

SIGNIFICANCE OF THE FORECAST IN THE SHORT TERM POWER TRADING

Efi Gogolou

Barcelona June 2016



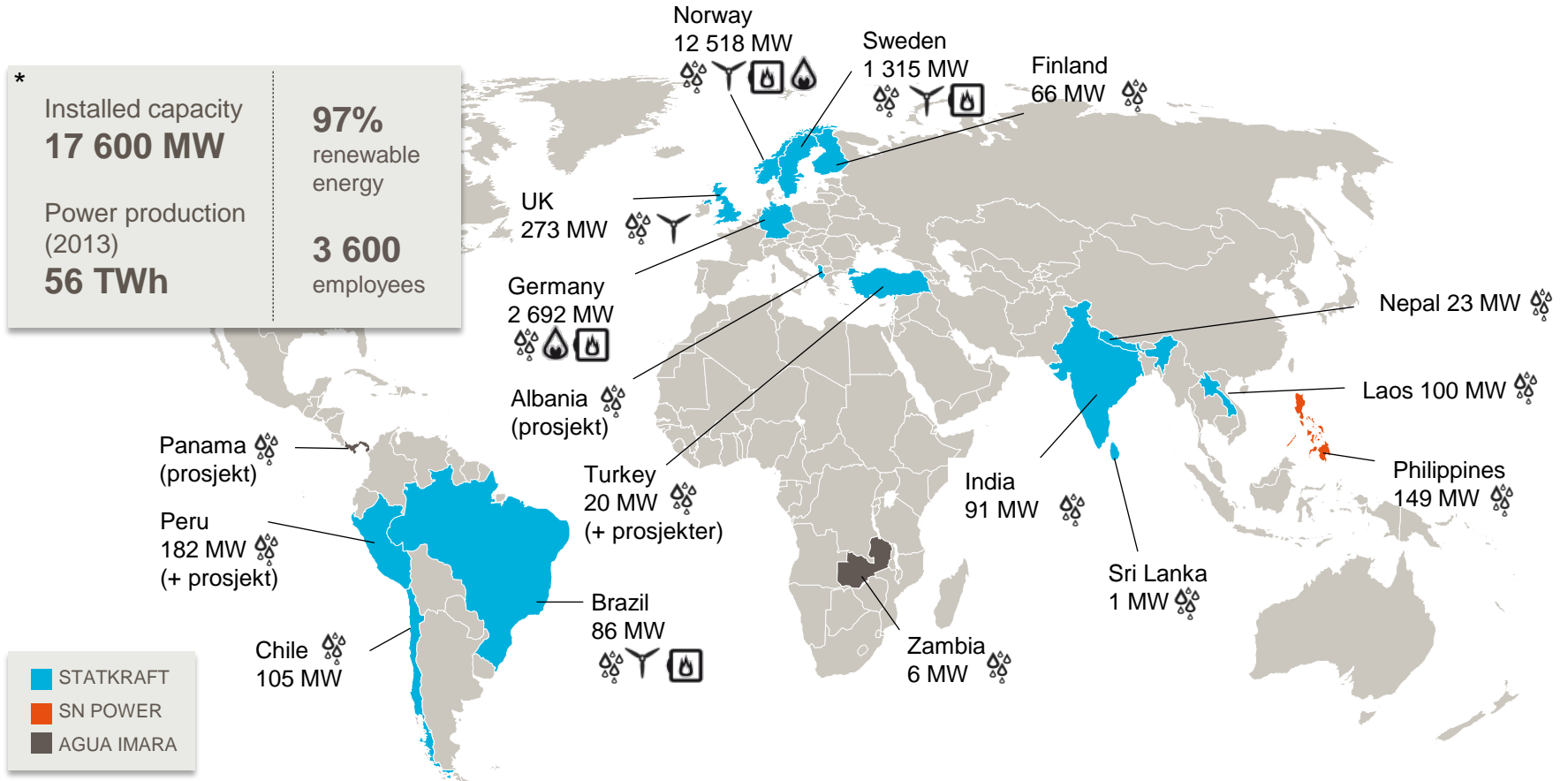
Statkraft at a glance

* Installed capacity
17 600 MW

Power production (2013)
56 TWh

97%
renewable energy

3 600
employees



* 2013 figures. Includes: - Statkraft's share of installed capacity
 - Statkraft SF's share of installed capacity in Laos

A major energy trader



- ▶ Statkraft is a major player on Europe's power exchanges
- ▶ The Group has special expertise within physical and financial power trading
- ▶ Statkraft is active in all energy-related commodities, offering origination and energy service agreements
- ▶ The Group is continually expanding power trading activities in Europe

Wind power



▶ Germany

- More than 1000 Onshore wind farms : 8,33 GW
- Ocean Breeze Offshore wind farm : 400 MW
- Total Installed capacity: 8.7 GW

▶ Norway

- Onshore wind farms Hitra, Kjøllefjord and Smøla
- Installed capacity: 244 MW

▶ Sweden

- Onshore wind farms Em and Stamåsen
- Installed capacity: 69 MW

▶ United Kingdom

- Onshore wind farms Alltwalis and Baillie, offshore wind farm Sheringham Shoal* and several PPAs
- Installed capacity: 1850 MW

