imbalance.

2.4 Wind power, wind speed and wind direction forecast errors

Evaluating forecasting errors has two functions in wind power forecasting:

- To give measures for the uncertainty of the forecasts, and
- To allow for an improvement of the forecasts in the case of systematic error sources.

Forecasting error is the difference between the measured and the forecasted value of a quantity (wind power, wind speed, wind direction or air density). Forecasting error indicators include [Madsen, 2005]:

- The mean forecasting error
- The mean squared forecasting error, and
- The mean absolute forecasting error;

where in this report the mean is valid for either a single day or the total period of in this case 6 months. Usually the power related error indicators are normalized to the production.

The mean forecasting error, also known as the systematic forecasting error or the bias, expresses to what extent the average of a number of measurements corresponds to the average of the corresponding forecasts. Mean forecasting error is caused by differences between reality and model which remain the same over time, such as processes not taken into account in the atmospheric model or errors in the employed power curve, and for that reason is a measure of the bias of a forecast. As will be explained in section 2.5, by correlating measured and forecasted values it is possible to minimize the systematic forecasting error, and by doing so to create optimized forecasts.

The mean squared forecasting error, also known as the standard deviation of the forecasting error, expresses the width of the forecast error distribution and for that reason is a measure of the probability of a correct forecast. The mean absolute error does the same, but for the absolute value of the difference between measurement and forecast. These errors are caused by differences between reality and model from one moment to the other, such as unexpected changes in weather or unplanned turbine stops, and cannot be corrected for.

³ A more complicated bidding strategy is beyond the scope of this project

Note that, apart from the conversion from power to energy explained in section 2.1, there is a direct relation between wind power forecasting error ΔP and programme imbalance energy E_{imb} , and between positive/negative wind power forecasting error and surplus/shortage energy⁴:

$$\begin{aligned} \text{Imbalance energy:} \quad E_{imb} &= \Delta E = E_{mea} - E_{frc} = c (P_{mea} - P_{frc}) = c \Delta P \\ \text{Surplus energy:} \quad E_{sur} &= E_{imb} \quad \text{if } E_{imb} > 0 \Leftrightarrow \Delta P > 0 \\ \text{Shortage energy:} \quad E_{sho} &= E_{imb} \quad \text{if } E_{imb} < 0 \Leftrightarrow \Delta P < 0 \end{aligned}$$

2.5 Forecast optimization

In forecast optimization errors that remain the same over time are removed from the forecasts. To this end first the systematic forecast error and next the optimized forecast is determined.

First the systematic forecast error is considered. In this report the systematic error is determined in two ways:

- By employing regression parameters, and
- By determining bulk averages.

As in the preceding report on wind forecasting [Brand, 2006b], the regression parameters are the slope α_w and the offset β_w of the linear regression

$$W_{frc} = \alpha_w W_{mea} + \beta_w$$

between measured wind speed W_{mea} and forecasted wind speed W_{frc} , and these define the measure ΔW_{sys} of the systematic wind speed forecast error:

$$\Delta W_{sys} = \left| (1 - \alpha_w) W_{mea} - \beta_w \right|.$$

Assuming that the uncertainty in the measured wind speed is 0.5 m/s or better, any combination of slope and offset giving $\Delta W_{sys} \leq 0.5$ m/s for $0 \text{ m/s} \leq W_{mea} \leq 25 \text{ m/s}$ indicates that the forecasts were almost perfect, whereas combinations giving $0.5 \text{ m/s} < \Delta W_{sys} \leq 1.0 \text{ m/s}$ indicate that the forecasts were good. On the other hand, combinations that give $\Delta W_{sys} > 1.0 \text{ m/s}$ indicate that the systematic wind speed forecasting error is significantly larger than the measurement error. In that case a compensation for the systematic forecasted error is needed.

The bulk average $\langle W_{mea} \rangle$ of the measured wind speed is an indication of the wind climate in the given period. The bulk averages $\langle W_{frc} \rangle$ and $\langle \Delta W \rangle$ of wind speed forecast resp. forecast error express to what extent the climate is reproduced by the forecasts. Again, error values less than 0.5 m/s indicate near perfect forecasts whereas error values between 0.5 m/s and 1.0 m/s indicate good forecasts and error values beyond 1.0 m/s indicate bad forecasts which must be compensated for.

Regressions and confidence intervals are determined on basis of the average of the forecasted wind speed in 0.5 m/s bins of measured wind speed that contain at least 0.5% of the total number of data points and that are larger than 4 m/s. Bulk averages, as the name suggests, are based on all data points.

⁴ Measurement minus forecast. Note that in this way forecast error corresponds to the definition of programme imbalance (power forecast error): measured power minus forecasted power

Next, the optimized forecast is determined. To this end the measured and the forecasted wind speed are correlated to the linear relation:

$$W_{\text{mea}} = a_w W_{\text{fc,AVDE}} + b_w .$$

Hence the optimized, that is compensated for systematic errors, wind speed forecast is:

$$W_{\text{fc,opt}} = a_w W_{\text{fc,AVDE}} + b_w \quad \text{if } 4 \leq W_{\text{fc,AVDE}} \leq 20 \text{ m/s}$$

and

$$W_{\text{fc,opt}} = (a_w + 0.25b_w) W_{\text{fc,AVDE}} \quad \text{if } 0 \leq W_{\text{fc,AVDE}} \leq 4 \text{ m/s,}$$

where the latter takes care of a smooth transient to zero wind speed.

2.6 Value of wind power forecasting

Since the offtake agreement or PPA between NoordzeeWind and Nuon is confidential, assumptions have been made in order to assess the value of wind power forecasting for the OWEZ. In this report two types of payment for imbalance energy are considered: one based on the assumption that the OWEZ settles imbalance energy with TenneT, and the other based on the assumption that imbalance energy is taken care of by a third party.

In the case that the OWEZ settles imbalance energy with TenneT it is assumed that shortage energy E_{sho} is bought from TenneT at the price p_{ext} for energy extraction, and that surplus energy E_{sur} is sold to TenneT at the price p_{fin} for energy feed-in for that period. The net imbalance payment to TenneT then consists of the payment by the OWEZ to TenneT (for shortage), minus the payment by TenneT to the OWEZ (for surplus):

$$\text{imbalance payment} = p_{\text{ext}} E_{\text{sho}} - p_{\text{fin}} E_{\text{sur}} .$$

Note that a negative value of the imbalance payment indicates a payment by TenneT to the OWEZ.

In the case that a third party takes care of imbalance energy, on basis of an assessment of the costs of imbalance [Van Tilburg, 2008, section 7.2], it is assumed that the OWEZ pays an imbalance fee which is based on the measured energy E_{mea} and a price equal to 11% of the APX price p_{APX} that is valid for that particular period:

$$\text{imbalance fee} = 0.11 p_{\text{APX}} E_{\text{mea}} .$$

To this end the hourly price is applied to the four 15-minute periods in that hour.

The difference between the imbalance payment and the imbalance fee is the key indicator on the value of wind power forecasting for the OWEZ.

2.7 Exceedances and extremes

In this report exceedances are related to a high wind speed cut-out events, where one or more wind turbines in the wind farm shut down because the cut-out wind speed, assumed to be 25 m/s at hub height, is reached. In this context an exceedance is the period when the 15-minute value of the wind

speed at 70 meter is greater than a preset threshold. Inspired by the Beaufort-scale based categories of KNMI⁵, this report considers three categories:

- Hurricane - Wind speed larger than 32.6 m/s
- Severe storm - Wind speed larger than 28.5 m/s but not larger than 32.6 m/s.
- Heavy storm - Wind speed larger than 24.5 m/s but not larger than 28.5 m/s.

Measured as well as forecasted exceedances are distinguished.

In this report extremes are:

- The smallest and the largest 15-minute value of a quantity (wind power, wind speed, wind direction or air density) in a given period (one day or six months).
- The largest downward and upward change of a quantity between two consecutive 15-minute periods, again in the given period.

Measured as well as forecasted extremes are distinguished.

Whether of not a forecasted exceedance/extreme was measured, or a measured one was forecasted, is the key indicator on the use of forecasts at events like storms.

⁵ Note KNMI considers the hourly averaged rather than the 15-minute averaged wind speed, a height of 10 meter rather than 70 meter, and the threshold to be exceeded in at least two rather than only one site

3. Experience

3.1 Daily base

Over a given day the experience with the prediction system is expressed in a summary of the performance plus a list with the data per 15-minute period.

The summary of the performance consists of four fields:

- Energy and payments.
- Statistics (minimum, maximum and average) of wind farm state, wind power, wind speed, wind direction and air density; and largest downward and upward change.
- Power forecasting error measures.
- Wind speed forecasting error measures.

Also indicated are the number of 15-minute periods on which a value is based, and the ptu⁶ when a given statistical value occurred. Table 3.1 shows an example that is valid for 2nd January 2007.

The list consists of a table with:

- Date, period and ptu.
- Farm state, measured and forecasted.
- Energy, measured and forecasted.
- Energy prices for day-ahead (APX), and feed-in and extraction (TenneT).
- Surplus energy and shortage energy.
- Payment by TenneT to OWEZ, by OWEZ to TenneT, and net imbalance payment.
- Imbalance fee.
- Wind speed, measured and forecasted.
- Wind direction, measured and forecasted.
- Air density, measured and forecasted.

As an example table 3.2 shows an excerpt from the data valid for 2nd January 2007.

