



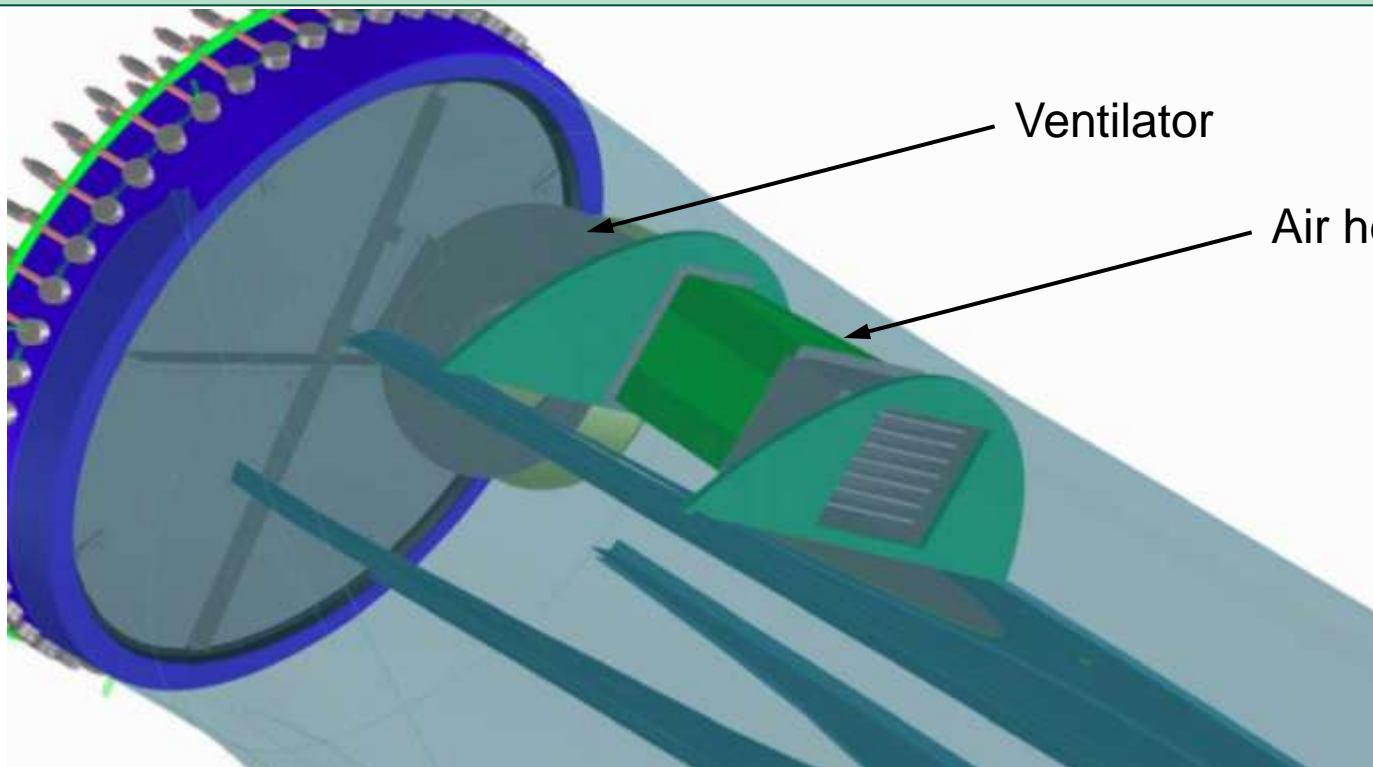
Rotor blade de-icing system.

WinterWind 2011, Umea
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10.02.2011

Icing on wind turbines bears the following **risks**:

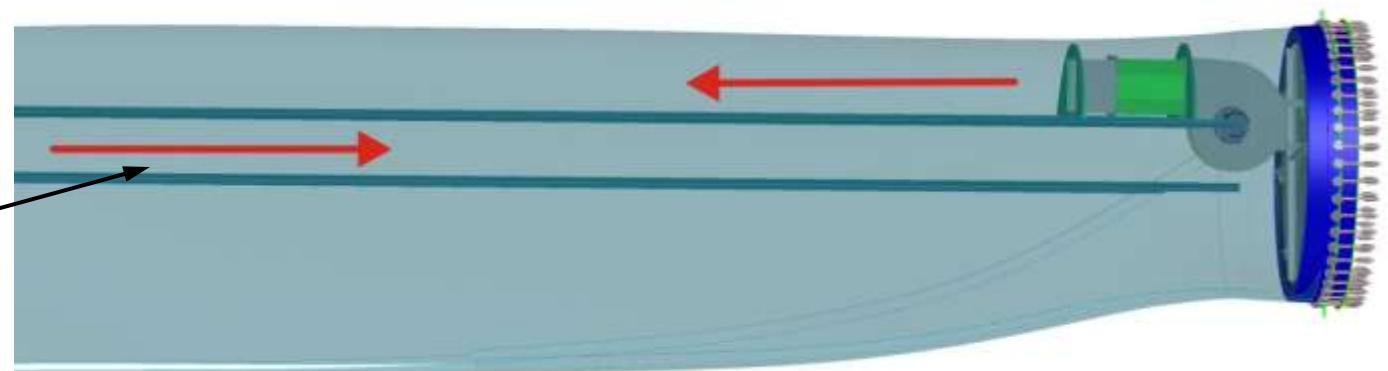
1. **Unbalance of rotor blades** lead to oscillations causing higher loads and probably shut down.
2. **Ice pieces can fall down** in a reasonable radius around the WEC.
3. Degredation of aerodynamic efficiency resulting in **decreased yield**.
4. **Total stop** of yield production due to ice detection.