Solar power



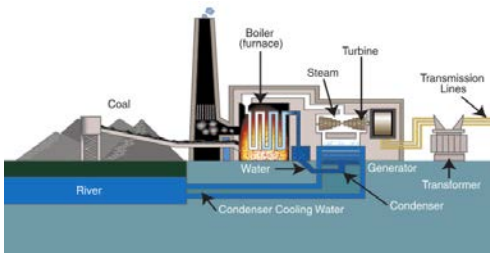
▶ Germany

- Total Installed capacity: 746 MW
- 153 Solar Plants

▶ United Kingdom

- Installed capacity: 233 MW
- 132 Solar Plants

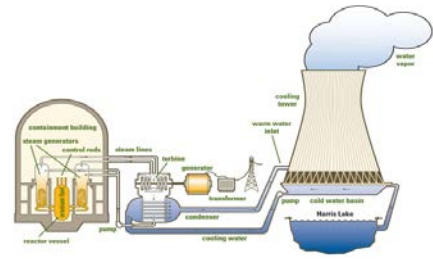
Traditional trading



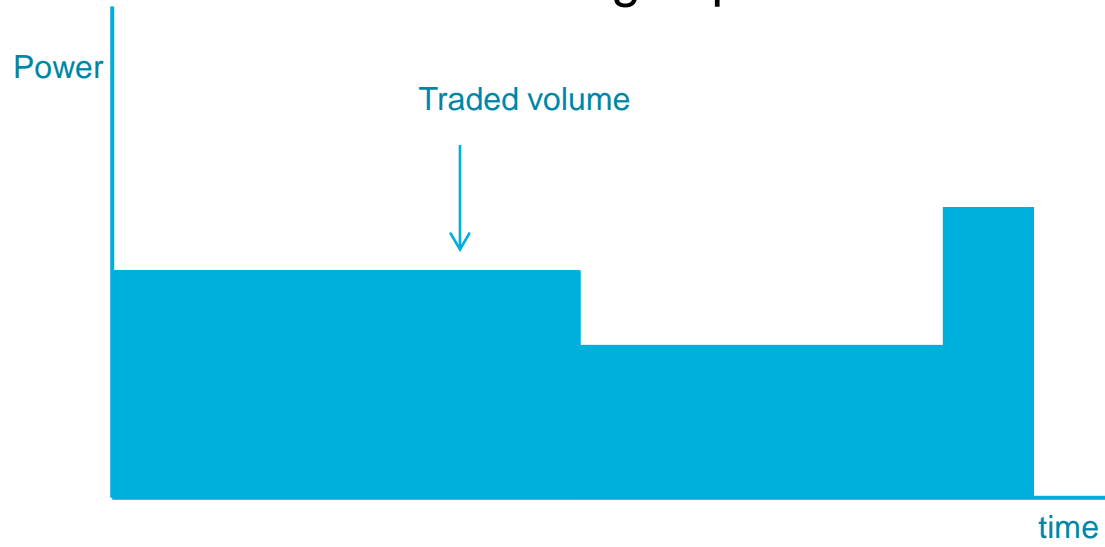
Coal plants



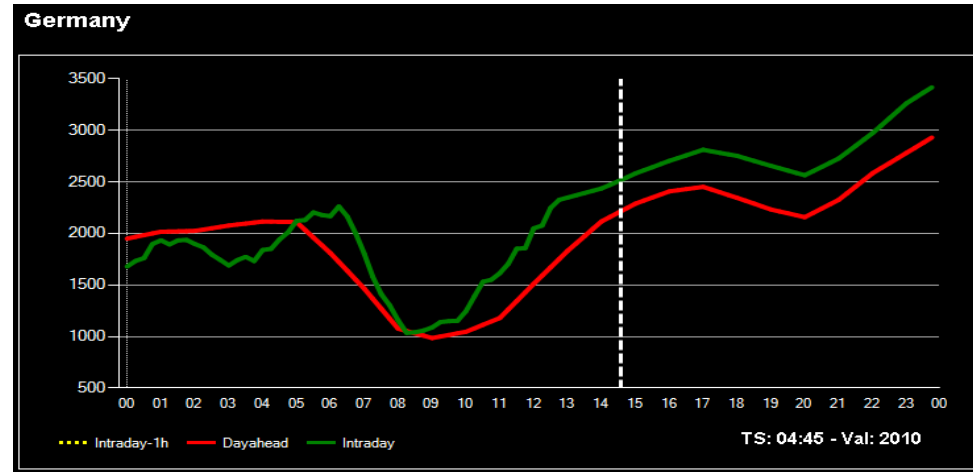
gas plants



nuclear plants



Renewable energy trading

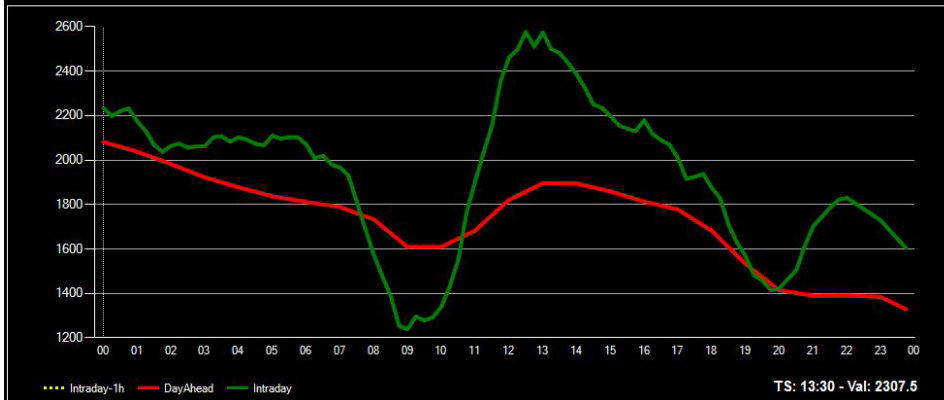


- ▶ Renewable energy is intermittent
- ▶ Priority dispatch on transmission lines
- ▶ Expected balancing volume : Intraday forecast – Day ahead forecast volume