⁶ Each 15-minute periods in a day has an unique programme time unit (ptu)

Table 3.1 *Example of a daily summary of the performance of the prediction system; 2nd January 2007. Here nqtr is the number of 15-minute periods on which a value is based, and iqtr indicates when a minimum/maximun or largest downward/upward change occurred*

20070102	nopt/cpc/regu						
Energy and payments							
Sold to TenneT	[nqtr][EUR][kWh]	96	57.82	4412.5			
Bought from TenneT	[nqtr][EUR][kWh]	96	7413.73	241063.8			
Net imbalance payment	[nqtr][EUR]	96	7355.91				
Imbalance fee	[nqtr][EUR]	96	6231.70				
Energy produced	[nqtr][kWh]	96	1634463				
Energy forecasted	[nqtr][kWh]	96	1871114				
Net imbalance payment vs production ratio	[EUR/MWh]	4.50					
Imbalance fee vs production ratio	[EUR/MWh]	3.81					
Production normalised imbalance	[%]	15.02					
Statistics							
Farm state observed (min/ave/max)	[nqtr][%][%][%][iqtr][iqtr]	96	69.4	72.2	77.8	2	87
Farm state forecasted (min/ave/max)	[nqtr][%][%][%][iqtr][iqtr]	96	72.2	72.2	72.2	1	1
Farm state largest changes observed (down/up)	[nqtr][%][%][iqtr][iqtr]	95	-2.8	2.8			
Wind power observed (min/ave/max)	[nqtr][kW][kW][kW][iqtr][iqtr]	96	149.6	68102.6	80965.4	10	65
Wind power forecasted (min/ave/max)	[nqtr][kW][kW][kW][iqtr][iqtr]	96	75704.2	77963.1	79233.9	3	96
Wind power largest change observed (down/up)	[nqtr][kW][kW][iqtr][iqtr]	95	-40570.5	55189.9			
Wind power largest change forecasted (down/up)	[nqtr][kW][kW][iqtr][iqtr]	95	-561.4	1075.3			
Wind speed observed (min/ave/max)	[nqtr][m/s][m/s][m/s][iqtr][iqtr]	87	2.9	13.8	17.2	6	49
Wind speed forecasted (min/ave/max)	[nqtr][m/s][m/s][m/s][iqtr][iqtr]	96	13.8	16.2	18.6	2	44
Wind speed largest change observed (down/up)	[nqtr][m/s][m/s][iqtr][iqtr]	80	-3.2	2.2			
Wind speed largest change forecasted (down/up)	[nqtr][m/s][m/s][iqtr][iqtr]	95	-0.3	0.5			
Wind direction observed (min/ave/max)	[nqtr][deg][deg][deg][iqtr][iqtr]	94	235	295.1	332.3	1	91
Wind direction forecasted (min/ave/max)	[nqtr][deg][deg][deg][iqtr][iqtr]	96	265.7	290.7	340.9	34	70
Wind direction largest change observed (down/up)	[nqtr][deg][deg][iqtr][iqtr]	92	-12.7	31.2			
Wind direction largest change forecasted (down/up)	[nqtr][deg][deg][iqtr][iqtr]	95	-4.6	9.4			
Air density observed (min/ave/max)	[nqtr][kg/m3][kg/m3][kg/m3][iqtr][iqtr]	92	1.246	1.253	1.262	11	2
Air density forecasted (min/ave/max)	[nqtr][kg/m3][kg/m3][kg/m3][iqtr][iqtr]	96	1.221	1.231	1.248	61	93
Air density largest change observed (down/up)	[nqtr][kg/m3][kg/m3][iqtr][iqtr]	88	-0.003	0.004			
Air density largest change forecasted (down/up)	[nqtr][kg/m3][kg/m3][iqtr][iqtr]	95	-0.003	0.004			
Power forecasting							
mean error	[kW]	-9860.5					
mean absolute error	[kW]	10228.2					
mean squared error	[kW]	17557.7					
production normalised mean error	[%]	-14.5					
production normalised mean absolute error	[%]	15					
production normalised mean squared error	[%]	25.8					
capacity normalised mean error	[%]	-9.1					
capacity normalised mean absolute error	[%]	9.5					
capacity normalised mean squared error	[%]	16.3					
Wind speed forecasting							
mean error	[m/s]	-2.446					
mean absolute error	[m/s]	2.533					
mean squared error	[m/s]	2.29					

Table 3.2 Excerpt from a daily list with the performance of the prediction system; 2nd January 2007; no compensation for systematic errors; calculated power curve

Date	Period	PTE	Farm state Observed	Farm state Forecasted	Energy Observed [kWh]	Energy Forecasted [kWh]	Energy price day-ahead [EUR/MWh]	Energy price sell-to [EUR/MWh]	Energy price buy-from [EUR/MWh]	Surplus Energy [kWh]	Shortage Energy [kWh]	Paid by TenneT to OWEZ [EUR]	Paid to TenneT by OWEZ [EUR]	Net imbalance payment [EUR]	Imbalance fee [EUR]	Wind speed Observed [m/s]	Wind speed Forecasted [m/s]	Wind direction Observed [deg]	Wind direction Forecasted [deg]	Air density Observed [kg/m ³]	Air density Forecasted [kg/m ³]	
02/01/2007	00:00-00:15	1	72.2	72.2	18324.3	19089.1	16.01	-20.19	-20.19	0	764.8	0	-15.44	-15.44	32.27	15.5	13.9	235	275.1	1.259	1.231	
02/01/2007	00:15-00:30	2	69.4	72.2	16912.8	18988.1	16.01	-21.19	-21.19	0	2075.3	0	-43.98	-43.98	29.79	13.1	13.8	242.7	277.8	1.262	1.23	
02/01/2007	00:30-00:45	3	72.2	72.2	18608.3	18926.1	16.01	-28.99	-28.99	0	317.8	0	-9.21	-9.21	32.77	11.7	13.8	246.8	280.8	1.261	1.228	
02/01/2007	00:45-01:00	4	72.2	72.2	18462.2	18932.8	16.01	-28.99	-28.99	0	470.6	0	-13.64	-13.64	32.51	-999	13.8	278.1	282.7	1.261	1.227	
02/01/2007	01:00-01:15	5	72.2	72.2	19284.4	18986.5	11	51.1	51.1	297.9	0	15.22	0	-15.22	23.33	-999	13.9	298.5	284.2	1.261	1.226	
02/01/2007	01:15-01:30	6	72.2	72.2	18164.6	19062.5	11	19.93	51.1	0	897.9	0	45.88	45.88	21.98	2.9	14	285.8	284.6	1.26	1.226	
...																						
02/01/2007	22:30-22:45	91	77.8	72.2	14098.8	19306.5	31.09	18.71	18.71	0	5207.7	0	97.44	97.44	48.22	7.9	13.9	332.3	300.2	1.259	1.245	
02/01/2007	22:45-23:00	92	77.8	72.2	12592.1	19299.3	31.09	14.06	14.06	0	6707.2	0	94.3	94.3	43.06	7.1	13.9	329.7	298.8	1.259	1.247	
02/01/2007	23:00-23:15	93	77.8	72.2	11324.6	19426.1	29.84	0	0	0	8101.5	0	0	0	37.17	7.4	14.1	330.5	297	1.259	1.248	
02/01/2007	23:15-23:30	94	77.8	72.2	11967.9	19694.9	29.84	42.72	42.72	0	7727	0	330.1	330.1	39.28	6.9	14.5	325	295.3	1.259	1.248	
02/01/2007	23:30-23:45	95	77.8	72.2	10567.2	19804.6	29.84	27.92	44.95	0	9237.4	0	415.22	415.22	34.69	9.1	15	315.9	293.5	1.259	1.248	
02/01/2007	23:45-00:00	96	77.8	72.2	8228.6	19808.5	29.84	0	0	0	11579.9	0	0	0	27.01	10.2	15	311.4	292.5	1.259	1.248	
Accumulated over day																						
02/01/2007	00:00-24:00	**	*****	*****	1634463	1871114	-999	-999	-999	4412.5	241063.8	57.82	7413.73	7355.91	6231.7	-999	-999	-999	-999	-999	-999	-999

3.2 Total period

Figure 3.1 presents the time series of the measured wind power, forecasted wind power and wind power forecast error over the total period from 1st January 2007 to 30th June 2007.

Figure 3.2 presents the omni-directional scatter plot and the 84% confidence interval ($m-s$, $m+s$) of forecast versus measurement. This interval was determined from the bin average m and the standard deviation s of the forecasted wind power P_i in power bins of 2500 kW:

$$m = \frac{1}{N} \sum_{i=1}^N P_i \quad \text{and} \quad s^2 = \frac{1}{N} \sum_{i=1}^N (P_i - m)^2 .$$

It indicates the probability of a correct forecast.

The experience with the system also is expressed in a summary of the data plus a list with the data per 15-minute period. Table 3.3 presents the overview data. The contribution to the database consists of this list.

Figure 3.3 presents the time series of the measured wind speed, forecasted wind speed and wind speed forecast error. Note the long periods without measured data in March 2007 and in June 2007. Figure 3.4 shows the omni-directional scatter plot and the 84% confidence intervals of forecasted versus measured wind speed for a bin width of 0.5 m/s.

And the figures 3.5 and 3.6 do the same for the wind direction (bin width of 7.5 deg).

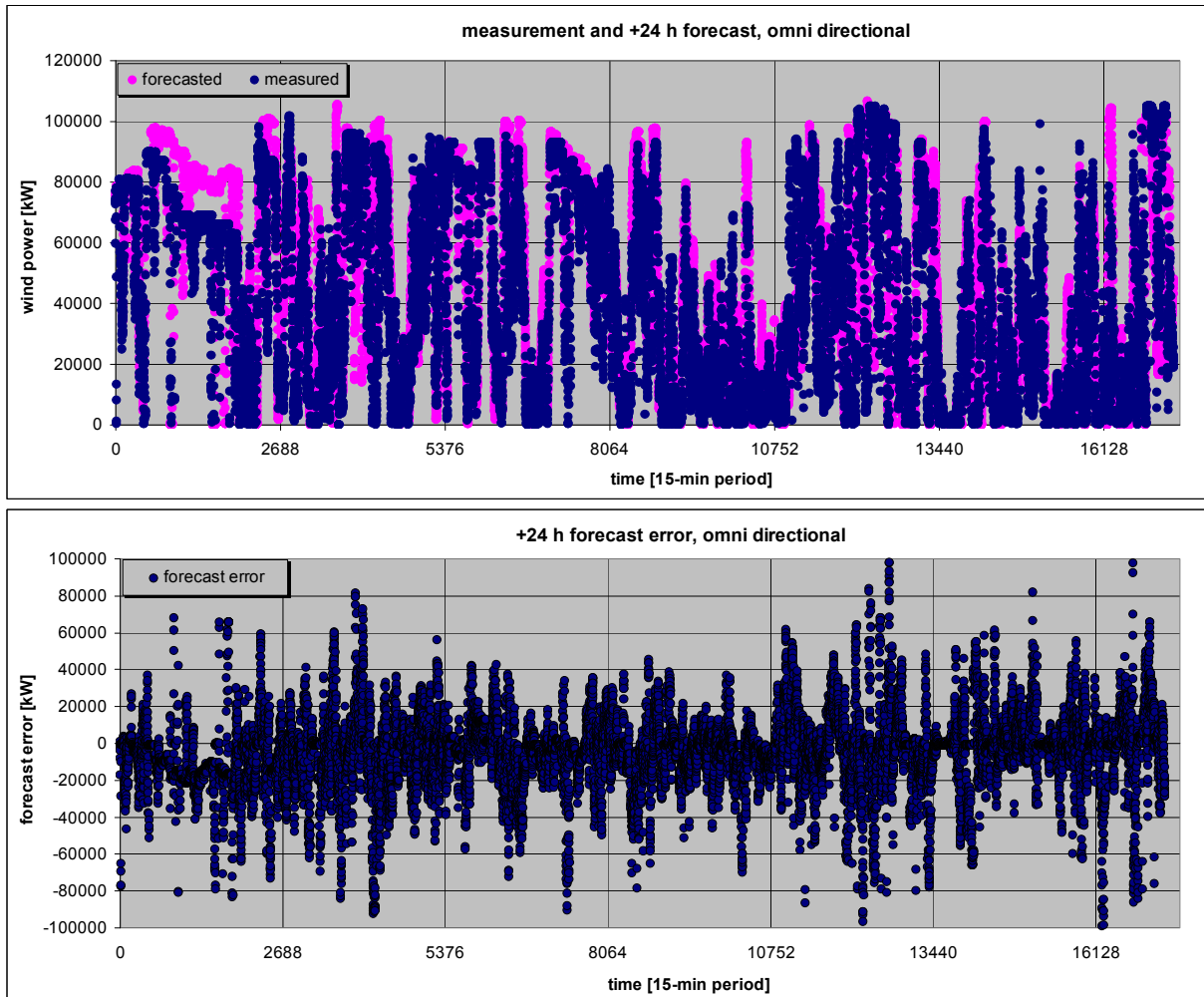


Figure 3.1 Time series of measured wind power, forecasted wind power and wind power forecast error between 1st January 2007 and 30th June 2007