Rotor blade de-icing system by means of warm air ventilation.

The system works while yield is produced.

Air flow of warm air ventilation in rotor blade.



The efficiency of the rotor blade de-icing system has been tested for 5 month in winter 2009/2010 in locations at

- a) Dragaliden in Sweden and
- b) Krystofovy-Hamry in Czech Republic.

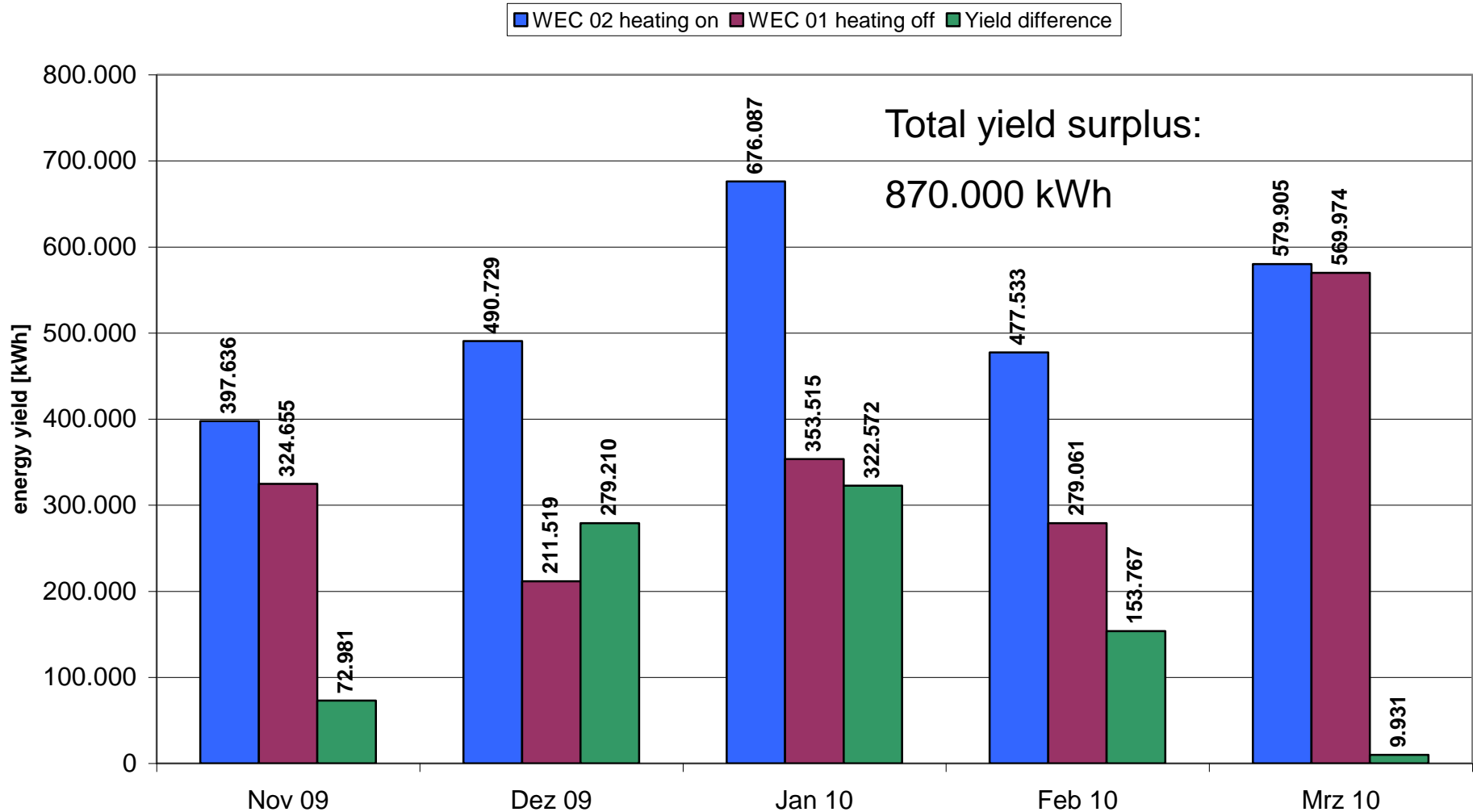
On both locations 2 WECs E-82 2 MW have been compared. Both WECs are located next to each other.

On one WEC the rotor blade heating was activated while it was deactivated on the other WEC.