EEG Portfolio in Germany

Example of Dayahead (red) and Intraday (green) Wind Forecast

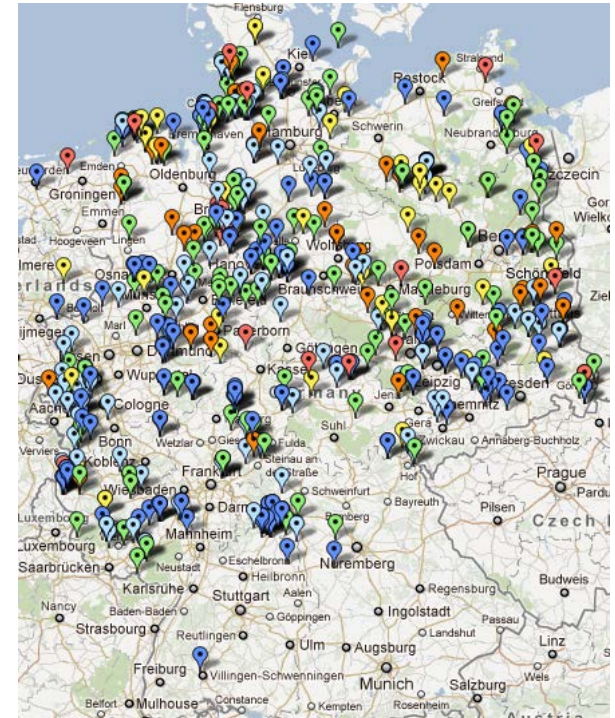
EEG Wind Forecast: 1604 MW



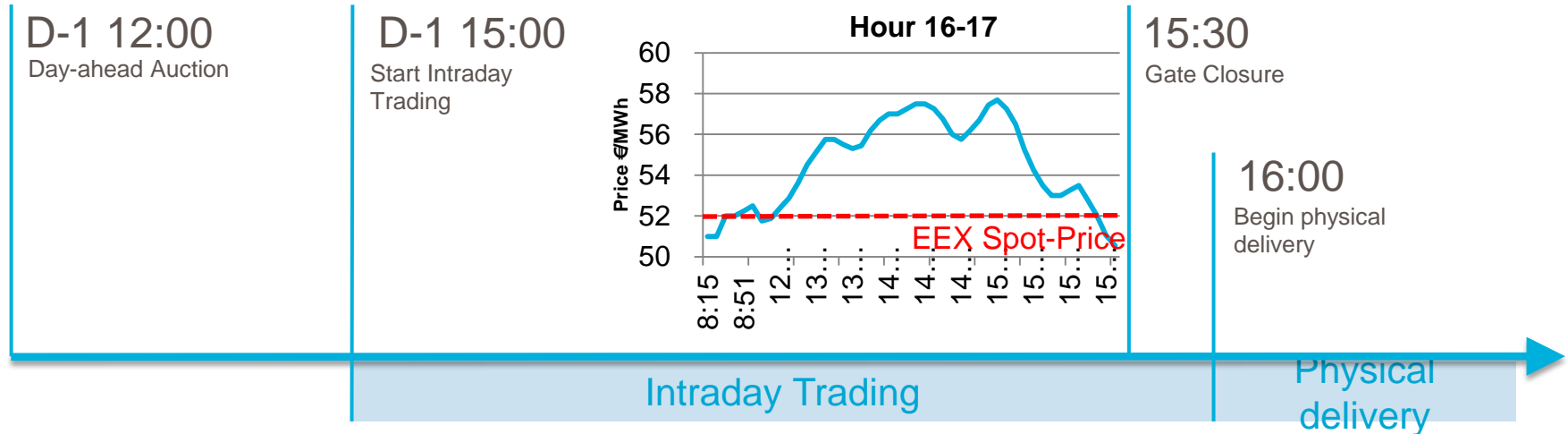
- ▶ Germany: Market Premium Model -> financial bonus for renewable sources
- ▶ UK: PPAs benchmarked against the Market Index Price Operators' profit margin ~90-99% of MIP
- ▶ Forecast-Production -> Imbalance (Prices \neq MIP)

Technology	Installed Capacity MW
Wind	8700
Bio	200
Hydro	28
Solar	426

Locations of our EEG2 Assets

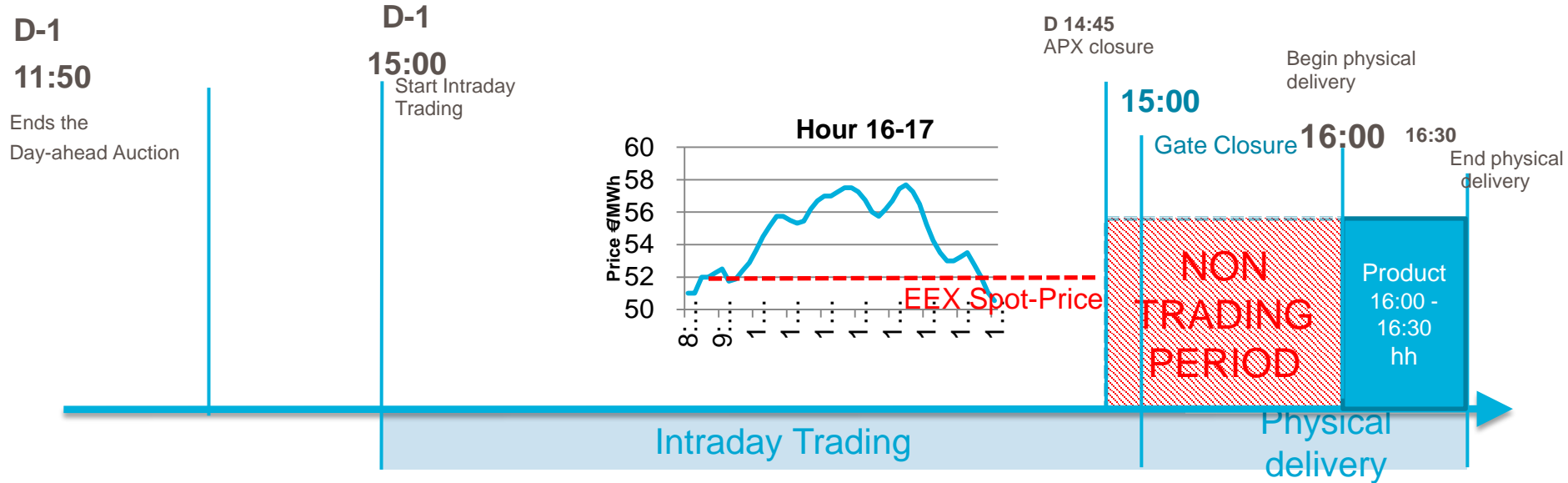


Trading German Power Intraday



- ▶ Our trades take place between the day-ahead auction EPEX Spot and the physical delivery
- ▶ We continuously trade quarter-hour, hour and block products. Gate closure is 30 minutes before begin of delivery.

Trading UK Power Intraday



- ▶ Our trades take place between the day-ahead auction and the APX closure
- ▶ We continuously trade half hour and block products. Gate closure is 60 minutes before begin of delivery.