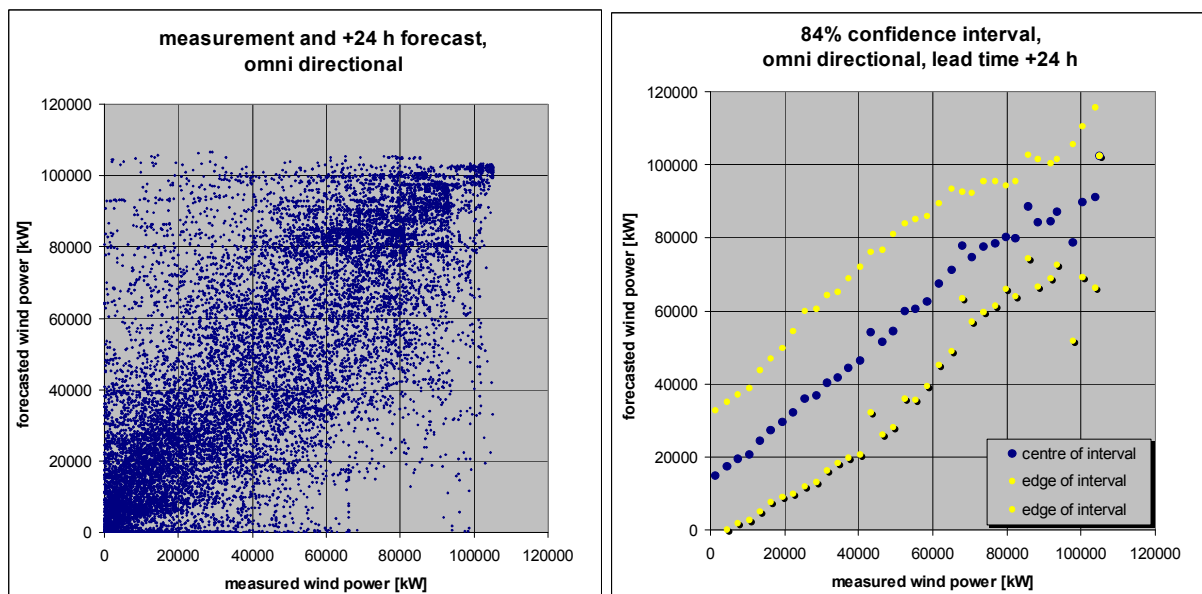


Figure 3.2 Scatter plot and 84% confidence interval of measured and forecasted wind power; 1st January 2007 - 30th June 2007

Table 3.3 Summary of the performance of the prediction system between 1st January 2007 and 30th June 2007. Here *nqtr* is the number of 15-minute periods on which a value is based, and *iqtr* indicates when a minimum/maximun or largest downward/upward change occurred

20070102-20070630	nopt/cpc /regu						
Energy and payments							
Sold to TenneT	[nqtr][EUR][kWh]	15500	621670.4	21167846			
Bought from TenneT	[nqtr][EUR][kWh]	15500	1588771	39687242			
Net imbalance payment	[nqtr][EUR]	15500	967100				
Imbalance fee	[nqtr][EUR]	15592	614356				
Energy produced	[nqtr][kWh]	15592		177876259			
Energy forecasted	[nqtr][kWh]	17180		197778974			
Net imbalance payment vs production ratio	[EUR/MWh]	5.44					
Imbalance fee vs production ratio	[EUR/MWh]	3.45					
Production normalised imbalance	[%]	34.21					
Statistics							
Farm state observed (min/ave/max)	[nqtr][%][%][%][iqtr][iqtr]	17276	0	97.2	100	2007/02/08=87	2007/05/07=70
Farm state forecasted (min/ave/max)	[nqtr][%][%][%][iqtr][iqtr]	17276	55.6	88.1	100	2007/04/26=05	2007/05/09=05
Farm state largest changes observed (down/up)	[nqtr][%][%][iqtr][iqtr]	17275	-88.9	77.8		2007/06/15=09	2007/05/15=11
Wind power observed (min/ave/max)	[nqtr][kW][kW][kW][iqtr][iqtr]	15592	0	45632.7	105020.2	2007/02/08=85	2007/06/26=54
Wind power forecasted (min/ave/max)	[nqtr][kW][kW][kW][iqtr][iqtr]	17180	0	46048.7	106729.1	2007/01/11=37	2007/05/09=91
Wind power largest change observed (down/up)	[nqtr][kW][kW][iqtr][iqtr]	15447	-89447.4	76862		2007/05/11=09	2007/05/14=11
Wind power largest change forecasted (down/up)	[nqtr][kW][kW][iqtr][iqtr]	17178	-84774.3	73697.5		2007/05/29=01	2007/05/15=01
Wind speed observed (min/ave/max)	[nqtr][m/s][m/s][m/s][iqtr][iqtr]	9626	0.1	9.3	23.1	2007/05/23=29	2007/01/11=34
Wind speed forecasted (min/ave/max)	[nqtr][m/s][m/s][m/s][iqtr][iqtr]	17180	0.2	10.2	34.2	2007/02/04=25	2007/01/18=61
Wind speed largest change observed (down/up)	[nqtr][m/s][m/s][iqtr][iqtr]	9259	-4.2	3.7		2007/02/05=93	2007/01/22=51
Wind speed largest change forecasted (down/up)	[nqtr][m/s][m/s][iqtr][iqtr]	17178	-10.6	7.6		2007/05/10=01	2007/03/03=01
Wind direction observed (min/ave/max)	[nqtr][deg][deg][deg][iqtr][iqtr]	13653	0	271.5	344.9	2007/02/05=20	2007/03/13=69
Wind direction forecasted (min/ave/max)	[nqtr][deg][deg][deg][iqtr][iqtr]	16652	0.2	280.1	344.9	2007/03/22=60	2007/05/28=76
Wind direction largest change observed (down/up)	[nqtr][deg][deg][iqtr][iqtr]	13380	-169.5	106		2007/01/25=75	2007/05/17=93
Wind direction largest change forecasted (down/up)	[nqtr][deg][deg][iqtr][iqtr]	16594	-171.5	177.8		2007/05/25=30	2007/03/30=01
Air density observed (min/ave/max)	[nqtr][kg/m3][kg/m3][kg/m3][iqtr][iqtr]	14342	1.185	1.241	1.299	2007/04/15=72	2007/01/25=44
Air density forecasted (min/ave/max)	[nqtr][kg/m3][kg/m3][kg/m3][iqtr][iqtr]	17180	1.139	1.224	1.291	2007/01/18=59	2007/02/04=42
Air density largest change observed (down/up)	[nqtr][kg/m3][kg/m3][iqtr][iqtr]	13617	-0.018	0.018		2007/04/16=19	2007/04/16=22
Air density largest change forecasted (down/up)	[nqtr][kg/m3][kg/m3][iqtr][iqtr]	17178	-0.028	0.038		2007/06/09=01	2007/06/10=01
Power forecasting							
mean error	[kW]	-4779.2					
mean absolute error	[kW]	15704.5					
mean squared error	[kW]	21190.3					
production normalised mean error	[%]	-10.5					
production normalised mean absolute error	[%]	34.6					
production normalised mean squared error	[%]	46.6					
capacity normalised mean error	[%]	-4.4					
capacity normalised mean absolute error	[%]	14.5					
capacity normalised mean squared error	[%]	19.6					
Wind speed forecasting							
mean error	[m/s]	-1.055					
mean absolute error	[m/s]	2.08					
mean squared error	[m/s]	2.54					

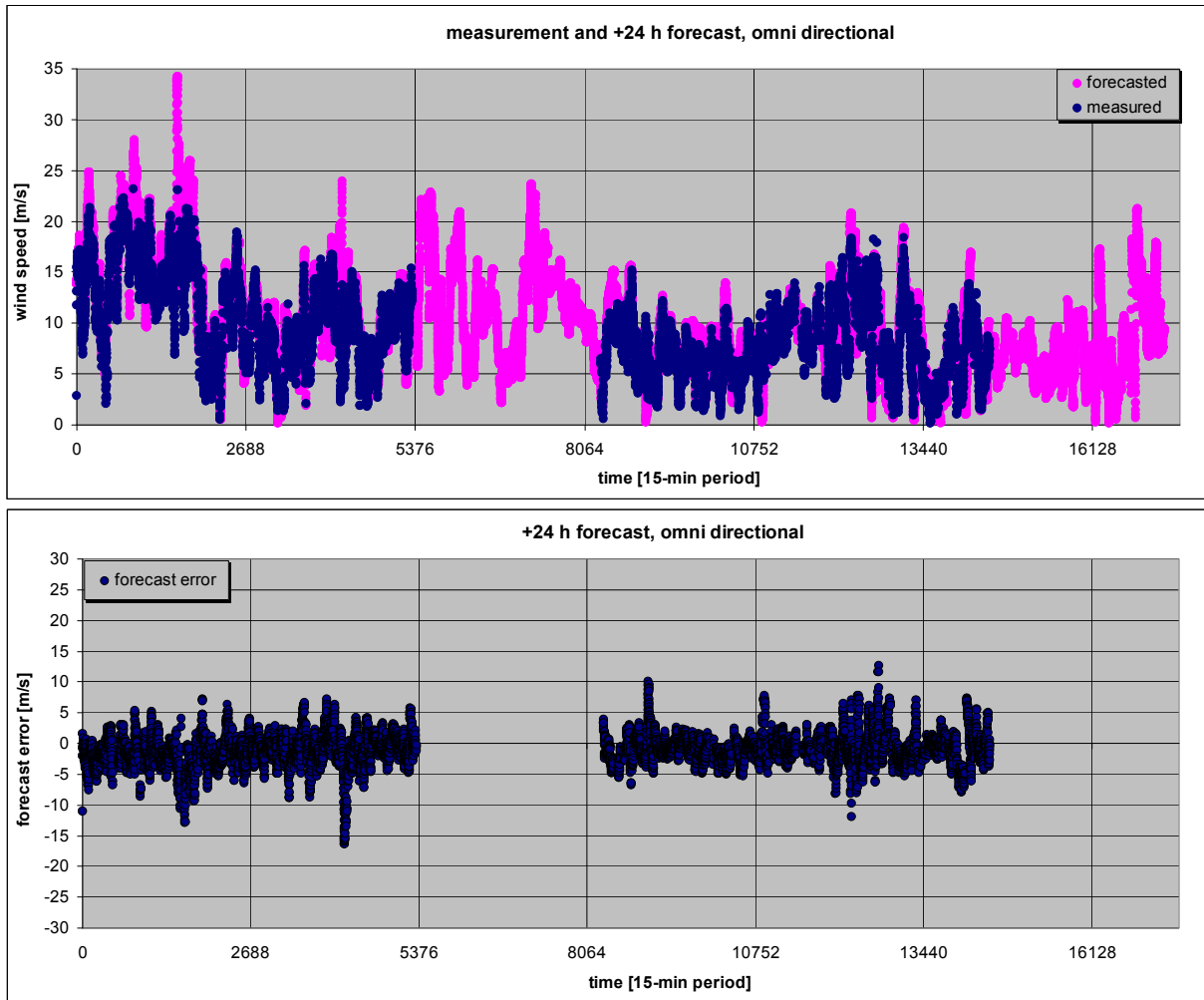


Figure 3.3 Time series of measured wind speed, forecasted wind speed and wind speed forecast error between 1st January 2007 and 30th June 2007

