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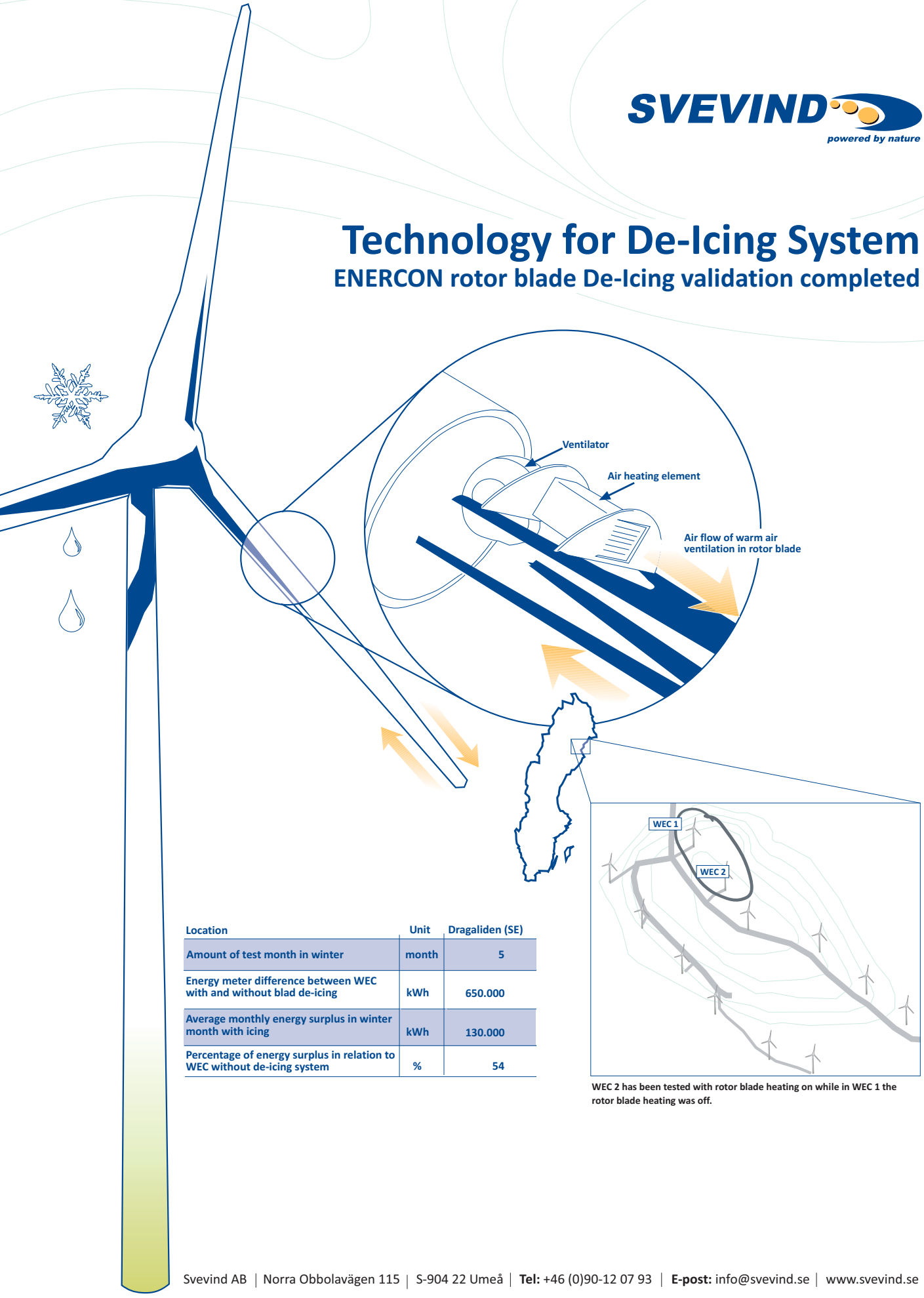
Technology for De-Icing System

ENERCON rotor blade De-Icing validation completed



Location	Unit	Dragaliden (SE)
Amount of test month in winter	month	5
Energy meter difference between WEC with and without blad de-icing	kWh	650.000
Average monthly energy surplus in winter month with icing	kWh	130.000
Percentage of energy surplus in relation to WEC without de-icing system	%	54

WEC 2 has been tested with rotor blade heating on while in WEC 1 the rotor blade heating was off.

