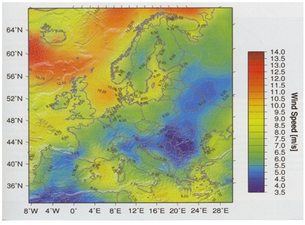
« The O'Dowd paper on aerosols and global warming.
Decline in wind power: the slump in capacity factors. »

The dramatic decline in available wind power

In two previous comments (here and here) I wrote about declining wind power and declining capacity factors of installed wind turbines in Europe and especially in Germany and Ireland. The German Fraunhofer "Institut für Windenenergie und Energiesystemtechnik IWES" has published a very interesting report "Windenergie Report Deutschland 2012" which I recommend for reading to everyone interested in wind energy, be he a 100% fan or a more skeptic individual. Sure, the IWES must be on the side of the wind power pushers, but this report has serious scientific reflections and, if you read it carefully, they do not refrain to put the finger on spots that hurt (click here for an English version).

I intend to write a couple of comments on this report; this first one will exclusively document the dramatic decline in available wind power over Europe during the last 21 years.

1. The potential wind velocities over Europe.



This picture taking from a EEA report shows the mean wind speed over sea and land (I do not know if this a an average over a certain period neither at what height above ground it is measured, so let us take it simply as a rough indicator). Wind power in W/m2 is proportional to the cube of wind speed and to the air density (P = 1/2*density*speed**3), so to convert to W/m2 multiply the cube by 1.25 as the density of air is about 2.5). This gives approx. 1.25*1000 = 1250 W/m2 for offshore locations , and this number must be approximately divided by 3. The main unsurprising result is that offshore potential is much higher that onshore. Onshore potential at 5 m/s is only 5**3/10**3 = 0.5**3 = 1/8 of offshore potential.

2. The year 2012 with respect to the long time mean over 20 years

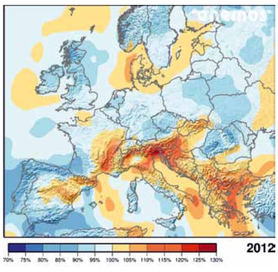
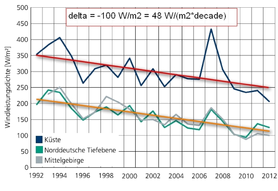


Abbildung 32: Windressourcen 2012 im Verhältnis zum 20-jährigen Mittel, Datenquelle: anemos GmbH

This picture from the report clearly shows that at most locations the 2012 wind potential is considerably lower than the 20 year mean: onshore locations in Germany are about 20% lower than this mean. The blue color describing lower potential is dominant if we neglect the offshore locations at great distances from shorelines.

3. The trend over 21 years for German locations.

The IWES report has another figure, that documents the real dramatic decline for various German wind power locations. I have digitized the curves relative to the coastal ("Küste") and northern plain regions ("Norddeutsche Tiefebene") using the wonderful UNSCAN-IT software, and calculated the linear trends:



This figure (modified fig.34 of the report) shows an eye-opening decline from 1992 to 2012, with the 2007 peak being a real exception. The trend lines have approximately the same slopes: at coastal and plain locations, potential wind power decreased by **~100 W/m2 (-29%)**, which gives a **decrease of roughly -14% per decade (percentages calculated w.r. to the start point of the trend line) !**
This is a very worrying trend for wind power, and one wonders why this trend is mostly ignored in the media and political discussions. The extreme increase in yearly added wind turbines masks this decline of the available resource. But if the installation of new turbines comes to a halt due to saturation, the negative trend (**if it continues...**) could well spell disaster for wind energy production and investors.

PS: The ZHAO et al. paper I referred to in a previous post finds a decline of -2.9% for wind velocity per decade (from 1978 to 2008). This results in approx. -24%/3 = -8% per decade in wind power (the divisor 3 represents very roughly the usual efficiency of wind turbines).

References:

IWES: Windenergie Report Deutschland 2012. (link)

MASSEN F., 2013: Bad wind, lower wind power, exploding costs. (link)

MASSEN F,. 2011: Wind Power (link)

MASSEN F., 2011: Réflexions sur les éoliennes (link)

ZHAO et al: Is Global Strong Wind declining? Advances in Climate Change, 2011.

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