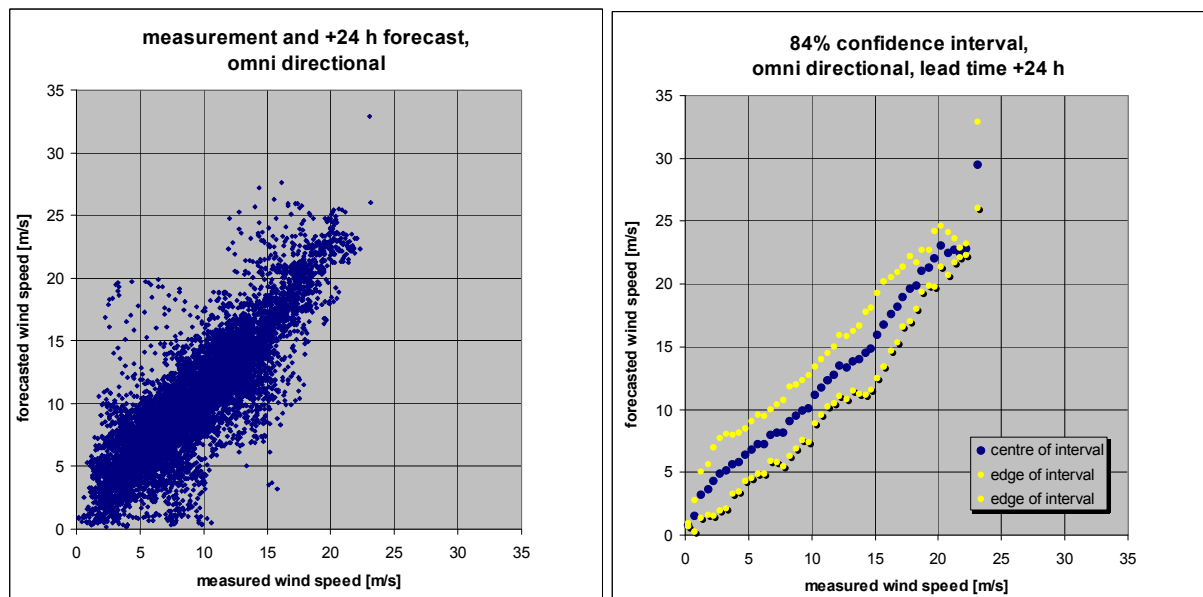


Figure 3.4 Scatter plot and 84% confidence interval of measured and forecasted wind speed; 1st January 2007 - 30th June 2007

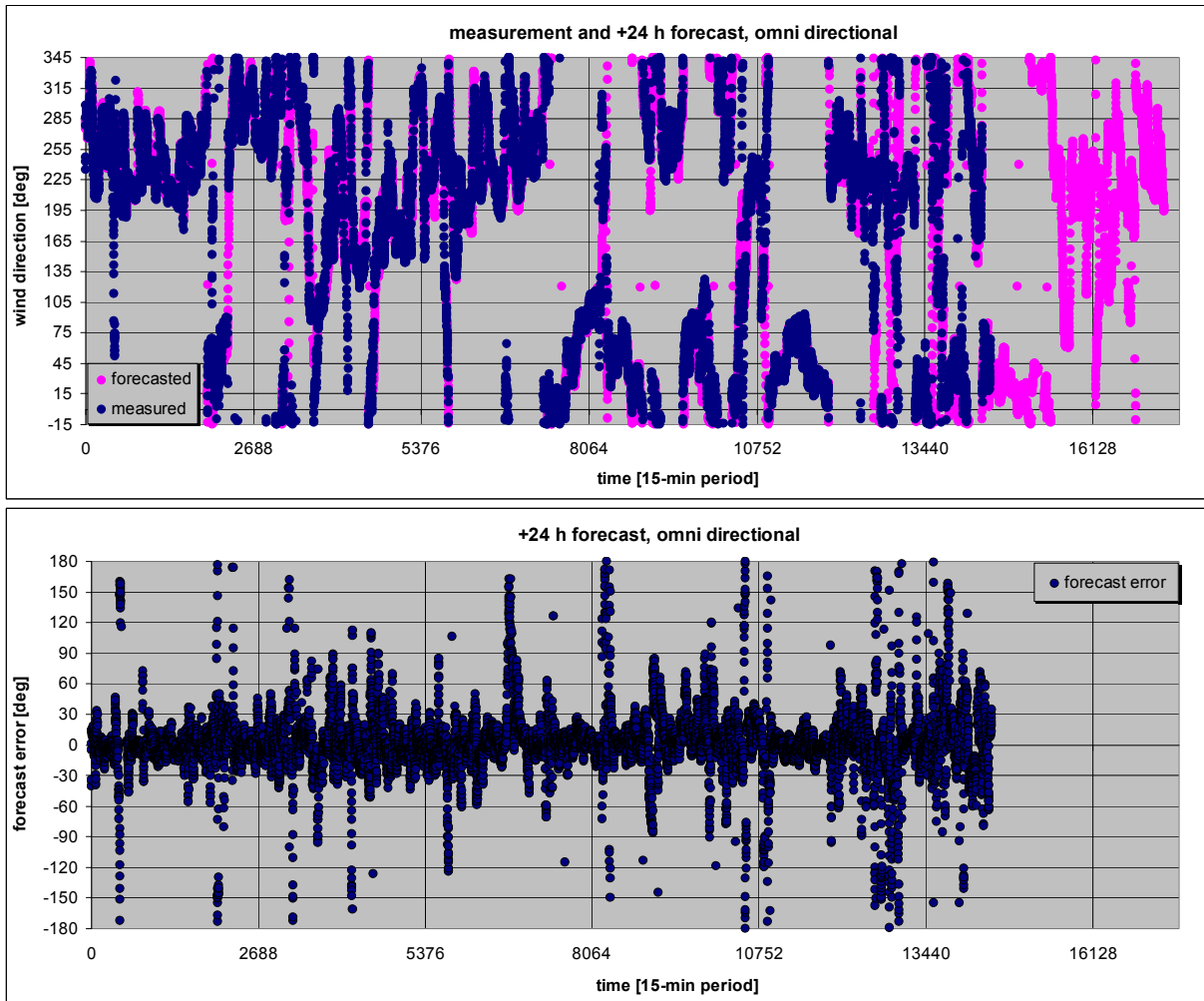


Figure 3.5 Time series of measured wind direction, forecasted wind direction and wind direction forecast error between 1st January 2007 and 30th June 2007

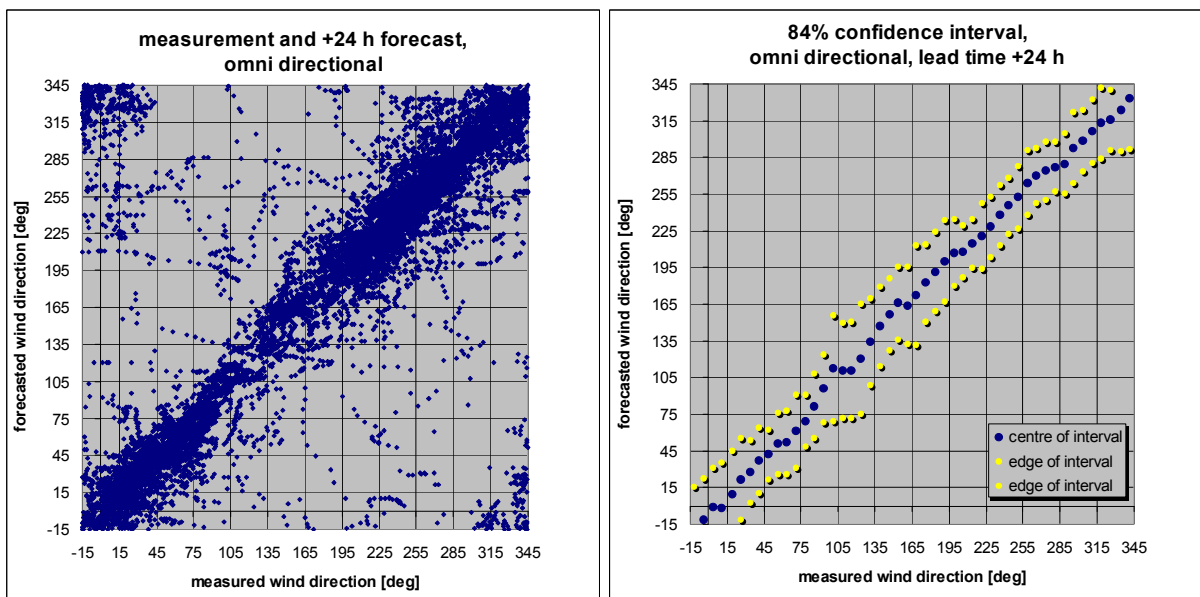


Figure 3.6 Scatter plot and 84% confidence interval of measured and forecasted wind direction; 1st January 2007 - 30th June 2007

3.3 Impact of systematic forecasting errors

In this section, on basis of the methods outlined in section 2.5, the impact of systematic errors is addressed and optimized wind speed forecasts are derived.

For the period from 1st January 2007 to 30th June 2007 table 3.4 presents the:

- Slope α_w and offset β_w of the linear regression between measured and forecasted wind speed, and
- Bulk averages $\langle W_{\text{mea}} \rangle$ of measured wind speed, $\langle W_{\text{frc}} \rangle$ of forecasted wind speed, and $\langle \Delta W \rangle$ of wind speed forecast error.