Wind is a price driver

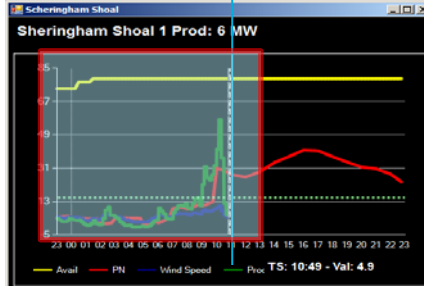
- ▶ The Grid publishes the forecasted demand for the following day -> expectations for prices -> schedule of plants to run or not accordingly
- ▶ Wind and solar forecast are a part of the expected supply -> fluctuations of forecast affect the supply-demand equilibrium -> prices
- ▶ **Example:**
 - UK Wind production – Wind forecast = 2GWs
 - Demand > Supply
 - Buyers in the market will have to pay more in order to secure the power they need
 - Prices rising
 - Generators with higher production costs start producing



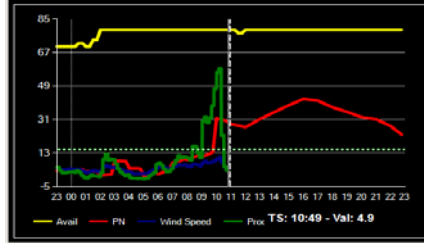
Example : Date
24.05.2014

Parks: Sheringham Shoal I & Sheringham Shoal II

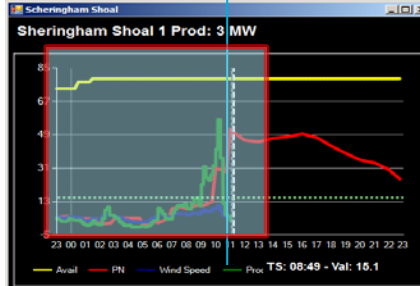
Forecast delivery 11.53
27,33 MW



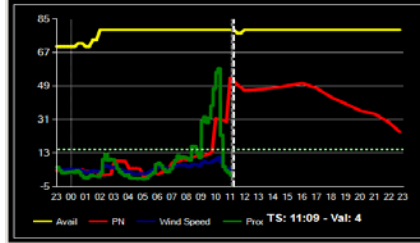
Sheringham Shoal 2 Prod: 4 MW



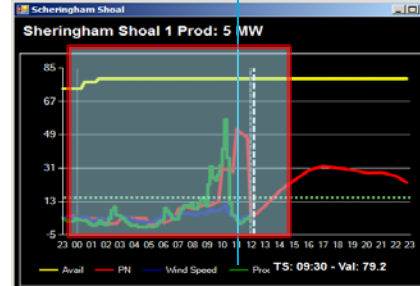
Forecast delivery 12.13
14,53 MW



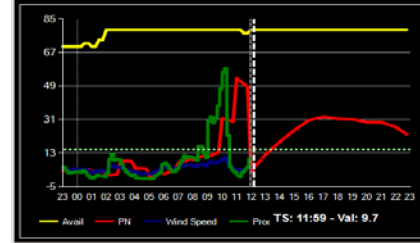
Sheringham Shoal 2 Prod: 1 MW



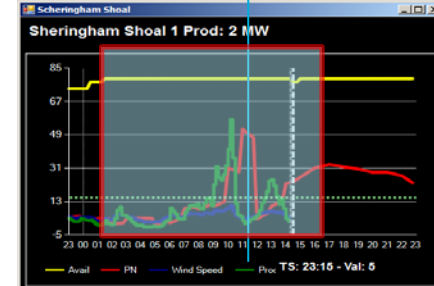
Forecast delivery 13.11
6,53 MW



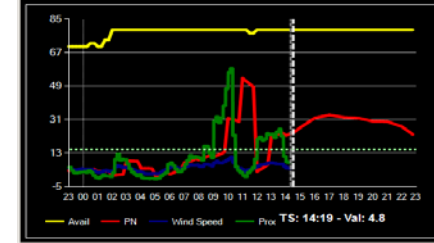
Sheringham Shoal 2 Prod: 10 MW



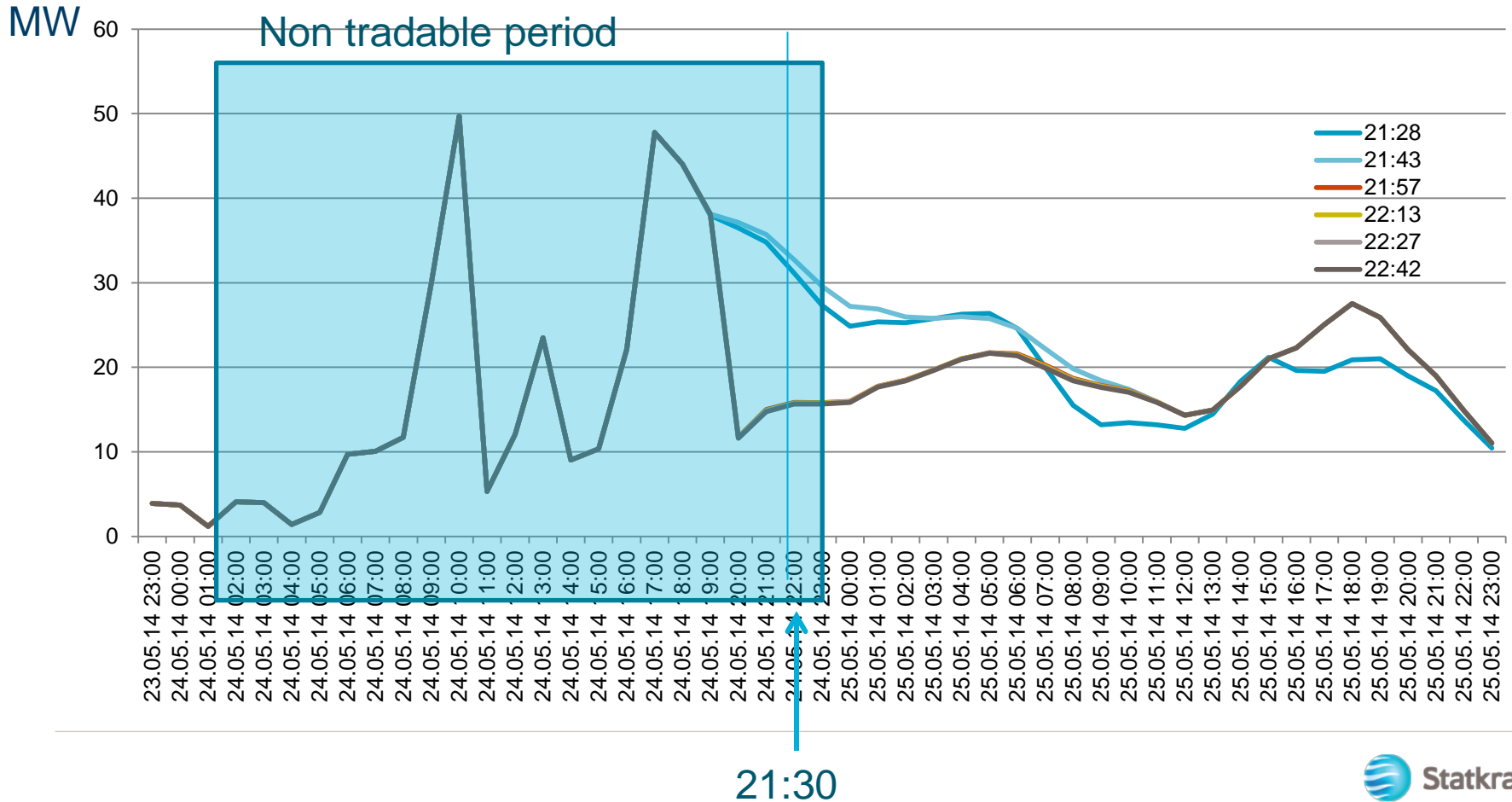
Forecast delivery 15.30
5,32MW



Sheringham Shoal 2 Prod: 8 MW



Sheringham Shoal I



Wind forecast... affects the prices



Thu, 02/13

Time	€/MWh	MWh
00 - 01	11.40	36,831.3
01 - 02	10.70	37,317.0
02 - 03	9.94	36,460.4
03 - 04	8.34	36,142.1
04 - 05	16.83	37,354.1
05 - 06	14.50	35,010.6
06 - 07	29.70	33,801.8
07 - 08	32.02	36,419.7
08 - 09	32.90	37,174.2
09 - 10	33.11	37,741.5
10 - 11	32.09	39,599.8
11 - 12	31.76	40,179.2
12 - 13	31.73	39,281.9
