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Onshore wind energy: Potential outstrips need More than one tenth of land surface is in principle suited for wind turbines

There are more possibilities for onshore wind energy in Germany than has been previously assumed. According to assumptions made in a new study by the Federal Environment Agency (UBA) and using state-of-the-art turbines, up to 13.8 per cent of the land surface in Germany could be used for wind energy generation - without causing significant harm to sensitive protected areas or compromising noise protection regulation. In theory, an amount of electricity could be generated on this land surface that is greater than the need for onshore wind energy which was assumed in previous scenarios. What this means: "In principle there is more space available to expand onshore wind energy farms than we actually need, even if the share of onshore wind energy in the renewable energy mix were increased. We need only to tap a small portion of the potential to achieve our climate goals. On a national scale this means a lot of room for manoeuvre in the development of onshore wind energy and for the future renewable energy mix in general," said UBA President Jochen Flasbarth. The study results do not call into question offshore wind energy and continued support for it. However, until the middle of the century some thought will have to be given to what the scale of development of offshore wind energy should be.

The development of wind turbines is crucial to be able to meet all of the demand for electricity with renewable sources of energy. Onshore wind energy is the cheapest form of renewable energy after hydropower. These wind turbines are already producing electricity for an average price of 8 cents per kilowatt hour, which is only slightly higher than the price of electricity produced from coal and natural gas. The installed capacity of onshore wind energy is currently about 30 gigawatts, which is already supplying eight per cent of the electricity in Germany. The Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) was commissioned by UBA to compute the amount of land surface in Germany that is in principle suited for wind energy use. Conclusion: 13.8 per cent of the country's land surface could theoretically be used for wind energy turbines, equal to a capacity of 1200 GW. This amount far outstrips the capacity of wind energy which the UBA assumed in a 2010 scenario to achieve a switch to 100-per cent production of electricity from renewable energy - along with offshore wind energy, photovoltaics, hydropower and geothermal energy. It had claimed that there would be a need for 60 gigawatts of onshore wind energy in 2050.

The calculations in the potential study are based on the following two turbine types: a high-wind system, which has a capacity of 3.4 megawatts with a hub height of 100 metres and a 104-metre rotor diameter. The second system is suited for low-to-medium wind speeds of less than 7.5 metres per second at a hub height of 140 metres, a 114-metre rotor diameter and a capacity of 3.2 megawatts. This modern turbine technology is able to achieve a high national average of about 2,400 hours of full capacity utilisation per year. The current average of all existing wind turbines is 1,700 hours of full capacity utilisation. This technology allows - on condition of public acceptance - a relatively short distance between turbines and housing areas. Legislative and administrative court requirements stipulate a minimum distance of 600 metres for these wind turbines. This would also comply with the noise criteria in effect at night. The greater the distances to settlement areas the lower the calculated land area potential is. If the distance is doubled to 1,200 metres, for example, the potential comes to 3.4 per cent of the land surface in Germany.

The computed land area potential is tied to several complex assumptions. In addition to settlement areas, national parks and other nature reserves were excluded as well as roads, bodies of water and airports. In the surface modelling it was not possible to take account of the land surfaces that are required for the protection of individual species. These nature conservation requirements are relevant to especially endangered species which can not be assigned to any concrete protected areas. These areas include the resting sites and breeding grounds of threatened bird species- which may also lie outside of protected areas. To take account of these aspects, local data is needed and must be factored in explicitly in wind farm planning.

In reality, there are more local limitations to the computed potential. "Of course a nation-wide study cannot take into account all of the important aspects - in particular the acceptance by the local population or the economic viability of an actual project", said Flasbarth. Authorisation of a wind turbine is ultimately decided on a case-by-case basis and is a decision which is made on site.

UBA President Jochen Flasbarth warned against an interpretation of the results that suggests onshore wind energy will overshadow other renewable energy technologies. Flasbarth said, "Despite the high onshore wind energy potential, it makes sense and is important to combine it with other renewable sources of energy such as photovoltaic power and offshore wind energy." A number of different studies have shown that renewable energy can only gain a high share in the electricity supply with a suitable technology mix to balance out any fluctuations in electricity production by the different sources of renewable energy. However, the potential study shows that there is room for manoeuvre in the development of onshore wind energy.

Further information and links

Status of wind power in 2012: In 2012, there were approximately 23,000 onshore turbines in Germany with an installed capacity of 31,000 megawatts.

The study entitled *Potenziale der Windenergie an Land - Studie zur Ermittlung des bundesweiten Flächen und Leistungspotentials der Windenergienutzung an Land* is based on calculations done by the Fraunhofer Institute for Wind Energy and Energy System Technology IWES:
<http://www.umweltbundesamt.de/uba-info-medien-e/4467.html>

Dessau-Roßlau, 11 June 2013