The data in table 3.4 show that:

- In the "undisturbed" sectors between 165 deg and 315 deg the systematic wind speed forecasting error is smaller than in the other sectors, and
- In all sectors the systematic forecasting error is larger than calculated in the preceding periods [Brand, 2006b]⁷.

The data also show that in several sectors the error is larger than 1 m/s, so that now the compensation of systematic wind speed forecast error is needed.

By correlating the measured and the forecasted wind speed in the undisturbed sectors, it is found that, for measured wind speeds between 4 m/s and 20 m/s, the slope a_w and the offset b_w of the linear correlation between the two wind speeds are +0.924 and -0.14 m/s, respectively. Hence the optimized, that is compensated for systematic errors, wind speed forecast is:

$$W_{\text{frc,opt}} = 0.924 W_{\text{frc,AVDE}} - 0.14 \quad \text{if } 4 \leq W_{\text{frc,AVDE}} \leq 20 \text{ m/s}$$

$$W_{\text{frc,opt}} = 0.889 W_{\text{frc,AVDE}} \quad \text{if } 0 \leq W_{\text{frc,AVDE}} \leq 4 \text{ m/s,}$$

Table 3.4 *Performance of AVDE on basis of +24 hour wind forecasts in the period between 1st January 2007 and 30th June 2007. Presented are sectorwise slope and offset of the linear regression between measured and forecasted wind speed, and bulk averages of measured wind speed, forecasted wind speed, and wind speed forecast error*

2007/01 - 2007/06 +24 hour forecast		Wind Direction Sector [deg]													
		-015 - 015	015 - 045	045 - 075	075 - 105	105 - 135	135 - 165	165 - 195	195 - 225	225 - 255	255 - 285	285 - 315	315 - 345	omni	
Regression	Slope	[-]	1.475	0.713	0.871	0.923	0.590	0.675	0.902	1.062	1.133	0.917	1.069	1.011	1.076
	Offset	[m/s]	-3.22	2.95	2.46	1.81	5.04	2.94	0.75	0.44	-0.26	1.61	0.70	1.56	0.24
Bulk average	Measured wind speed	[m/s]	5.33	7.48	7.07	7.59	6.59	9.90	8.57	12.20	10.75	10.79	8.90	6.68	9.28
	Forecasted wind speed	[m/s]	6.09	8.32	8.80	8.94	8.28	10.18	8.78	13.43	11.75	11.58	10.22	8.27	10.33
	Wind speed frc. error	[m/s]	-0.75	-0.83	-1.73	-1.35	-1.68	-0.28	-0.11	-1.23	-1.00	-0.78	-1.32	-1.58	-1.05

⁷ This can be explained by the small distance between the location of the Meteo Mast and the centre of the OWEZ, or by a slight aging of the wind speed measurement system

A check of the optimized wind speed forecasts consists of subsequently correlating the measured and the forecasted wind power (as based on the optimized wind speed) to the linear relation

$$P_{\text{mea}} = a_p P_{\text{fr,AVDE}} + b_p .$$

It is found that the slope a_p and the offset b_p of the linear correlation are +1.094 and -2766.7 kW, respectively.

Table 3.5 summarizes the impact of systematic forecasting error compensation. It appears that the imbalance payment, the production normalized mean power forecasting error and the mean wind speed forecasting error have decreased, all quite significantly. On the other hand the other indicators have remained of the same order of magnitude. Because of these improvements the optimized wind speed forecasts will be applied in the subsequent reporting period 1st July 2007 to 31st December 2007.

Table 3.5 *Impact of systematic errors on the key indicators for economics, imbalance and forecasting errors*

Type of forecast	Imbalance payment	Production normalized programme imbalance	Wind power			Wind speed		
			Production normalized mean error	Production normalized mean absolute error	Production normalized mean squared error	Mean error	Mean absolute error	Mean squared error
	[EUR/MWh]	[%]	[%]	[%]	[%]	[m/s]	[m/s]	[m/s]
Optimized	1.45	35.5	-0.6	35.8	48.9	-0.13	1.74	2.39
Not-optimized	5.44	34.2	-10.5	34.6	46.6	-1.06	2.08	2.54

3.4 Economic value of forecasting

The average imbalance fee is found to be 3.45 EUR/MWh over the period from 1st January 2007 to 30th June 2007. This value is to be compared to the imbalance payment to TenneT. As is clear from table 3.5 the actual value of the imbalance payment depends heavily on whether not-optimized wind speed forecasts (5.44 EUR/MWh) or optimized wind speed forecasts (1.45 EUR/MWh) are used. If not-optimized forecasts would have been used over the six month period, the OWEZ would have been better off with the imbalance fee. If, on the other hand, the optimized forecasts would have been available as a-priori knowledge, the OWEZ would have been better off with the imbalance payments. Since the imbalance payment primarily depends on which type of wind speed forecasts is used, after six months of experience it is premature to draw conclusions on the value of the applied wind power forecasting for the OWEZ.

3.5 Predictability of exceedances and extremes

Table 3.6 on page 31-36 presents the 15-minute periods when the measured or the forecasted wind speed is more than 24.5 m/s indicating heavy storm, severe storm or hurricane. Even if the low availability of the measurement system is taken into account (out of the 131 forecasted exceedances only 36 could have been observed), from these data it is concluded that the predictability of exceedances is poor: none of the 36 forecasted exceedances that could be observed did occur whereas 0 exceedances were measured⁸. As to the ability to serve as an early warning to high wind speed cut-out the data in table 3.6 is inconclusive:

- 11th January 2007: Cut-out is expected and seems to occur although what happened is obscured by missing measured data.
- 18th January 2007: Cut-out is expected but nothing can be concluded because measured data lack for most of the day.
- 20th January 2007: The expected cut-out did not occur.

From an inspection of the statistics in the daily overviews (table 3.1 gives an example) it is concluded that the predictability of extreme values (minima and maxima) or extreme events (largest downward and upward changes) is poor: the extremes that were predicted did not occur, and the extremes that occurred were not predicted.

⁸ Measured data were not available during the severe storm Kyrill in the afternoon of 18th January 2007

4. Summary and conclusion

For the period between 1st January 2007 and 30th June 2007 overviews of measured and forecasted power, the corresponding programme imbalance, imbalance payments and fees, as well as information on exceedances (wind speed beyond 24.5 m/s) and extremes are stored in the NSW-MEP database maintained by ECN.

As to the value of the applied wind power forecasting for the OWEZ after six months of experience it is premature to draw conclusions because the imbalance payment primarily depends on which type of wind speed forecasts is used. If not-optimized forecasts would have been used over the six month period, the OWEZ would have been better off with the imbalance fee. If, on the other hand, the optimized forecasts would have been available as a-priori knowledge, the OWEZ would have been better off with the imbalance payments.

Regarding the use of wind power forecasting at events like storms it is concluded that the predictability of exceedances and extremes is poor: the exceedances/extremes that were forecasted and could have been measured did not occur, whereas no exceedances were measured at all and the extremes that occurred were not forecasted. As to the ability to serve as an early warning for high-speed cut-out events the information is inconclusive because measured data lack on the three days with severe/heavy storms.

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Table 3.6 List with wind speed exceedances in the period between 1st January 2007 and 30th June 2007; no compensation for systematic errors; calculated power curve

Date	Period	PTE	Farm state Observed	Farm state Forecasted	Energy Observed	Energy Forecasted	Energy price day-ahead	Energy price sell-to	Energy price buy-from	Surplus Energy	Shortage Energy	Paid by TenneT to OWEZ	Paid to TenneT by OWEZ	Net imbalance payment	Imbalance fee	Wind speed Observed	Wind speed Forecasted	Wind direction Observed	Wind direction Forecasted	Air density Observed	Air density Forecasted
[da/mo/year]	[hr.mi]	[-]	[%]	[%]	[kWh]	[kWh]	[EUR/MWh]	[EUR/MWh]	[EUR/MWh]	[kWh]	[kWh]	[EUR]	[EUR]	[EUR]	[EUR]	[m/s]	[m/s]	[deg]	[deg]	[kg/m**3]	[kg/m**3]
03/01/2007	23:45-00:00	96	77.8	72.2	20254.1	19320.4	38.05	-1.99	-1.99	933.6	0	-1.86	0	1.86	84.77	-999	21.5	212.9	215.8	1.238	1.213
04/01/2007	00:00-00:15	1	77.8	77.8	20254.1	14294	31.01	1.42	74.19	5960	0	8.46	0	-8.46	69.09	-999	24.8	213.3	215.8	1.238	1.202
04/01/2007	00:15-00:30	2	77.8	77.8	20254.1	13592.2	31.01	74.19	74.19	6661.9	0	494.25	0	-494.25	69.09	-999	24.8	213.6	216.3	1.239	1.202
04/01/2007	00:30-00:45	3	77.8	77.8	20253.9	13907.1	31.01	0.73	0.73	6346.8	0	4.63	0	-4.63	69.09	19.8	24.8	212.6	216.9	-999	1.202
04/01/2007	00:45-01:00	4	77.8	77.8	20253.9	15339.3	31.01	4.68	4.68	4914.6	0	23	0	-23	69.09	19.5	24.8	212	217.3	1.238	1.201
04/01/2007	01:00-01:15	5	77.8	77.8	20254	18140.2	28.69	64.19	64.19	2113.8	0	135.69	0	-135.69	63.92	19.7	24.6	212.3	217.5	1.237	1.2
04/01/2007	01:15-01:30	6	77.8	77.8	20253.7	20087.6	28.69	59.98	59.98	166.1	0	9.96	0	-9.96	63.92	20.2	24.5	214.6	217.5	1.236	1.199
04/01/2007	01:30-01:45	7	77.8	77.8	20253.8	20408.7	28.69	30	47.9	0	155	0	7.42	7.42	63.92	-999	24.2	215.1	217.3	1.235	1.197
09/01/2007	07:45-08:00	32	88.9	91.7	20997.3	23881.9	36.54	221.54	221.54	0	2884.6	0	639.06	639.06	84.4	20.3	24.4	221.4	224.2	1.218	1.19
09/01/2007	08:00-08:15	33	88.9	91.7	20997.1	23880.8	40	-4.19	-4.19	0	2883.7	0	-12.08	-12.08	92.39	20.4	24.5	223.2	224.5	1.218	1.191
09/01/2007	08:15-08:30	34	88.9	91.7	20997.3	23882.2	40	-0.19	-0.19	0	2884.8	0	-0.55	-0.55	92.39	20.2	24.5	225.1	224.9	1.217	1.191
09/01/2007	08:30-08:45	35	88.9	91.7	20997.2	23769.7	40	0	49.96	0	2772.5	0	138.52	138.52	92.39	19.7	24.5	223.4	225.6	1.218	1.191
09/01/2007	08:45-09:00	36	88.9	91.7	20997.1	23227.3	40	0	0	0	2230.1	0	0	0	92.39	19.7	24.5	223.5	226.1	1.218	1.191
09/01/2007	09:00-09:15	37	88.9	91.7	20997.1	22788.2	39.33	0.67	0.67	0	1791.2	0	1.2	1.2	90.84	20.1	24.5	223.8	226.8	1.218	1.191
09/01/2007	09:15-09:30	38	88.9	91.7	20996.9	23588.4	39.33	49.96	49.96	0	2591.6	0	129.47	129.47	90.84	20.5	24.4	221.9	227.3	1.218	1.19
11/01/2007	07:15-07:30	30	86.1	88.9	16983.8	23644.3	35.99	14.11	54.9	0	6660.6	0	365.66	-65.66	67.24	-999	24.3	215	218.7	-999	1.214
11/01/2007	07:30-07:45	31	86.1	88.9	16221.1	17713	35.99	206.06	206.06	0	1491.9	0	307.42	307.42	64.22	-999	24.8	214.6	219.2	-999	1.214
11/01/2007	07:45-08:00	32	86.1	88.9	11615.1	9004.2	35.99	212	212	2610.9	0	553.52	0	-553.52	45.98	-999	25.1	215.2	219.5	-999	1.214
11/01/2007	08:00-08:15	33	86.1	88.9	17098.7	167.5	39.93	1.19	1.19	16931.2	0	20.15	0	-20.15	75.1	-999	25.6	214.1	219.5	-999	1.214
11/01/2007	08:15-08:30	34	86.1	88.9	15382.4	98.2	39.93	13.9	13.9	15284.2	0	212.45	0	-212.45	67.56	23.1	26	213.3	219.1	-999	1.213
11/01/2007	08:30-08:45	35	86.1	88.9	12604.7	31.3	39.93	81.74	81.74	12573.4	0	1027.75	0	-1027.75	55.36	-999	26.3	212.6	218.5	-999	1.212
11/01/2007	08:45-09:00	36	86.1	88.9	6741.6	3.2	39.93	80	80	6738.4	0	539.07	0	-539.07	29.61	-999	26.5	213.5	218.1	-999	1.21