13 - 14	33.94	37,203.7
14 - 15	40.75	35,130.6
15 - 16	45.25	33,418.5
16 - 17	42.91	31,882.2
17 - 18	48.66	31,579.1
18 - 19	66.92	32,828.6
19 - 20	58.89	33,718.6

Index (€/MWh)	Base: 37.44			Peak: 49.97			
	Low (€/MWh)	High (€/MWh)	Last (€/MWh)	Weight. Avg. (€/MWh)	Index (€/MWh)	Buy Vol (MW)	Sell Vol (MW)
► 00 - 01	-5.00	21.75	21.50	10.62	10.62	2,048.3	2,051.5
► 01 - 02	-4.50	22.00	20.00	12.59	12.59	1,896.7	1,896.7
► 02 - 03	0.00	16.50	15.95	10.83	10.83	1,920.3	1,920.3
► 03 - 04	0.00	20.00	12.75	11.87	11.87	1,322.7	1,277.7
► 04 - 05	0.10	17.00	17.00	13.91	13.91	1,309.9	1,171.3
► 05 - 06	4.10	28.50	20.50	18.80	18.80	1,258.6	1,261.8
► 06 - 07	15.00	44.00	37.00	33.61	33.61	1,050.9	1,053.9
► 07 - 08	29.00	41.50	35.00	36.72	36.72	1,135.1	1,138.9
► 08 - 09	25.00	42.50	38.00	34.52	34.52	1,737.5	1,740.7
► 09 - 10	20.01	43.50	29.75	30.02	30.02	1,966.5	1,969.9
► 10 - 11	17.00	42.75	17.00	25.90	25.90	3,150.7	3,154.2
► 11 - 12	21.00	43.25	24.00	27.00	27.00	3,561.3	3,564.5
► 12 - 13	24.50	43.00	43.00	33.02	33.02	3,561.7	3,564.9
► 13 - 14	25.00	114.00	95.00	52.21	52.21	3,873.4	3,828.2
► 14 - 15	28.00	137.00	135.00	67.70	67.70	5,222.3	4,411.1
► 15 - 16	35.25	128.50	84.10	71.22	71.22	5,711.7	4,604.1
► 16 - 17	38.00	95.00	78.10	63.78	63.78	6,061.9	5,635.8
► 17 - 18	43.66	79.00	55.00	62.40	62.40	4,085.1	4,050.3
► 18 - 19	59.00	99.00	99.00	72.36	72.36	2,492.8	3,093.4
► 19 - 20	48.70	90.00	90.00	59.53	59.53	2,776.9	3,403.2
► 20 - 21	41.02	85.00	81.00	57.23	57.23	2,940.7	3,256.8
► 21 - 22	27.00	54.00	34.10	39.65	39.65	2,260.7	2,926.1
► 22 - 23	6.40	38.50	29.40	27.48	27.48	2,623.6	2,623.6
► 23 - 24	16.50	35.00	28.95	25.51	25.51	3,541.6	3,545.0