Energy yield surplus due to Rotor blade de-icing Dragaliden

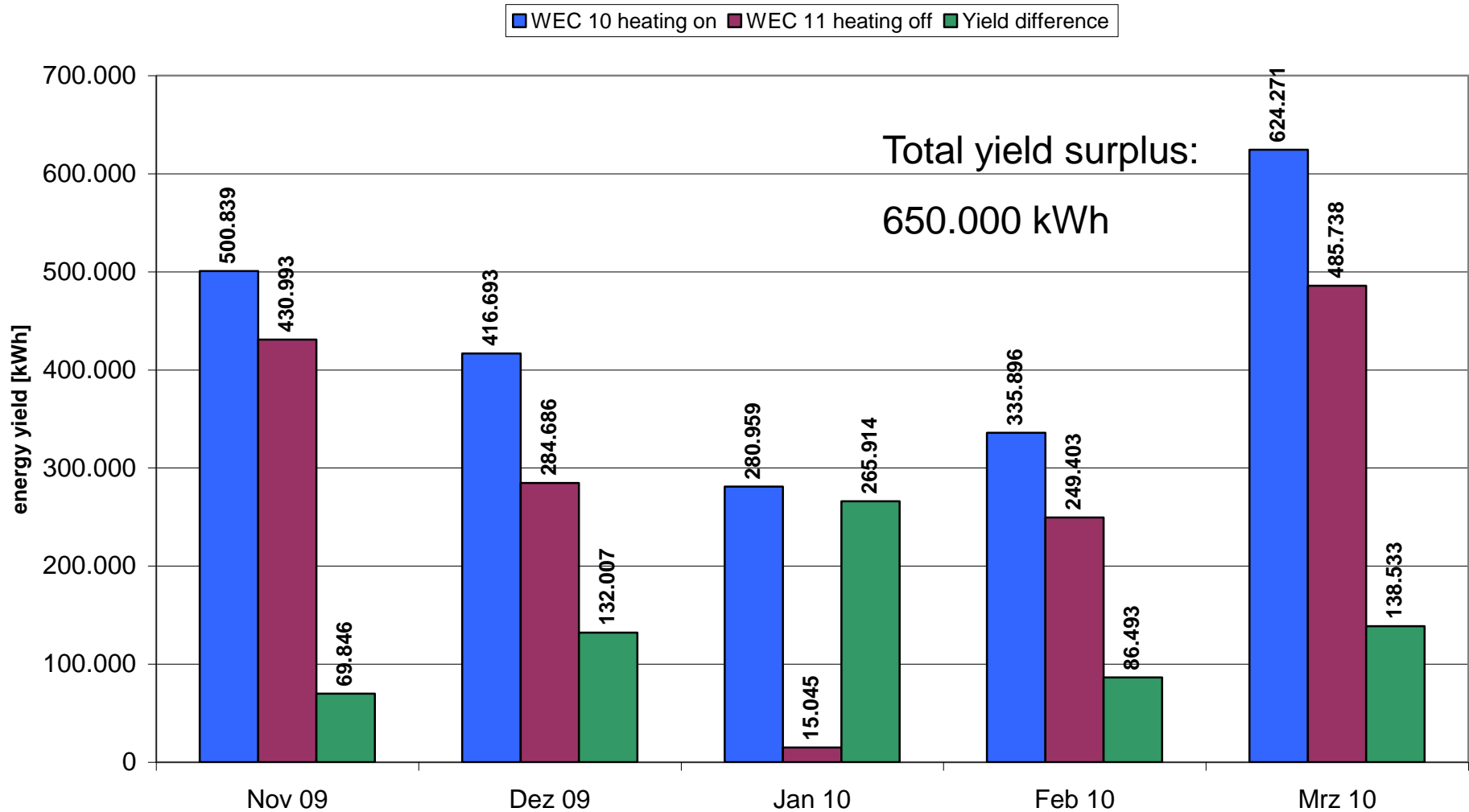
Energy meter readings

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



Energy yield surplus due to Rotor blade de-icing in Krystofovy-Hamry (CZ), energy meter readings

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



Location	unit	Krystofovy-Hamry (CZ)	Dragaliden (SE)
Amount of test month in winter	month	5	5
Energy meter difference between WEC with and without blade de-icing	kWh	870.000	650.000
Average monthly energy surplus in winter month with icing	kWh	174.000	130.000
Percentage of energy surplus in relation to WEC without de-icing system	%	48	54

The energy yield surplus due to the rotor blade de-icing system strongly depends on meteorological conditions like icing and wind speed on site.

ENERCON assumes that on heavy icing locations an additional net energy amount in the range of

20% to 30% of the annual energy production (AEP)

can be produced additionally in case the WEC is equipped with the rotor blade de-icing system

For an E-82 2MW WEC with an AEP of 4.000.000 kWh this results in about 800.000 kWh/year to 1.200.000 kWh/year.

The ENERCON DE-ICING SYSTEM convinces by its efficiency and simplicity.



Thank you for your
attention.