Date	Period	PTE	Farm state Observed	Farm state Forecasted	Energy Observed	Energy Forecasted	Energy price day-ahead	Energy price sell-to	Energy price buy-from	Surplus Energy	Shortage Energy	Paid by TenneT to OWEZ	Paid to TenneT by OWEZ	Net imbalance payment	Imbalance fee	Wind speed Observed	Wind speed Forecasted	Wind direction Observed	Wind direction Forecasted	Air density Observed	Air density Forecasted
[da/mo/year]	[hr:mi]	[-]	[%]	[%]	[kWh]	[kWh]	[EUR/MWh]	[EUR/MWh]	[EUR/MWh]	[kWh]	[kWh]	[EUR]	[EUR]	[EUR]	[EUR]	[m/s]	[m/s]	[deg]	[deg]	[kg/m**3]	[kg/m**3]
11/01/2007	09:00-09:15	37	86.1	88.9	3108.8	0	39.44	79	79	3108.8	0	245.6	0	-245.6	13.49	-999	26.6	214.5	217.9	-999	1.208
11/01/2007	09:15-09:30	38	86.1	88.9	3525.2	0	39.44	86	86	3525.2	0	303.16	0	-303.16	15.29	-999	26.7	214.4	218.1	-999	1.207
11/01/2007	09:30-09:45	39	83.3	88.9	3753.5	0	39.44	30	30	3753.5	0	112.6	0	-112.6	16.28	-999	26.7	214.4	218.7	-999	1.205
11/01/2007	09:45-10:00	40	86.1	88.9	5393.5	0	39.44	80	80	5393.5	0	431.48	0	-431.48	23.4	-999	26.7	215.1	219.4	-999	1.204
11/01/2007	10:00-10:15	41	86.1	88.9	6839.4	0	39.99	67	67	6839.4	0	458.24	0	-458.24	30.09	-999	26.7	217.5	220.1	-999	1.203
11/01/2007	10:15-10:30	42	86.1	88.9	5555.8	0	39.99	51	51	5555.8	0	283.35	0	-283.35	24.44	-999	26.7	220.9	220.5	-999	1.203
11/01/2007	10:30-10:45	43	86.1	88.9	3527.2	0	39.99	61.54	61.54	3527.2	0	217.07	0	-217.07	15.52	-999	26.8	221.6	220.9	-999	1.203
11/01/2007	10:45-11:00	44	86.1	88.9	3705.2	0	39.99	76.3	76.3	3705.2	0	282.71	0	-282.71	16.3	-999	26.9	221	221.3	-999	1.203
11/01/2007	11:00-11:15	45	86.1	88.9	5946	0	50	76.26	76.26	5946	0	453.44	0	-453.44	32.7	-999	27.1	221.7	222.1	-999	1.203
11/01/2007	11:15-11:30	46	86.1	88.9	5598.8	0	50	67	67	5598.8	0	375.12	0	-375.12	30.79	-999	27.2	221.6	223.1	-999	1.203
11/01/2007	11:30-11:45	47	86.1	88.9	1869.2	0	50	73.06	73.06	1869.2	0	136.56	0	-136.56	10.28	-999	27.5	221.4	224.5	-999	1.202
11/01/2007	11:45-12:00	48	86.1	88.9	644.8	0	50	80	80	644.8	0	51.58	0	-51.58	3.55	-999	27.7	221.3	225.6	-999	1.201
11/01/2007	12:00-12:15	49	86.1	88.9	610.7	0	52.5	99	99	610.7	0	60.46	0	-60.46	3.53	-999	27.9	223.2	226.7	-999	1.2
11/01/2007	12:15-12:30	50	86.1	88.9	109.6	0	52.5	79	79	109.6	0	8.66	0	-8.66	0.63	-999	28	223.6	227.5	-999	1.198
11/01/2007	12:30-12:45	51	86.1	88.9	-999	0	52.5	83	83	-999	-999	-999999	-999999	0	-999999	-999	27.9	225.6	228.4	-999	1.196
11/01/2007	12:45-13:00	52	86.1	88.9	-999	0	52.5	76.46	76.46	-999	-999	-999999	-999999	0	-999999	-999	27.8	227.2	229.3	-999	1.194
11/01/2007	13:00-13:15	53	86.1	88.9	-999	0	60	160.45	160.45	-999	-999	-999999	-999999	0	-999999	-999	27.6	226.4	230.9	-999	1.193
11/01/2007	13:15-13:30	54	86.1	88.9	-999	0	60	151.3	151.3	-999	-999	-999999	-999999	0	-999999	-999	27.4	226.9	232.6	-999	1.193
11/01/2007	13:30-13:45	55	86.1	88.9	-999	0	60	138.55	138.55	-999	-999	-999999	-999999	0	-999999	-999	26.9	229.5	235.3	-999	1.193
11/01/2007	13:45-14:00	56	86.1	88.9	-999	29	60	79.74	79.74	-999	-999	-999999	-999999	0	-999999	-999	26.4	230.2	238	-999	1.193
11/01/2007	14:00-14:15	57	86.1	88.9	-999	95.5	60	87	87	-999	-999	-999999	-999999	0	-999999	-999	26	241.3	241.1	-999	1.192
11/01/2007	14:15-14:30	58	86.1	88.9	-999	99.9	60	83.6	83.6	-999	-999	-999999	-999999	0	-999999	-999	26	274.5	243.2	-999	1.192
11/01/2007	14:30-14:45	59	86.1	88.9	-999	92.1	60	76.3	76.3	-999	-999	-999999	-999999	0	-999999	-999	26	275.9	245.5	-999	1.192
11/01/2007	14:45-15:00	60	86.1	88.9	-999	121.4	60	88	88	-999	-999	-999999	-999999	0	-999999	-999	25.9	275.2	246.9	-999	1.191
11/01/2007	15:00-15:15	61	86.1	88.9	-999	1411.3	55.12	125	125	-999	-999	-999999	-999999	0	-999999	-999	25.5	277.5	248.1	-999	1.191
11/01/2007	15:15-15:30	62	86.1	88.9	2348.6	9561.3	55.12	76.3	76.3	0	7212.7	0	550.33	550.33	14.24	16.9	25.1	281.4	248.6	-999	1.19
11/01/2007	15:30-15:45	63	86.1	88.9	12511.6	23204	55.12	76.98	76.98	0	10692.4	0	823.1	823.1	75.86	16.4	24.1	264.1	248.5	-999	1.19
11/01/2007	21:45-22:00	88	86.1	88.9	19491.6	23285.4	29.71	14.01	14.01	0	3793.9	0	53.15	53.15	63.7	-999	24.4	274	263.8	-999	1.196