D-A prices

I-D prices

CORRECTIONS OF THE CLOSED PERIODS

00:00

01:04

04:42

06:14

ACT PRIO	Traded	IBS to P	Deal Vol (MW)	Price (€/MWh)	CP	Account PIC	Flag	10 min	Paration	Period
-239.0	188.2		130.5	214.1	47			75.6	68.8	47
-279.0	265.5		198.0	191.1	46			42.6	42.8	46
-148.0	184.0		134.0	226.6	1			84.0	71.0	1
-270.0	0.4		44.2	561.1	2			133.0	89.4	2
-71.4	132.2		271.4	361.3	3			186.6	98.2	3
-1.6	132.2		251.4	361.3	4			129.4	136.8	4
-1.6	189.7		241.8	361.3	5			261.2	179.2	5
-8.6	189.7		241.8	361.3	6			18.4	224.4	6
-13.6	197.7		251.4	361.3	8			219.4	210.4	8
1.4	211.2		255.4	216.2	9			228.4	216.4	9
6.4	224.1		252.4	178.2	10			221.4	219.4	10
18.4	255.2		256.4	262.2	11			213.4	224.4	11
14.4	242.9		271.4	361.3	12			6.4	255.5	12
19.0	239.5		270.0	281.2	13			11.6	269.6	13
25.4	252.4		252.4	288.2	14			23.4	276.3	14
39.6	131.1		181.4	219.2	15			136.4	144.6	15
88.6	134.9		184.4	234.2	16			137.4	128.4	16
82.6	126.7		182.4	234.2	17			142.4	133.4	17
78.6	148.1		174.4	289.3	17			159.2	110.2	18
72.6	183.4		196.4	289.3	19			196.4	186.4	19
86.6	230.9		249.4	219.4	20			249.4	219.4	20
84.6	259.4		262.4	219.4	21			262.4	214.4	21
88.6	259.4		261.4	212.4	23			261.4	212.4	23
84.6	259.4		256.4	216.4	24			256.4	216.4	24
84.6	259.4		255.4	216.4	25			255.4	216.4	25
82.6	259.4		253.4	216.4	26			253.4	216.4	26
82.6	259.4		251.4	212.4	27			251.4	212.4	27
82.6	259.4		247.4	219.4	28			247.4	219.4	28
82.6	259.4		243.4	214.4	29			243.4	214.4	29
82.6	259.4		223.4	214.4	30			223.4	214.4	30
121.6	151.4		165.4	158.0	31			165.4	158.0	31
121.6	151.4		151.7	142.2	32			151.7	142.2	32
121.6	151.4		94.0	87.3	33			94.0	87.3	33
121.6	151.4		85.0	81.8	34			85.0	81.8	34
121.6	151.4		76.0	69.9	36			76.0	69.9	36
121.6	151.4		71.0	64.8	37			71.0	64.8	37
121.6	151.4		71.0	62.9	38			71.0	62.9	38
121.6	151.4		41.0	39.9	39			41.0	39.9	39
121.6	151.4		41.0	37.9	41			41.0	37.9	41
121.6	151.4		41.0	35.9	42			41.0	35.9	42
121.6	151.4		41.0	33.9	43			41.0	33.9	43
121.6	151.4		44.0	31.8	44			44.0	31.8	44
121.6	151.4		41.0	29.8	45			41.0	29.8	45
121.6	151.4		18.0	29.8	46			18.0	29.8	46

00:00 01:04

64,0 MW → 134 MW

0,4 MW → 69,4 MW

233,8 MW → 90,2 MW

- 143,6 MW for period 3

04:42 6:14

111,1 MW → 115 MW

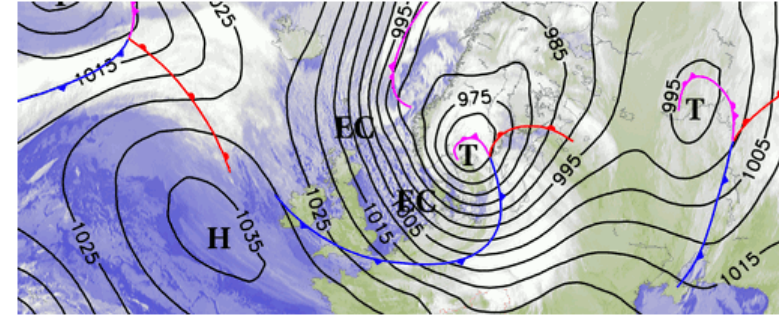
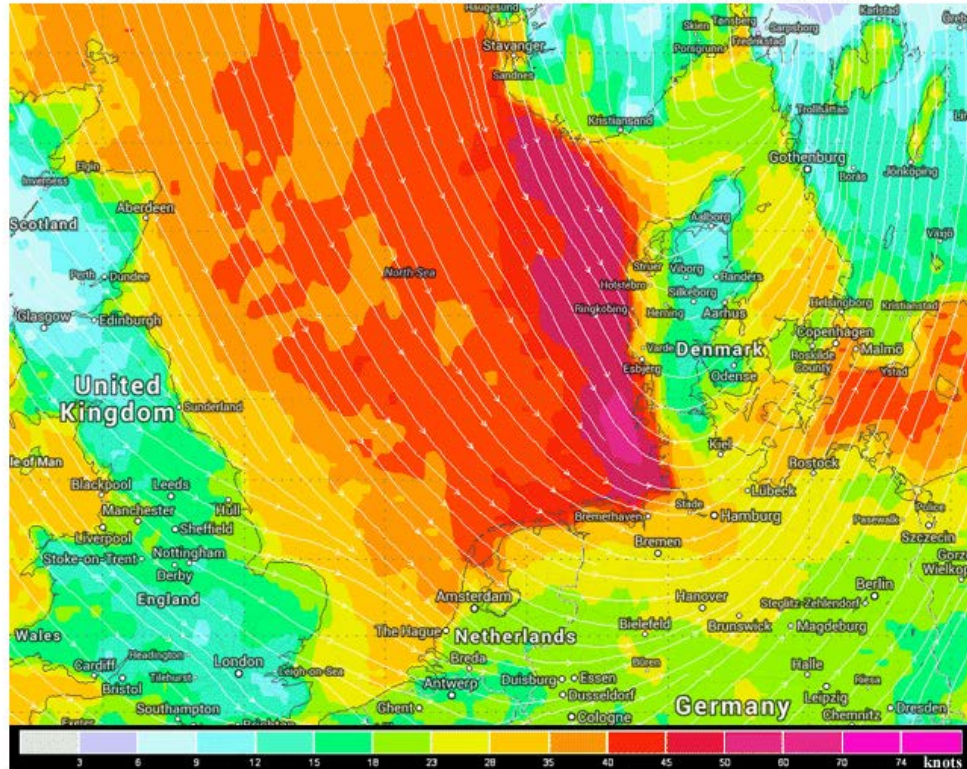
83,9 MW → 82,4 MW

