2016: Less Wind Energy and Higher Spot Prices

A year of broken trends

Some characteristics of Danish electricity supply in 2016:

- The energy content of wind was 91% (113% in 2015) (source: vindstat.dk)
- The wind energy production was 38% of electricity consumption (42% in 2015)
- Increasing thermal production for the first time since 2010
- Increasing average prices in the spot markets

Trends 2010 to 2016

	Volumes in GWh						
	Demand	Thermal/CHP[1]		Renewables		Exchange	
		Central	Local	Wind	Solar	Export	Import
2010	35.519	21.202	7.609	7.808	-	4.229	3.094
2011	34.561	16.980	6.511	9.751	-	3.224	4.543
2012	34.135	13.419	5.233	10.268	-	1.620	6.835
2013	33.529	16.518	4.802	11.126	-	2.967	4.048
2014	33.471	12.976	3.966	13.076	596	2.661	5.518
2015	33.535	9.206	3.687	14.127	604	1.908	7.819
2016	33.973	11.154	4.248	12.771	744	1.942	6.998

Table 1 - Denmark 2016 - Electricity volumes in GWh

	Market values in €/MWh						
	Demand	Thermal/CHP		Renewables		Exchange	
		Central	Local	Wind	Solar	Export	Import
2010	53,46	54,92	54,16	47,42	-	51,02	47,84
2011	50,35	52,15	52,32	45,42	-	48,17	49,00
2012	38,98	41,10	41,99	32,94	-	32,01	39,24
2013	40,56	41,13	43,16	33,79	-	30,90	45,35
2014	32,21	33,05	33,67	27,64	33,76	24,80	35,15
2015	24,75	27,99	26,77	19,99	25,30	17.91	25.98
2016	28.65	30.00	30.18	24,55	28.47	20.02	30.70

Table 2 - Denmark 2016 - Spot market values of electricity in €/MWh

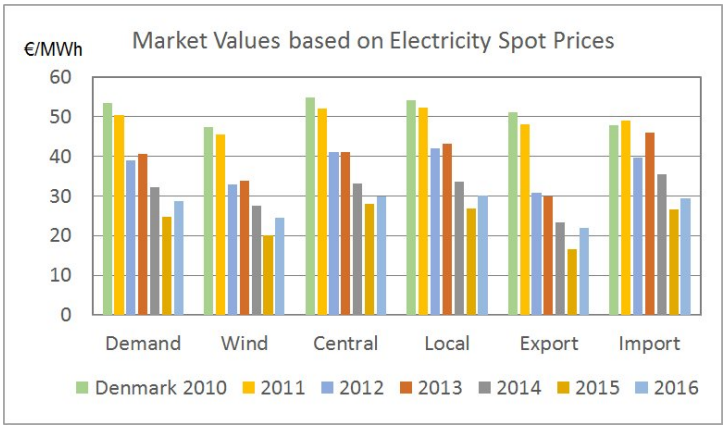

Figure 1 - Annual market values 2010 to 2016

Average market values in 2016 in percent of the demand value:

Import	107%
Local CHP	105%
Large CHP	105%
Solar	99%
Wind	86%
Export	70%

The low export prices should encourage the development of local utilizations of overflow electricity.

[1] CHP: Combined Heat and Power

The changes from 2015 to 2016 are probably not signs of a new long-term trend. The growth of wind power and the decline of thermal power will continue.

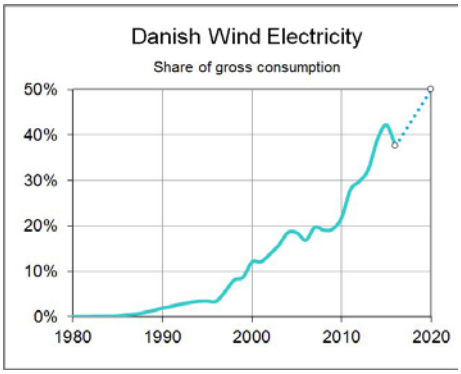

Figure 2 - 2016 was a poor wind year

The surprising result of the 2016 data is that it seems to confirm the interrelation between wind energy and wholesale prices. *Increasing wind power means decreasing wholesale prices.*

The implied condition is a parallel similar development in Germany, which is quite likely.

Therefore, it is still quite interesting to follow if the wholesale prices will continue their decline in the next few years or if they will find a stable level.

Monthly characteristics 2016

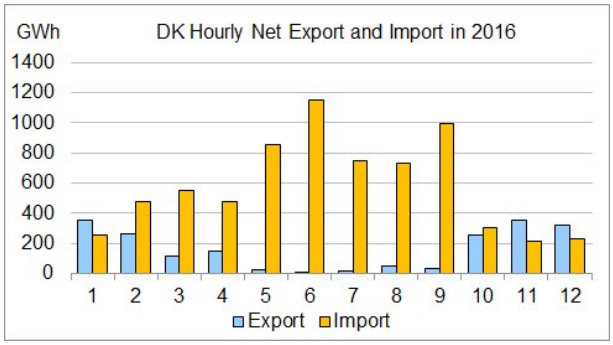

Figure 4 - Average hourly exchanges per month in 2016

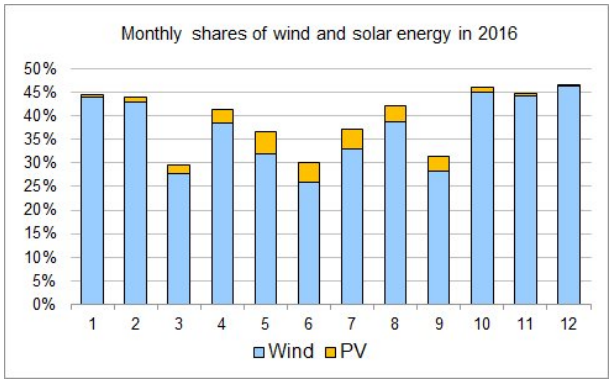

Figure 3 - Wind and solar energy as percentage of consumption in 2016

A few years ago, the typical pattern was winter export and summer import. Now, the pattern has changed to import dominance.