Date	Period	PTE	Farm state Observed	Farm state Forecasted	Energy Observed	Energy Forecasted	Energy price day-ahead	Energy price sell-to	Energy price buy-from	Surplus Energy	Shortage Energy	Paid by TenneT to OWEZ	Paid to TenneT by OWEZ	Net imbalance payment	Imbalance fee	Wind speed observed	Wind speed forecasted	Wind direction observed	Wind direction forecasted	Air density observed	Air density forecasted
[da/mo/year]	[hr:mi]	[-]	[%]	[%]	[kWh]	[kWh]	[EUR/MWh]	[EUR/MWh]	[EUR/MWh]	[kWh]	[kWh]	[EUR]	[EUR]	[EUR]	[EUR]	[m/s]	[m/s]	[deg]	[deg]	[kg/m**3]	[kg/m**3]
11/01/2007	22:00-22:15	89	83.3	88.9	18741.2	22938.3	25.93	27.19	36	0	4197.1	0	151.09	151.09	53.46	-999	24.5	276	265.2	-999	1.197
11/01/2007	22:15-22:30	90	83.3	88.9	18741.3	21133.7	25.93	21.06	36	0	2392.4	0	86.13	86.13	53.46	-999	24.6	277.9	265.9	-999	1.197
11/01/2007	22:30-22:45	91	83.3	88.9	18741.2	18373.4	25.93	15.44	15.44	367.8	0	5.68	0	-5.68	53.46	-999	24.7	277.6	266.3	-999	1.197
11/01/2007	22:45-23:00	92	83.3	88.9	18741.5	16264.2	25.93	12.96	12.96	2477.3	0	32.11	0	-32.11	53.46	-999	24.8	278.2	266.4	-999	1.197
11/01/2007	23:00-23:15	93	83.3	88.9	18723.8	13716	23.17	48.56	48.56	5007.8	0	243.18	0	-243.18	47.72	-999	24.9	280	266.5	-999	1.197
11/01/2007	23:15-23:30	94	83.3	88.9	14593.5	11722.8	23.17	62.19	62.19	2870.7	0	178.53	0	-178.53	37.19	-999	25	283.1	266.7	-999	1.196
11/01/2007	23:30-23:45	95	83.3	88.9	14501.8	9243.8	23.17	40.58	40.58	5258	0	213.37	0	-213.37	36.96	-999	25.1	285.2	267.2	-999	1.196
11/01/2007	23:45-00:00	96	83.3	88.9	17801.7	7231.6	23.17	51.07	51.07	10570.1	0	539.82	0	-539.82	45.37	-999	25.2	285.3	267.7	-999	1.196
12/01/2007	00:00-00:15	1	83.3	83.3	18626.4	22280.2	14.59	48.86	48.86	0	3653.8	0	178.53	178.53	29.89	-999	22.8	287.9	292.9	-999	1.213
18/01/2007	12:00-12:15	49	72.2	75	-999	19703.3	49.99	167.51	167.51	-999	-999	-999999	-999999	0	-999999	-999	23.6	227.3	231.5	-999	1.194
18/01/2007	12:15-12:30	50	75	75	-999	11574.9	49.99	57.51	57.51	-999	-999	-999999	-999999	0	-999999	-999	24.8	227.7	233.2	-999	1.188
18/01/2007	12:30-12:45	51	75	75	-999	9.3	49.99	56.05	56.05	-999	-999	-999999	-999999	0	-999999	-999	26.9	228.1	233.9	-999	1.179
18/01/2007	12:45-13:00	52	75	75	-999	0	49.99	81.19	81.19	-999	-999	-999999	-999999	0	-999999	-999	28.9	229.3	233.8	-999	1.171
18/01/2007	13:00-13:15	53	77.8	75	-999	0	75	83.19	83.19	-999	-999	-999999	-999999	0	-999999	-999	30.6	230.3	233.5	-999	1.162
18/01/2007	13:15-13:30	54	77.8	75	-999	0	75	98.75	98.75	-999	-999	-999999	-999999	0	-999999	-999	31.5	230.6	233.4	-999	1.156
18/01/2007	13:30-13:45	55	77.8	75	-999	0	75	120.19	120.19	-999	-999	-999999	-999999	0	-999999	-999	32.3	232.8	233.6	-999	1.15
18/01/2007	13:45-14:00	56	77.8	75	-999	0	75	98.75	98.75	-999	-999	-999999	-999999	0	-999999	-999	32.8	236	233.8	-999	1.145
18/01/2007	14:00-14:15	57	77.8	75	-999	0	60	86.3	86.3	-999	-999	-999999	-999999	0	-999999	-999	33.3	234	233.9	-999	1.142
18/01/2007	14:15-14:30	58	77.8	75	-999	0	60	84.19	84.19	-999	-999	-999999	-999999	0	-999999	-999	33.7	235.7	233.9	-999	1.14
18/01/2007	14:30-14:45	59	77.8	75	-999	0	60	76.76	76.76	-999	-999	-999999	-999999	0	-999999	-999	34	235.7	233.9	-999	1.139
18/01/2007	14:45-15:00	60	77.8	75	-999	0	60	53.19	53.19	-999	-999	-999999	-999999	0	-999999	-999	34.1	235.4	234	-999	1.139
18/01/2007	15:00-15:15	61	77.8	75	-999	0	43.01	27.22	27.22	-999	-999	-999999	-999999	0	-999999	-999	34.2	249	234.4	-999	1.141
18/01/2007	15:15-15:30	62	77.8	75	-999	0	43.01	61.96	61.96	-999	-999	-999999	-999999	0	-999999	-999	34.2	270.8	235	-999	1.143
18/01/2007	15:30-15:45	63	77.8	75	-999	0	43.01	27.22	27.22	-999	-999	-999999	-999999	0	-999999	-999	34.1	263	236.1	-999	1.147
18/01/2007	15:45-16:00	64	75	75	-999	0	43.01	23.87	23.87	-999	-999	-999999	-999999	0	-999999	-999	33.8	259.6	237	-999	1.15
18/01/2007	16:00-16:15	65	75	75	-999	0	50.06	16.19	16.19	-999	-999	-999999	-999999	0	-999999	-999	33.4	259	238.1	-999	1.153
18/01/2007	16:15-16:30	66	75	75	885.1	0	50.06	12.58	12.58	885.1	0	11.13	0	-11.13	4.87	23.1	32.9	255	239.1	-999	1.156
18/01/2007	16:30-16:45	67	77.8	75	8028.9	0	50.06	10.19	10.19	8028.9	0	81.81	0	-81.81	44.21	-999	32.3	257.3	240.9	-999	1.159

Date	Period	PTE	Farm state Observed	Farm state Forecasted	Energy Observed	Energy Forecasted	Energy price day-ahead	Energy price sell-to	Energy price buy-from	Surplus Energy	Shortage Energy	Paid by TenneT to OWEZ	Paid to TenneT by OWEZ	Net imbalance payment	Imbalance fee	Wind speed Observed	Wind speed Forecasted	Wind direction Observed	Wind direction Forecasted	Air density Observed	Air density Forecasted
[dmo/year]	[hr:mi]	[-]	[%]	[%]	[kWh]	[kWh]	[EUR/MWh]	[EUR/MWh]	[EUR/MWh]	[kWh]	[kWh]	[EUR]	[EUR]	[EUR]	[EUR]	[m/s]	[m/s]	[deg]	[deg]	[kg/m**3]	[kg/m**3]
18/01/2007	16:45-17:00	68	77.8	75	9778.6	0	50.06	10.19	10.19	9778.6	0	99.64	0	-99.64	53.85	-999	31.6	261.6	243.2	-999	1.159
18/01/2007	17:00-17:15	69	75	75	10084.9	0	129.44	22.85	22.85	10084.9	0	230.44	0	-230.44	143.59	-999	30.7	260.3	247.8	-999	1.16
18/01/2007	17:15-17:30	70	75	75	9704.1	0	129.44	172.28	172.28	9704.1	0	1671.82	0	-1671.82	138.17	-999	30	262.6	253	-999	1.161
18/01/2007	17:30-17:45	71	75	75	8335.7	0	129.44	112.19	112.19	8335.7	0	935.18	0	-935.18	118.69	-999	29.4	260.1	260.4	-999	1.162
18/01/2007	17:45-18:00	72	77.8	75	3196.5	0	129.44	70.19	70.19	3196.5	0	224.36	0	-224.36	45.51	-999	29	260	266.1	-999	1.165
18/01/2007	18:00-18:15	73	77.8	75	340.7	0	49.99	17.75	17.75	340.7	0	6.05	0	-6.05	1.87	-999	28.1	263.1	271.4	-999	1.168
18/01/2007	18:15-18:30	74	77.8	75	-999	0	49.99	17.73	17.73	-999	-999	-999999	0	-999999	-999999	-999	27	263.5	273.8	-999	1.17
18/01/2007	18:30-18:45	75	77.8	75	-999	17.3	49.99	23.86	23.86	-999	-999	-999999	0	-999999	-999999	-999	26.4	269.2	274.5	-999	1.17
18/01/2007	18:45-19:00	76	77.8	75	-999	41.2	49.99	23.19	23.19	-999	-999	-999999	0	-999999	-999999	-999	26.2	276.1	273.9	-999	1.17
18/01/2007	19:00-19:15	77	77.8	75	-999	63.6	35.99	166.36	166.36	-999	-999	-999999	0	-999999	-999999	-999	26.1	277.3	271.9	-999	1.169
18/01/2007	19:15-19:30	78	77.8	75	-999	79.2	35.99	85.99	85.99	-999	-999	-999999	0	-999999	-999999	-999	26	276.7	269.8	-999	1.168
18/01/2007	19:30-19:45	79	77.8	75	-999	96.5	35.99	18.53	18.53	-999	-999	-999999	0	-999999	-999999	-999	25.9	278	267.5	-999	1.168
18/01/2007	19:45-20:00	80	77.8	75	-999	110	35.99	21.19	21.19	-999	-999	-999999	0	-999999	-999999	-999	25.8	275.3	266.5	-999	1.168
18/01/2007	20:00-20:15	81	77.8	75	-999	124.8	32.99	167.51	167.51	-999	-999	-999999	0	-999999	-999999	-999	25.7	276.8	266.4	-999	1.17
18/01/2007	20:15-20:30	82	77.8	75	-999	135	32.99	103.19	103.19	-999	-999	-999999	0	-999999	-999999	-999	25.6	279.6	267.4	-999	1.172
18/01/2007	20:30-20:45	83	77.8	75	-999	148.3	32.99	23	23	-999	-999	-999999	0	-999999	-999999	-999	25.6	279.1	269.8	-999	1.176
18/01/2007	20:45-21:00	84	77.8	75	-999	506.8	32.99	24.19	69.19	-999	-999	-999999	0	-999999	-999999	-999	25.5	280.4	271.8	-999	1.179
18/01/2007	21:00-21:15	85	77.8	75	-999	2374.3	25.49	121.38	121.38	-999	-999	-999999	0	-999999	-999999	-999	25.4	283.5	273.4	-999	1.182
18/01/2007	21:15-21:30	86	77.8	75	-999	4442.3	25.49	95.19	95.19	-999	-999	-999999	0	-999999	-999999	-999	25.3	285.2	273.9	-999	1.183
18/01/2007	21:30-21:45	87	77.8	75	-999	7208.8	25.49	57.16	57.16	-999	-999	-999999	0	-999999	-999999	-999	25.1	288	273.7	-999	1.184
18/01/2007	21:45-22:00	88	77.8	75	-999	9297.4	25.49	54.19	54.19	-999	-999	-999999	0	-999999	-999999	-999	25	285.9	273.1	-999	1.184
18/01/2007	22:00-22:15	89	77.8	75	-999	11333.4	24.01	114.19	114.19	-999	-999	-999999	0	-999999	-999999	-999	24.9	286.5	272.3	-999	1.184
18/01/2007	22:15-22:30	90	77.8	75	-999	12355.9	24.01	49.19	49.19	-999	-999	-999999	0	-999999	-999999	-999	24.9	286.7	271.9	-999	1.185
18/01/2007	22:30-22:45	91	77.8	75	-999	13010.3	24.01	15.26	15.26	-999	-999	-999999	0	-999999	-999999	-999	24.8	287.3	271.7	-999	1.186
18/01/2007	22:45-23:00	92	77.8	75	-999	13224.2	24.01	15.26	15.26	-999	-999	-999999	0	-999999	-999999	-999	24.8	287.1	271.7	-999	1.187
18/01/2007	23:00-23:15	93	77.8	75	-999	13323.8	19	-0.1	41.19	-999	-999	-999999	0	-999999	-999999	20	24.8	287.1	271.9	-999	1.188
18/01/2007	23:15-23:30	94	77.8	75	385.1	13344.8	19	14.9	46.19	0	12959.7	0	598.61	598.61	0.8	18.7	24.8	288.1	272.1	-999	1.188
18/01/2007	23:30-23:45	95	77.8	75	4538	13298.4	19	2.5	2.5	0	8760.4	0	21.9	21.9	9.48	-999	24.8	286.4	272.3	-999	1.188
18/01/2007	23:45-00:00	96	77.8	75	12131.2	13173.2	19	12.96	12.96	0	1042	0	13.5	13.5	25.35	15.7	24.8	284.1	272.4	-999	1.188

