

Wind Power in Denmark, Germany, Ireland, Great Britain, France, Spain and Belgium

Statistical Survey 2013

Short version

Preface

This text supplements *Wind Power and Spot Prices: German and Danish Experience 2006-2008*¹ and Statistical Surveys 2009 to 2012 by adding data for the calendar year 2013.

The evaluations are based on data published by Energinet.dk, by the four German transmission system operators, by Eirgrid and by Elexon Portal. French data has been extracted from the eCO2mix/RTE web site by Hubert Flocard who also extracted Spanish and Belgian wind power time series. Furthermore data from Norwegian Water Resources and Energy Directorate², Statnett³ and Nord Pool Spot⁴ has been used. Evaluations are offered, though with reservations regarding the accuracy of the data.

A selection of the hourly time series used for the statistical analyses in this text is available at <http://pfbach.dk/>.

Abbreviations:

EEX	European Energy Exchange	DKE	Denmark East	DE	Germany
NP	Nord Pool	N	Norway	ENDK	Energinet.dk
DKW	Denmark West	S	Sweden	IE	Ireland
GB	Great Britain	F	France	E	Spain
B	Belgium				

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¹ <http://www.ref.org.uk/publications/148-spot-price-study-in-germany-and-denmark->

² <http://nve.no/>

³ <http://www.statnett.no/>

⁴ <http://www.nordpoolspot.com/>

1. Overview

European perspectives

- The electricity production in 2013 was 133 TWh in Norway and 148 TWh in Sweden. It was 27 TWh less for the two countries together than in 2012. The total content of the hydro storages in Norway, Sweden and Finland was at the same level at the end of 2013 as one year before.
- The total export from Norway and Sweden to the Netherlands, Denmark, Germany and Poland was 2.2 TWh against 22.9 TWh in 2012.
- The interconnectors between Scandinavia and the Continent were correspondingly relieved.
- The German net export in 2013 was 11 TWh higher than in 2012. In Germany there were strained grids and curtailments of renewable power again in 2013.

Net exchanges 2013			
Exporters	TWh	Importers	TWh
France	50.1	Italy	42.3
Germany	37.4	The Netherlands	18.4
Czech Rep.	16.9	Finland	15.2
Sweden	9.5	Great Britain	13.2
Russia	7.0	Hungary	11.8

Source: ENTSO-E

Spot market results

2013	Average area prices	Spot prices <= 0	Standard deviation
	€/MWh	No of hours	€/MWh
West Denmark (DKW)	38,91	40	47,04
East Denmark (DKE)	39,54	30	12,12
Nord Pool system price	38,02	0	6,95
EEX, Germany	37,71	65	16,46

- 2013 was characterized by small differences between Nordic and German average spot prices and lower exchange of energy than in the previous years.
- The German EEX price is slightly lower than the Nordic spot prices. This unusual distribution reflects the increasing German surplus of electricity.
- The observations for 2013 confirm that spot prices in Germany and Denmark are closely related.
- Nord Pool allowed negative spot prices in Denmark from October 2009. In 2013 most of the negative spot prices occurred simultaneously in Denmark and Germany.

Wind power performance

2013		Denmark	Germany	Ireland	Great Britain	France	Spain	Belgium	
Wind	GWh	11.124	47.181	4.642	18.619	15.793	54.034	3.063	
	Max	MW	4.304	26.023	1.763	6.061	16.819	1.338	
	Min	MW	2	128	3	25	150	2	
	Load factor		0.30	0.21	0.30	0.35	0.28	0.37	0.26
	Estimated share of load		33.2%	7.9%	18.0%	6.0%	3.2%	20.7%	3.8%

- The average capacity factors in Denmark were 0.23 onshore and 0.41 offshore⁵. The corresponding duration hours were 2,024 hours onshore and 3,574 hours offshore.

⁵ The capacity factor is based on **installed capacity** for wind turbines operating throughout the year. The load factor is based on the **maximum total production** for wind turbines in a country.

- Strong wind power correlations are found between France and Belgium, between Denmark and Germany and between Ireland and Great Britain. Weak correlations are found between Spain and Ireland and between Spain and Denmark.

Correlation coefficients	2013	Belgium	Spain	France	Great Britain	Ireland	Germany
Hourly wind power	Denmark	0,329	0,115	0,265	0,385	0,198	0,658
	Germany	0,584	0,121	0,488	0,465	0,260	
	Ireland	0,314	0,039	0,275	0,645		
	Great Britain	0,616	0,150	0,458			
	France	0,746	0,299				
	Spain	0,121					

- For each of the 7 countries the recorded minimum wind power output in one hour was between 0.0% and 0.9%. For 24 consecutive hours the minimum average wind power output for each country in 2013 was between 0.57% and 2.71%.
- International aggregation of wind power cannot create a smooth total output, not even for all 7 countries together. The minimum average wind power output for 7 countries during 24 consecutive hours in 2013 was 5.2% of the hourly maximum.

Interconnector performance

2013	Max capacity MW				Trading availability			
	To DKW	From DKW	To DKE	From DKE	To DKW	From DKW	To DKE	From DKE
Norway	1.000	1.000			83,4	87,1		
Sweden	680	740	1.300	1.700	83,1	66,8	86,2	71,5
Germany	1.500	1.780	600	585	60,0	35,8	94,6	94,6
DKW			590	600			89,7	88,9

- The trading capacity across a border can be reduced due to technical faults at the interconnector or due to operational limits in the interconnected AC networks.
- The average trading availability for all Danish interconnectors for the years 2006-2013 is 82% which is well below typical planning assumptions for interconnectors.

	→	←	Total	Net
2013	GWh	GWh	GWh	GWh
DKW-N	2,841	2,553	5,394	288
DKW-S	1,689	927	2,616	762
DKW-DE	2,037	3,124	5,161	-1,087
DKE-S	2,451	2,211	4,662	240
DKE-DE	1,214	2,497	3,711	-1,283
DKW-DKE	2,716	106	2,822	2,610

- Operational limitations and wind power variations seem to be equal important as reasons for congestions and market problems.
- For Great Britain the main exchange direction in 2013 was from the Continent to Great Britain and from Great Britain to Ireland
- Hourly time series with physical exchanges between countries have been found only for Denmark and Great Britain. Other European exchange data seem to be commercial exchanges.

GWh	Import	Export	Net import
EW	60	2,221	-2,162
IFA	10,922	519	10,403
Moyle	7	1,560	-1,553
BritNed	6,444	114	6,330
Total	17,432	4,413	13,019