121,0 MW → 2,3 MW

- 118,7 MW for period 11

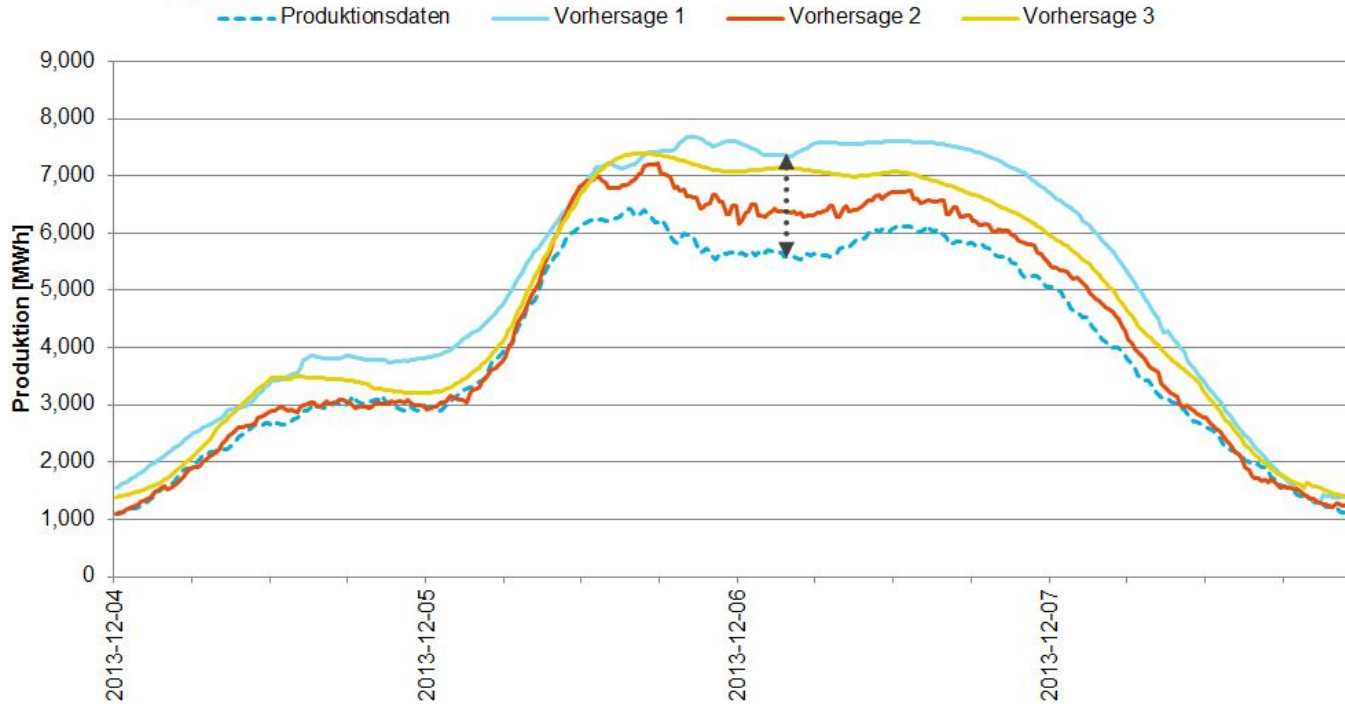
Extreme weather situations: Windstorm Xaver

ECMWF Wind Forecast Valid 18 UTC Thursday December 5, 2013



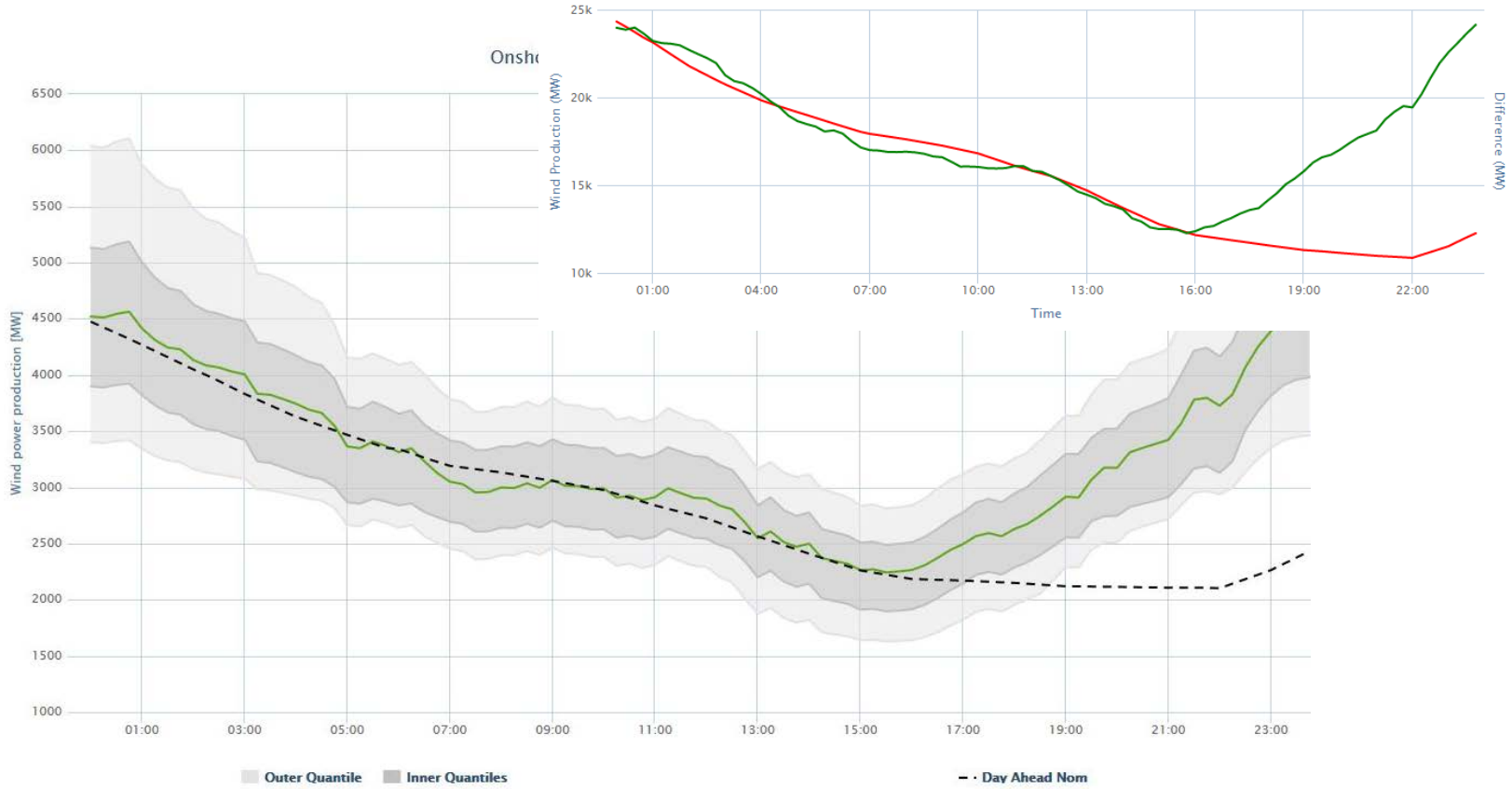
Extreme weather situations

Storm „Xaver“



2015-12-25 Portfolio Forecast

Wind Forecasts



2015-12-25 Prices

i: Average Intraday. 5 Days to the past and past 5 weeks of current day.