Date	Period	PTE	Farm state Observed	Farm state Forecasted	Energy Observed	Energy Forecasted	Energy price day-ahead	Energy price sell-to	Energy price buy-from	Surplus Energy	Shortage Energy	Paid by TenneT to OWEZ	Paid by TenneT to OWEZ	Net imbalance payment	Imbalance fee	Wind speed observed	Wind speed forecasted	Wind direction observed	Wind direction forecasted	Air density observed	Air density forecasted
[dmo/year]	[hr:mi]	[-]	[%]	[%]	[kWh]	[kWh]	[EUR/MWh]	[EUR/MWh]	[EUR/MWh]	[kWh]	[kWh]	[EUR]	[EUR]	[EUR]	[EUR]	[m/s]	[m/s]	[deg]	[deg]	[kg/m**3]	[kg/m**3]
19/01/2007	00:00-00:15	1	77.8	75	16404.4	0	15.21	125	125	16404.4	0	2050.55	0	-2050.55	27.45	16.1	27.6	279.6	279.6	1.226	1.188
19/01/2007	00:15-00:30	2	77.8	75	16486.1	0	15.21	65.19	65.19	16486.1	0	1074.73	0	-1074.73	27.58	14.4	27.2	274.6	280	1.225	1.189
19/01/2007	00:30-00:45	3	77.8	75	16486.5	0	15.21	55.38	55.38	16486.5	0	913.02	0	-913.02	27.58	-999	26.7	268	281.2	1.226	1.19
19/01/2007	00:45-01:00	4	75	75	15734.3	33.3	15.21	51	51	15701	0	800.75	0	-800.75	26.33	15.6	26.3	275.1	282.1	1.227	1.19
19/01/2007	01:00-01:15	5	77.8	75	16480.3	121.2	12.15	51.9	51.9	16359.1	0	849.04	0	-849.04	22.03	14	25.7	269.7	283.2	1.228	1.19
19/01/2007	01:15-01:30	6	77.8	75	16304.1	4273.5	12.15	47.56	47.56	12030.7	0	572.18	0	-572.18	21.79	12.8	25.3	261.2	283.8	1.228	1.19
19/01/2007	01:30-01:45	7	77.8	75	16444.8	14481.1	12.15	47.56	47.56	1963.7	0	93.39	0	-93.39	21.98	12.1	24.8	252.8	284.4	-999	1.189
19/01/2007	01:45-02:00	8	77.8	75	16477.9	19144.4	12.15	42.43	42.43	0	2666.5	0	113.14	113.14	22.02	14.3	24.4	251.4	284.7	-999	1.189
20/01/2007	07:45-08:00	32	77.8	77.8	16491.8	20214	15.59	45.9	45.9	0	3722.1	0	170.85	170.85	28.28	20.2	24.4	220.8	223.9	1.224	1.187
20/01/2007	08:00-08:15	33	77.8	77.8	16490.8	16503	24.59	18.19	48.19	0	12.2	0	0.59	0.59	44.61	20.3	24.7	219.3	223.1	1.224	1.187
20/01/2007	08:15-08:30	34	77.8	77.8	16492.2	12203.8	24.59	49.44	49.44	4288.4	0	212.02	0	-212.02	44.61	20.4	24.9	219.2	222.8	1.224	1.187
20/01/2007	08:30-08:45	35	77.8	77.8	16491	7671.5	24.59	51.9	51.9	8819.5	0	457.73	0	-457.73	44.61	20.1	25.1	219.3	222.8	1.224	1.187
20/01/2007	08:45-09:00	36	77.8	77.8	16492.5	4694.2	24.59	52.38	52.38	11798.3	0	617.99	0	-617.99	44.61	20.1	25.3	218.5	223.1	1.223	1.187
20/01/2007	09:00-09:15	37	77.8	77.8	16488.1	1879.2	27.39	21.06	21.06	14608.9	0	307.66	0	-307.66	49.68	20.2	25.4	219.5	223.9	1.223	1.187
20/01/2007	09:15-09:30	38	77.8	77.8	16489.2	1026.8	27.39	22.9	45.9	15462.4	0	354.09	0	-354.09	49.68	20.7	25.5	219.9	224.9	1.223	1.187
20/01/2007	09:30-09:45	39	77.8	77.8	16488.6	1990.6	27.39	49.96	49.96	14498	0	724.32	0	-724.32	49.68	20.8	25.4	222.3	226.6	1.223	1.188
20/01/2007	09:45-10:00	40	77.8	77.8	16491.4	4394.9	27.39	49.96	49.96	12096.5	0	604.34	0	-604.34	49.69	21.1	25.3	225.1	228.5	1.223	1.188
20/01/2007	10:00-10:15	41	77.8	77.8	16489	9460.9	38.61	49.96	49.96	7028.1	0	351.13	0	-351.13	70.03	-999	25	240.1	231.4	-999	1.189
20/01/2007	10:15-10:30	42	75	77.8	15737.9	14953.1	38.61	49.96	49.96	784.7	0	39.2	0	-39.2	66.84	-999	24.8	261.8	234.3	-999	1.191
20/01/2007	10:30-10:45	43	75	77.8	15741.4	20314.7	38.61	56.63	56.63	0	4573.3	0	258.98	258.98	66.86	-999	24.4	263.6	238.3	-999	1.193
20/01/2007	14:30-14:45	59	77.8	77.8	16491.4	20544.9	28	18.51	18.51	0	4053.5	0	75.03	75.03	50.79	17.7	24.3	249.5	252.4	1.232	1.206
20/01/2007	14:45-15:00	60	77.8	77.8	16489.5	17790.3	28	19.9	19.9	0	1300.8	0	25.89	25.89	50.79	17.9	24.6	250.7	252.7	1.232	1.207
20/01/2007	15:00-15:15	61	77.8	77.8	16491.1	10853	25	10.29	10.29	5638	0	58.02	0	-58.02	45.35	18.3	25	252.1	253.2	1.232	1.208
20/01/2007	15:15-15:30	62	77.8	77.8	16492.1	6098.4	25	10.85	10.85	10393.8	0	112.77	0	-112.77	45.35	18.3	25.2	254.8	253.7	1.232	1.208
20/01/2007	15:30-15:45	63	77.8	77.8	16490.5	1409.5	25	3.59	3.59	15081	0	54.14	0	-54.14	45.35	-999	25.5	265.8	254.3	1.232	1.208
20/01/2007	15:45-16:00	64	77.8	77.8	16492.2	146.4	25	5	5	16345.8	0	81.73	0	-81.73	45.35	17.5	25.6	267.1	254.9	1.232	1.207
20/01/2007	16:00-16:15	65	77.8	77.8	16491	117.9	27.35	-2	-2	16373.2	0	-32.75	0	32.75	49.61	16.6	25.8	266.1	255.7	1.233	1.206

Date	Period	PTE	Farm state Observed	Farm state Forecasted	Energy Observed	Energy Forecasted	Energy price day-ahead	Energy price sell-to	Energy price buy-from	Surplus Energy	Shortage Energy	Paid by TenneT to OWEZ	Paid to TenneT by OWEZ	Net imbalance payment	Imbalance fee	Wind speed Observed	Wind speed Forecasted	Wind direction Observed	Wind direction Forecasted	Wind speed [m/s]	Wind speed [m/s]	Wind direction [deg]	Wind direction [deg]	Air density Observed	Air density Forecasted
[da/mo/year]	[hr:mi]	[-]	[%]	[%]	[kWh]	[kWh]	[EUR/MWh]	[EUR/MWh]	[EUR/MWh]	[kWh]	[kWh]	[EUR]	[EUR]	[EUR]	[EUR]	[m/s]	[m/s]	[deg]	[deg]	[m/s]	[m/s]	[deg]	[deg]	[kg/m**3]	[kg/m**3]
20/01/2007	16:15-16:30	66	77.8	77.8	16492.1	103.9	27.35	5	5	16388.2	0	81.94	0	-81.94	49.62	16.6	25.9	263.7	256.4	16.6	25.9	263.7	256.4	1.233	1.206
20/01/2007	16:30-16:45	67	77.8	77.8	16490.4	96.8	27.35	7.9	7.9	16393.6	0	129.51	0	-129.51	49.61	-999	25.9	259.8	257.4	-999	25.9	259.8	257.4	1.233	1.206
20/01/2007	16:45-17:00	68	77.8	77.8	16488.8	98	27.35	-2	-2	16390.8	0	-32.78	0	32.78	49.61	-999	25.9	258.4	258.4	-999	25.9	258.4	258.4	1.233	1.206
20/01/2007	17:00-17:15	69	77.8	77.8	16488.7	106.6	70	10.2	10.2	16382.1	0	167.1	0	-167.1	126.96	17.4	25.9	258.1	259.7	17.4	25.9	258.1	259.7	1.233	1.206
20/01/2007	17:15-17:30	70	77.8	77.8	16480.5	118.4	70	91.52	91.52	16362.1	0	1497.46	0	-1497.46	126.9	17.7	25.8	259.4	260.9	17.7	25.8	259.4	260.9	1.234	1.207
20/01/2007	17:30-17:45	71	77.8	77.8	16489.1	138.6	70	140.19	140.19	16350.5	0	2292.17	0	-2292.17	126.97	-999	25.7	258.3	262.5	-999	25.7	258.3	262.5	1.234	1.208
20/01/2007	17:45-18:00	72	77.8	77.8	16491.1	161.1	70	140.19	140.19	16330	0	2289.31	0	-2289.31	126.98	-999	25.5	259	263.7	-999	25.5	259	263.7	1.234	1.209
20/01/2007	18:00-18:15	73	77.8	77.8	16489.8	420.5	55	82.59	82.59	12284.8	0	1014.6	0	-1014.6	99.76	-999	25.3	254.3	265.1	99.76	25.3	254.3	265.1	1.234	1.209
20/01/2007	18:15-18:30	74	77.8	77.8	16488.8	9281.9	55	49.96	49.96	7206.9	0	360.06	0	-360.06	99.76	-999	25.1	252.9	266	99.76	25.1	252.9	266	1.234	1.21
20/01/2007	18:30-18:45	75	77.8	77.8	16490.1	17041.9	55	35.86	49.96	0	551.8	0	27.57	27.57	99.77	-999	24.7	252.2	267	99.77	24.7	252.2	267	1.233	1.21
20/01/2007	18:45-19:00	76	77.8	77.8	16490.1	20576.2	55	26.99	26.99	0	4086.1	0	110.28	110.28	99.77	-999	24.3	252.7	267.6	99.77	24.3	252.7	267.6	1.233	1.21