European Wind Integration Study (EWIS)

EWIS Final Report - A Remarkable Progress

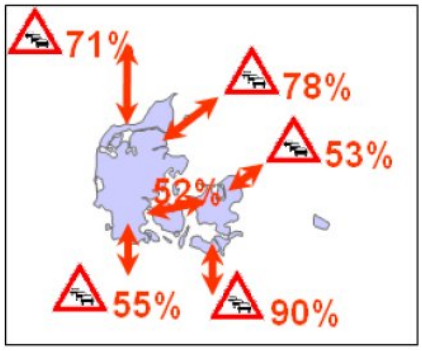
After 36 months working period EWIS has published its report on integration of wind power in 2015. The study has been supported by EU and hosted by ENTSO-E (European Network of Transmission System Operators for Electricity). This work is comprehensive and path-breaking:

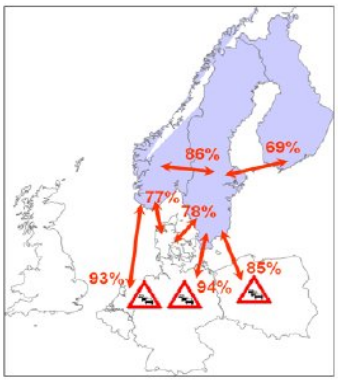
- It includes nearly 30 European countries
- The *EWIS market model* calculates flows across borders for an entire year
- The market model results were used for selection of points-in-time snapshots for closer analyses
- The *EWIS network model* was used for the analysis of steady state power flow in the European grid for the selected snapshots
- The system security was evaluated by transient stability analyses

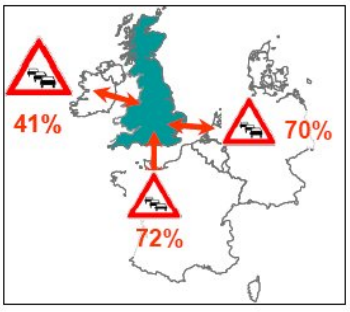
Different wind development scenarios for 2015 have been considered:
- *Reference:* Wind generation capacity across Europe at about 70 GW (2008 level)
- *Best estimate (BE):* About 140 GW across Europe
- *Optimistic wind (OW):* About 185 GW across Europe

Essential results

Congestion:
According to the market model simulations the interconnections will be congested a considerable part of the year in 2015. The following excellent charts refer to best estimate wind and expected grid reinforcements:







For each interconnector the congestion is defined as the number of hours with congestion divided by the total number of hours.

Observations from the period 2006 to 2009 have demonstrated that the available transfer capability of each interconnector is considerably below the nominal capacity due to outages of equipment and security restrictions. It is not clear to which degree these limitations have been considered in the EWIS study.

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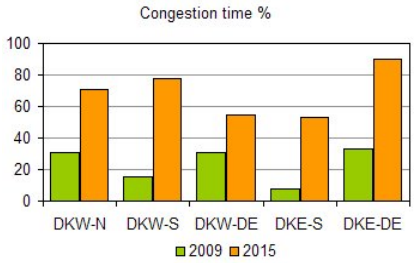
23 May 2010

The simulated results can be compared with observations from 2009:

Hours	Export	Congest.	Import	Congest.	Total	% congest.	Simulated %
						2009	2015
DKW-N	2725	11	5989	2625	8760	30,1	71
DKW-S	5925	927	2604	214	8760	13,0	78
DKW-DE	5806	2351	2952	353	8760	30,9	55
DKE-S	3085	32	5674	673	8760	8,0	53
DKE-DE	3595	1067	4696	1391	8760	28,1	90

The results demonstrate that congestion time is expected to increase considerably within a few years.



The report does not discuss impact on market prices, but an increased price volatility will be a most likely consequence. It is a question if the market participants can be properly served by 2015.

Power flow:
Snapshots with low demand and high wind power output were selected for point in time analyses because they are particularly challenging. The results show lines with critical load and loop flows in the central parts of Europe.

Particularly at the German-Polish border there is a risk that the cross border flow can exceed security limits. Without appropriate technical measures the trading capacities must be substantially reduced.

System security:
The statements do not seem to be very clear. Quotation from the executive summary: *To exploit improved dynamic line ratings, EWIS has found that improvements in stability performance may be required (for example by improving the speed of protection operation and by enhancing system voltage profiles). Even with such improvements stability may remain a limit to power transfer capability such that it will need ongoing assessment, especially as power transfers are increased on existing lines.*

The fault in figure 4-15 is supposed to cause disconnection of 2,600 MW wind power. The fault will be very challenging to the west Danish power system and is therefore of particular interest.

The voltage at Dollern (a few km to the west of Krümmel) is supposed to be 40% for 150ms. The fault-ride-through capability of the fleet of wind power

