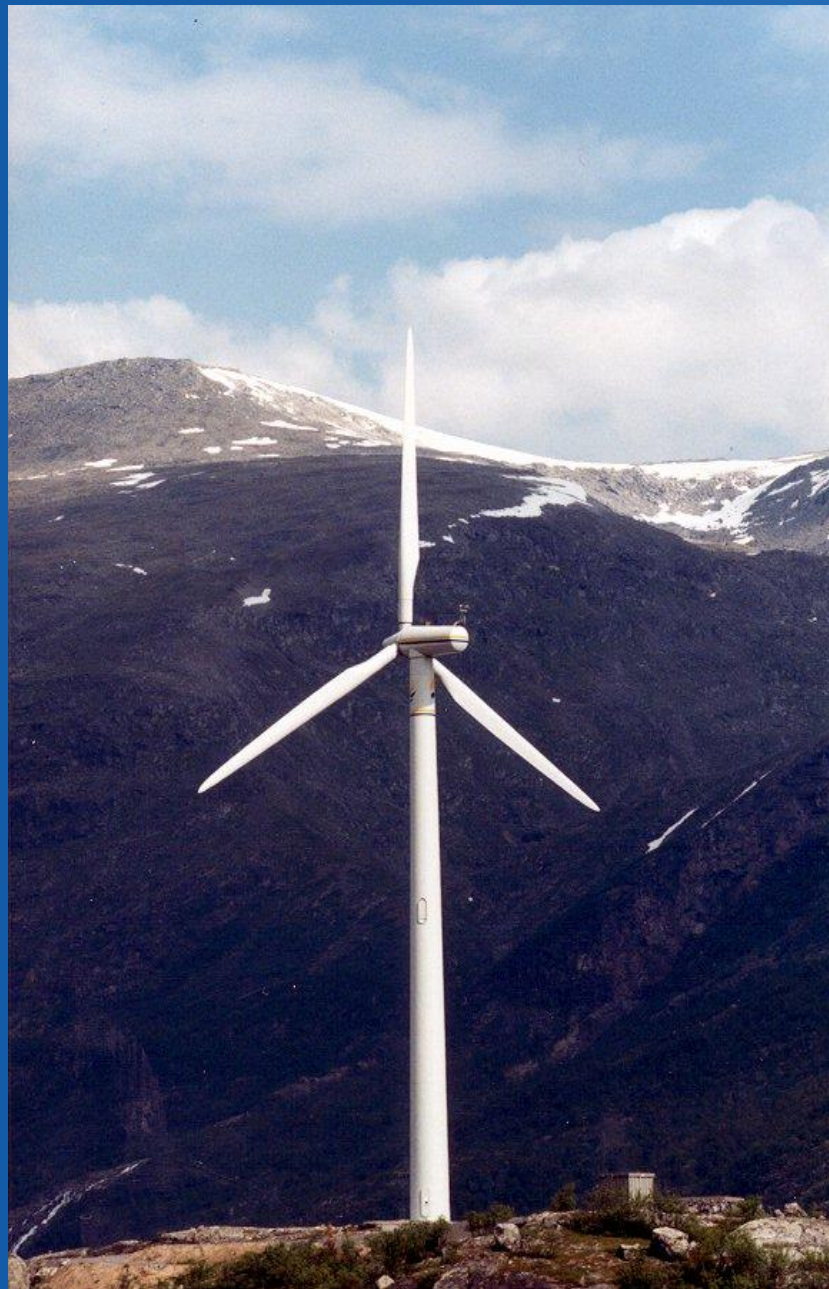


# Suorva

A 600 kW cold climate  
research turbine

A journey from 1998  
till today

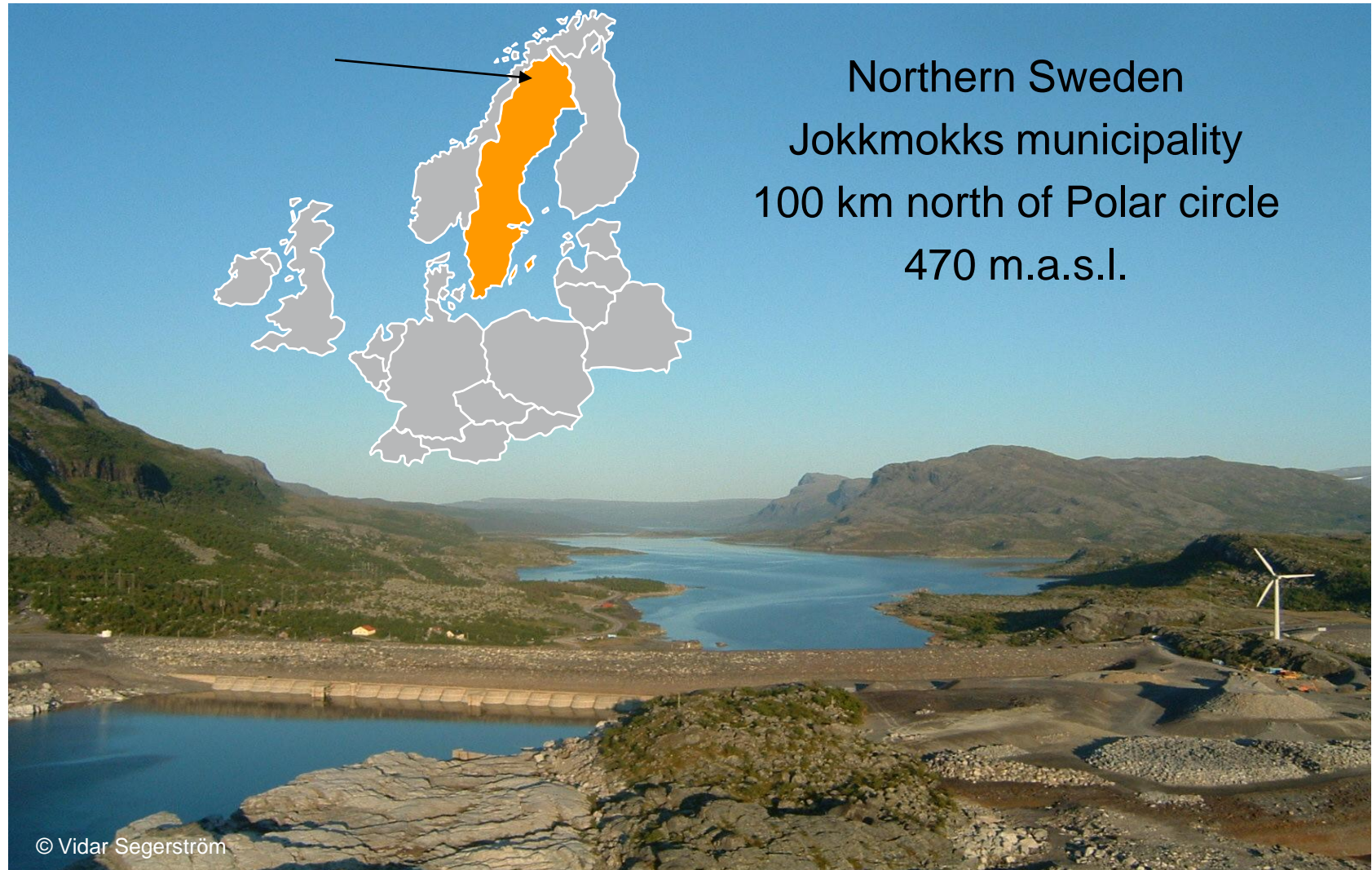
2014-02-12  
None (C1)



# Agenda

<b>1</b>	<b>Background</b>
2	Evaluation 1998-2001
3	Experience 1998 - 2014
4	The Future

# Background - Location



Northern Sweden  
Jokkmokks municipality  
100 km north of Polar circle  
470 m.a.s.l.

© Vidar Segerström

# Background – Some Data

600 kW Bonus (Siemens)

Commissioned 1998

Hub height 40 m, rotor  $\varnothing$  44 m

Stall regulated

Cold Climate equipped

Site between hydro power dams

8-8,5 m/s on 25-100 m.a.g.l. (!)

Two dominant wind directions,  
up and down the valley

No severe icing conditions



# Background - Cold Climate Equipment

Blade heating system (JE-system)

