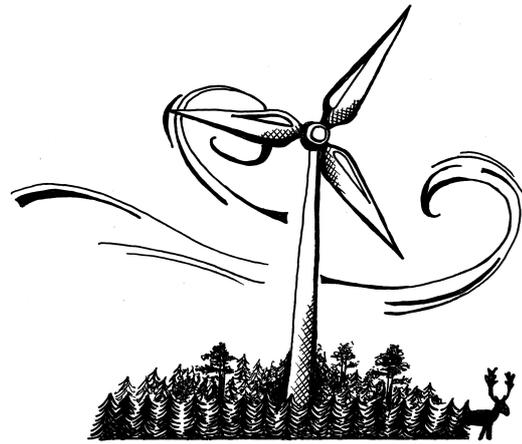


Wind power

in the land of forests

By Ellinor Hultmark

In Sweden, the land of forests, wind power is on the rise. Wind turbines are fuelled by the wind and therefore, it is necessary to investigate how forests affect the wind above them.



We need to rely more and more on renewable energy resources in order for our life-style to be sustainable. This includes power production through solar and wind power. Therefore, the Swedish parliament decided in 2009 that we need to build both more land-based and more sea-based wind power. In Sweden, 69% of the land area is covered in forest. It is not hard to guess that we will find some of those white towers sticking up above the tree tops.

The wind is strongly affected by the features of the ground. The closer to the ground you are, the lower the wind speed. This is caused by the friction against the ground. So, when the ground is rough the difference in wind speed between two heights is larger. Imagine the difference between ice-skating on ice and ice-skating on pavement. It is off course a lot harder on the pavement. Therefore, when the ground is covered in forest it will have quite a large influence on the features of the wind.

What also affects the wind is the temperature in the atmosphere and how this decrease with altitude. On a sunny day, the ground will heat the air, the air will rise and this will make the air unstable. Under these unstable conditions, the turbulence will be strong. During the night, the ground will cool the air and the opposite will occur – the air will settle and the turbulence will be weaker. This is when stable conditions arise.

Neutral conditions are a no man's land, when the air is not affected by how the temperature decrease with altitude. This often occurs during a cloudy day.

With these different conditions and the surface of the Earth affecting the wind, one might wonder what favourable wind conditions for wind power are. Well, that is a complex thing to answer. Both turbulence and large difference in wind speed with height put strain on a wind turbine's internal parts. So, actually neither is favourable, but in reasonable amounts – a wind turbine is designed to handle it.

This study has investigated just how much the wind is affected by the forest. This has been done both by looking at meteorological measurements collected above a forest in Sweden, but also by simulating the wind using a numerical method. Simulating the wind proved to be a great asset, when trying to understand what happened to the wind above a forest.

The results from the study are striking, but may be not unexpected. The forest both increase turbulence and the difference in wind speed with height. With unstable conditions on top of that, the turbulence is even stronger. In stable conditions, the difference in wind speed with height is even greater. Conditions where the design criteria for the strongest wind turbines were exceeded, almost always happened.

But we need to build wind power and we need to build it here – in the land of forests. So, even though forests pose as a challenging task when designing wind turbines, we now know what we are up against.