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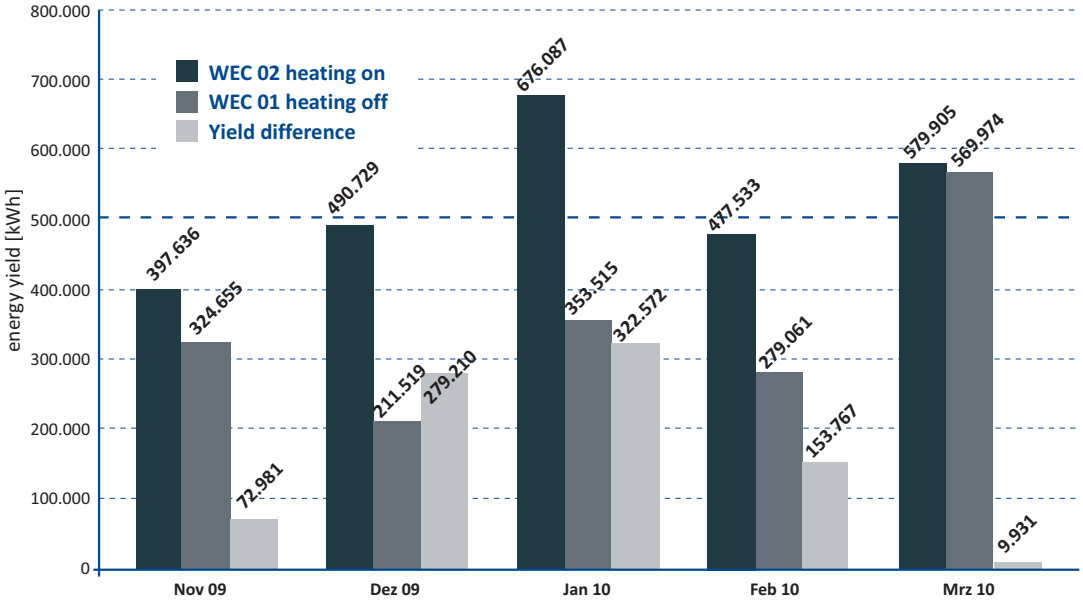
State-of-the-art technology for rotor blade de-icing system

Result from the testing shows that WEC with de-icing system gives 54% more energy than without.



Difference in yield per month between heated and unheated WEC E-82 2MW at location in Dragaliden.

When icing occurs, wind turbines are expected to automatically detect this and react accordingly. At most sites, the machines are usually shut down to prevent ice throw. However, this means a considerable loss in revenue for turbine owners. Consequently, to reduce these losses, Enercon has designed a highly efficient de-icing system which has been tested during a winter season in the north of Sweden.

The testing site is Dragaliden, about 60 kilometers outside the city Piteå in the north of Sweden. In the end of 2008 Svevind AB projected and raised 2 E-82 wind turbines. 1 ½ years later there are 10 more wind turbines in that area producing electricity. All 12 turbines are equipped with Enercons de-icing system and during the winter 2009/2010 this system was tested. The objective with testing the de-icing system was to make it more effective due to the input energy in the heating elements and also to determine just how efficient the system is compared to the absence of it.

Icing conditions in Dragaliden and its surrounding is harsh. The climate is very cold and at the same time windy. Dragaliden is situated about 125 kilometers south of the arctic polar circle and due to that it is very dark in the winter time. There are very few days when the sun could melt the built up ice on the turbine blades.

Ice detection works by comparing WEC-specific power curves for the respective site. Ice that builds up on the rotor blades changes the WEC's aerodynamic profile meaning that whith the extra weight on the rotor blades power output drops and the curve no longer corresponds to the optimized profile for maximum yield. Thus the power curve registered by SCADA (the monitoring system) is below the "normal" curve for respective WEC. The wind turbine's control system then activates the rotor blade heating system which warms the blades to temperatures well over 4^{o}C. Any ice and snow crystals on the blades immediately turn to water and drip of.

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