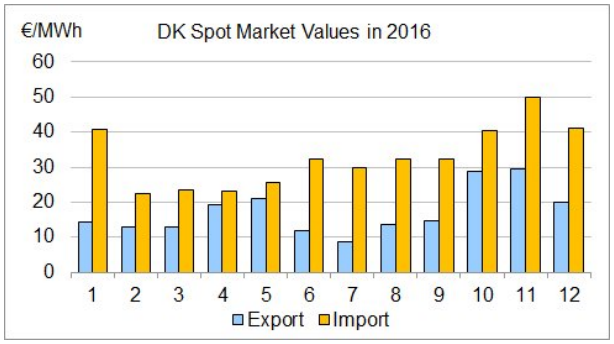

Figure 5 - Market values of exchanges per month in 2016

Contrasts in December 2016

December 2016 had periods with low wind and high wind, not only in Denmark but also in Germany. There has been some debate about the risk of low wind for several days and for a larger area. Therefore, this section presents hourly data for Germany and Denmark for December 2016.

Figure 6 shows:

- Wind power contributed only little to the electricity supply in both countries from 12th to 20th December.
- The storm "Urd"[2] affected the power systems in both countries during the Christmas days.
- Danish spot prices are less volatile than German spot prices due to influence from the other Nordic power systems.
- Danish spot prices were dragged down to negative German levels during the storm "Urd".

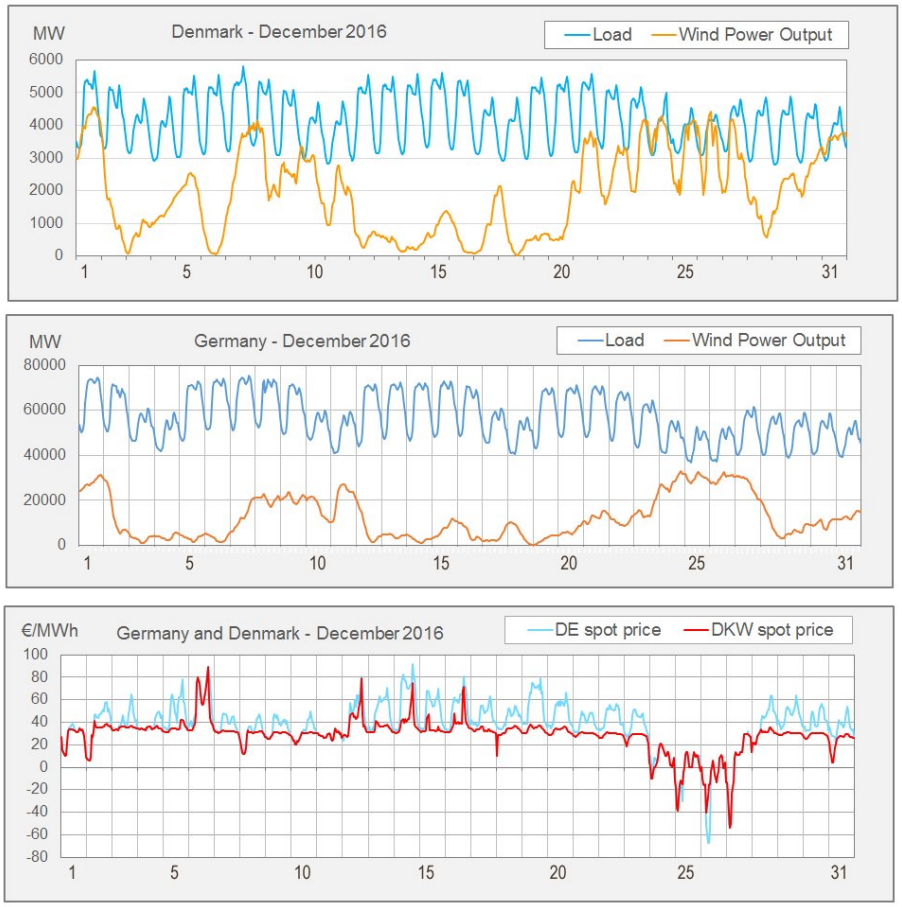

Figure 6 - German and Danish power systems in December 2016

Curtailments of wind power during the storm "Urd" occurred in Denmark and probably also in Germany.

For maintaining normal supply quality, backup capacity for maximum "classical" demand will be needed.

The wholesale prices will probably be even more volatile in the future, unless sufficient flexible electricity demand can be developed and implemented.

[2] Urd is the name of a norn (female being who rules the destiny of gods and men) in the Nordic mythology
http://pfbach.dk/firma_pfb/references/pfb_wind_peak_2016_12_27.pdf and
http://pfbach.dk/firma_pfb/references/pfb_bottlenecks_during_storm_urd_2017_01_07.pdf