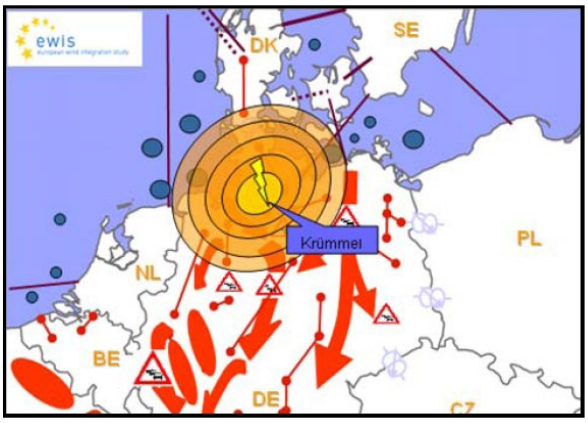


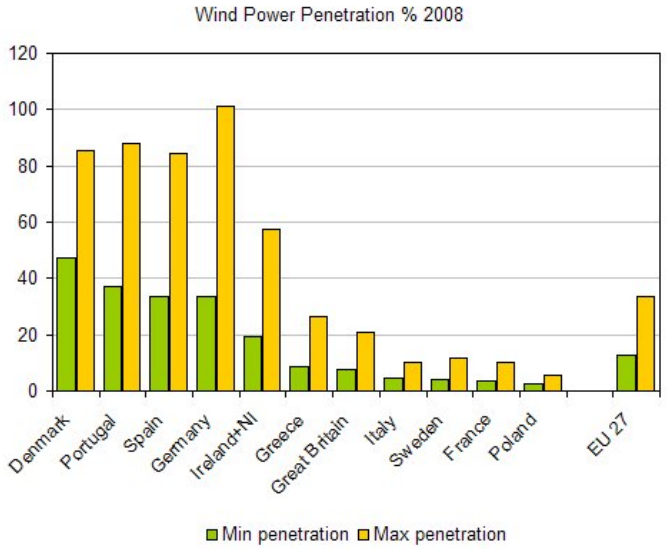
Figure 4-15:.Voltage dip during a three phase short circuit in the German grid

plants will be decisive to the stability of the entire system.

Missing quantification of wind energy penetration

The EWIS report presents results of comprehensive calculations but very little data has been published in the report.

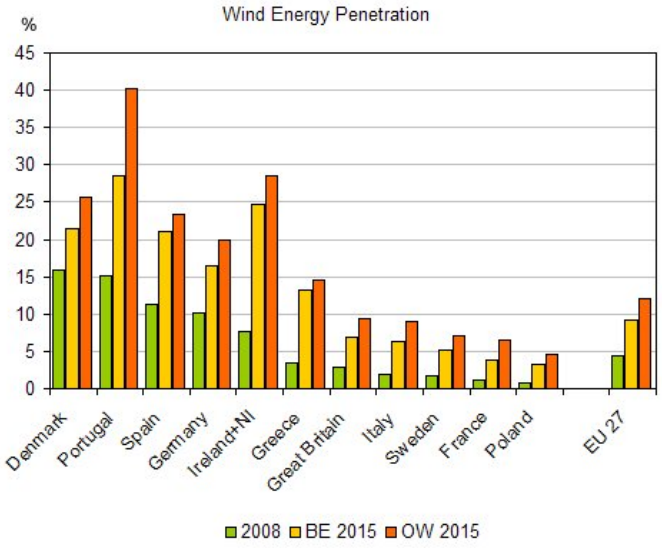
The minimum and maximum wind power penetrations are presented as installed wind power capacity as percent of peak demand and minimum demand. The wind power penetration chart is based on data for selected countries from table 2.1 and fig. 2.1 in the EWIS-report.



The capacity penetrations give an important impression of the magnitude of the operational challenges caused by wind power. In Germany the installed wind power in 2008 exceeded the minimum load giving a maximum penetration at 101%.

However, **energy** penetration is also interesting, because it is an indicator of the environmental effect of the wind power expansion. Data from other sources than the EWIS-report was necessary in order to compile the next chart.

The wind energy estimates are based on a common capacity factor, 0.25. This is the capacity factor observed in Denmark in 2009. Better estimates are desirable, but so far not available.



The energy penetration in 2015 will vary a lot between countries. For Europe as a whole the wind energy penetration in 2015 is estimated at 9% for best estimate wind and at 12% for optimistic wind estimate. The figures indicate a modest ambition on the future European share of renewables.

I think that this is useful information. EWIS has suggested grid reinforcements, improved system control and harmonized market arrangements in order to meet the challenges identified for 2015. They are important measures, but not necessarily sufficient, and for further increased wind energy penetrations other measures with direct participation of end-users of energy should be anticipated.

The German DENA study 2005

In order to pave the way for an ambitious wind power program the German government commissioned a comprehensive analysis of grid security and integration cost. The study was coordinated by DENA (Deutsche Energie Agentur). The targets were 12.5% wind energy penetration by 2010 and at least 20% penetration by 2020.

The study was published in February 2005, but without results for 2020. The summary in English says:

> *During the preparation of the study it became clear that within the given framework conditions of the study it would only be possible to draft technical solutions for the integration of renewable energy sources into the existing power system up to a share of approx. 20% in electric power generation (5% offshore-wind, 7.5% onshore-wind, and 7.5% other renewable sources). A further major increase in geographically concentrated offshore wind farms in Northern Germany, as it is planned after 2015, would require a more extensive investigation to develop viable technical solutions.*

Consequently analyses for 2020 were postponed to a later part II of the study and only results of analyses up to 2015 were published. The wind energy penetration in 2015 was supposed to be 15%.

However, in the light of the plans for a joint European wind power integration study the DENA study part II was abandoned and one of the German TSOs, Transpower, undertook the responsibility as coordinator of the EWIS study.

Already the DENA study stressed, that short circuits in Northern Germany might cause disconnection of 3,000 MW wind power in Germany and on the top of that another 1,000 MW in Denmark. Therefore this case should be studied with particular care in Denmark.

A continuation of the EWIS study is urgently needed

A study including all EU countries is a significant step forward. The amount of data and calculations must have been huge.

However, five years after the DENA study results beyond 2015 are still missing. Therefore the need for a continuation of the EWIS study with more ambitious targets for renewable energy is urgent.

Interested readers would welcome tables with some essential basic data such as assumed electricity consumption per country and wind energy output per country in the next EWIS report.