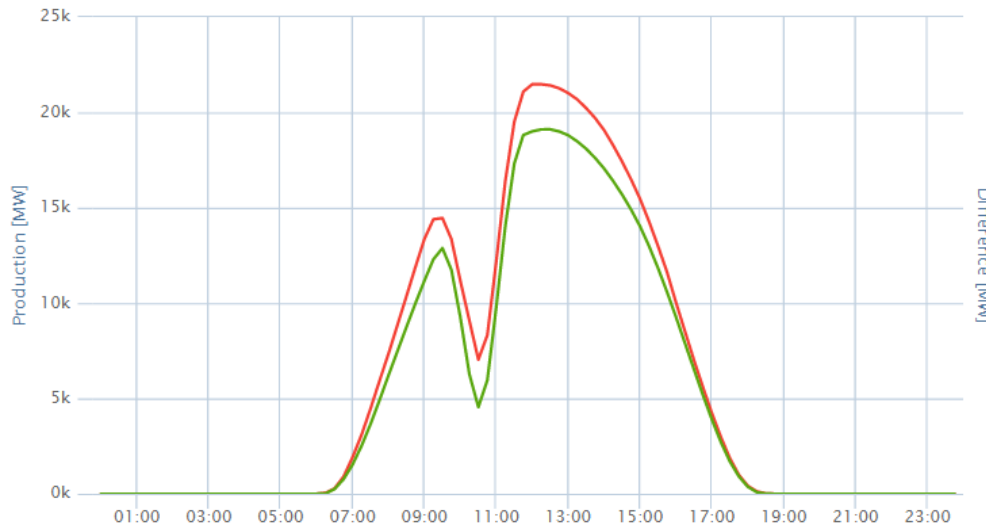
Intraday lower than Spot

traday higher than Spot

Time ▲	2015-11-20	2015-11-27	2015-12-04	2015-12-11	2015-12-18	2015-12-21	2015-12-22	2015-12-23	2015-12-24	2015-12-25
00:00	-1.6	1.1	-6.1	-8.7	-2.2	0.1	55.8	2.3	5.3	2.3
01:00	-3.6	0.7	-4	-6	1.4	-2.6	58	7.5	1.9	3.5
02:00	-1.2	0.8	0.6	-9.8	2.3	-0.2	66.6	6.6	2.3	1.6
03:00	1.1	1.6	0.3	-11.6	6.5	1.4	32.4	-5.5	3.9	3.6
04:00	8.3	-0.3	4.5	-8.7	7.7	0.2	24.3	-2.6	1.1	4.6
05:00	1.7	-1.8	6.5	-6.7	5.9	0.6	30.7	3.4	0.8	-1.1
06:00	4.4	-0.7	7.3	-8.4	4.3	1.9	0.6	3.4	3.3	-8.3
07:00	2.9	2	8.4	1.6	4.1	-1.3	-0.8	1.8	10.7	-0.3
08:00	4.3	3.4	4.9	9	1.9	-1	2.8	5.7	11.7	-12.2
09:00	-1.1	1.4	2.9	8.8	1.4	1.8	4.7	8.3	13.1	-15.4
10:00	-2.1	1.7	3.9	5.7	6.2	1.8	5.9	5.8	15.9	-8.3
11:00	-1.9	2	-4.3	3.8	4.8	2.8	9.2	3.4	12.6	-7.3
12:00	-1.2	-2.2	-0.7	1.7	3.2	9.8	11.9	6.3	10.5	-5.5
13:00	-1.6	0.6	0.9	2.2	0.6	6.3	6.4	5.8	5.7	-0.2
14:00	-9.3	1.6	5.3	1.3	1.1	7.3	5.1	2.8	2.4	2.3
15:00	-8	0.8	7	2.8	0.7	7	3.1	-1.5	1.9	-0.4
16:00	-3.9	-1.8	5.6	5.5	3.9	4.6	0.3	-5	3	-2.8
17:00	-5.7	-4.4	9.8	6.3	4.9	4.4	-1.6	-10.7	8	5.9
18:00	-2.5	-5.8	9	2.1	4.5	8.3	-1.5	-15.8	6.8	14.6
19:00	-4.5	-4.4	11.6	1	4.1	6	-1.8	-10.5	12.6	19.8
20:00	-0.6	-7	6.5	-1	-0.6	11.6	3.9	-1.5	42.8	28
21:00	1.9	-5.9	4.3	1.5	-0.7	14.3	9.1	-0.4	53.6	23.5
22:00	-2.2	-8.5	3.9	2.8	-2.6	13.8	0.8	-0.3	30.8	29.6
23:00	-5.2	-13.7	-6.5	3.8	-5	43.7	1	-2.5	18.5	32.7

EEG Solar

Germany Solar @ 2015-03-20



▶ Gradients

- First drop 7.5 GW
- Second increase 14 GW
- -2.7 GW per $\frac{1}{4}$ hour
- +4.3 GW per $\frac{1}{4}$ hour

▶ Dayahead $\frac{1}{4}$ -hourly auction

- High: 464.37 €/MWh Low: -164.48 €/MWh

▶ Intraday prices

- 9Q4: High 100 €/MWh, Low -975 €/MWh
- 10Q1: High 950 €/MWh, Low -130 €/MWh



THANK YOU



Statkraft
REN ENERGI

www.statkraft.no