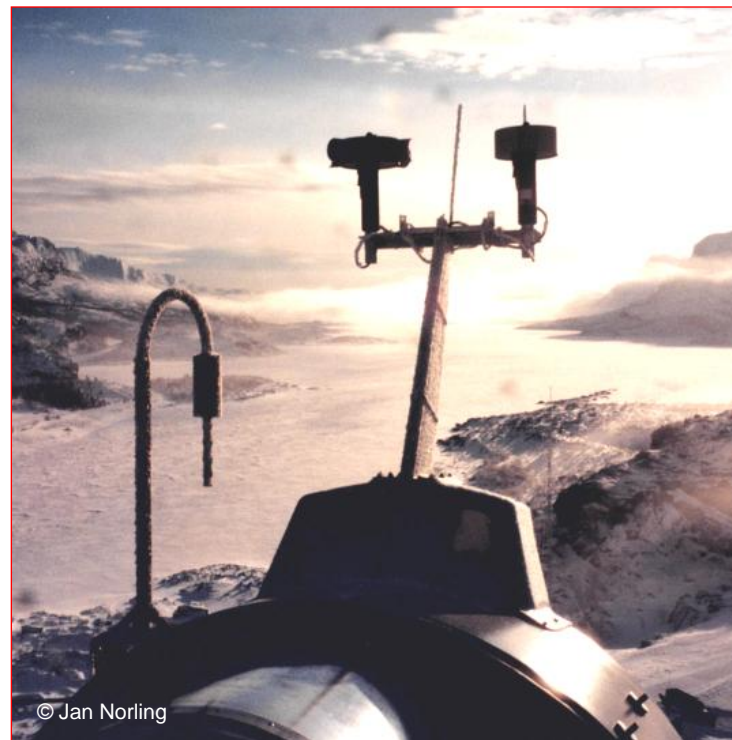
Heated

- gear box housing
- anemometer (Hydrotech)
- wind vane (Hydrotech)
- tower bottom
- blade tip shaft
- controller box

Ice detector (Vaisala → Labko)

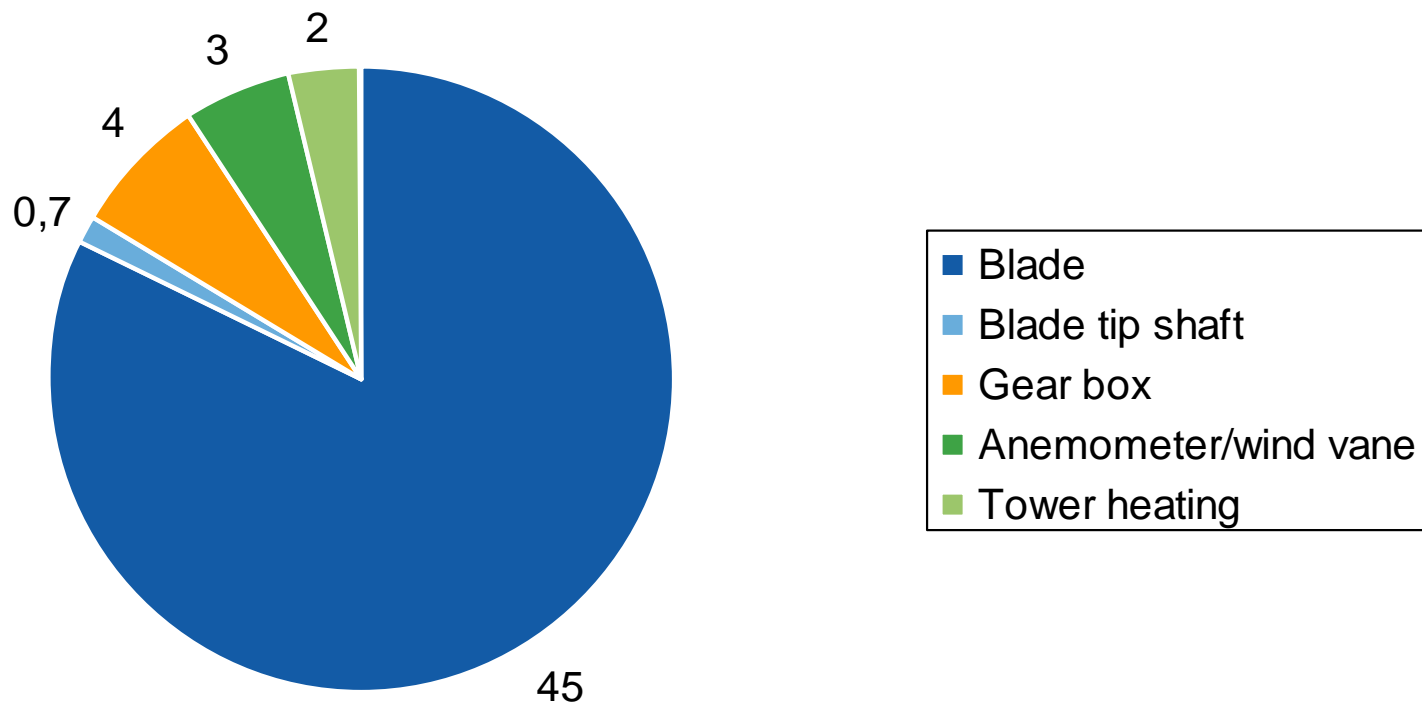
Low temp oils

No low temp steel → operative  $> -20^{\circ}$



# Background- Heating Equipment

Installed kW-capacity for heating, total 55 kW



# Background – Blade Heating System

Blade heating system (JE-system)

Carbon fibre layer

<11 m/s + ice-signal → 3 \* 9 kW

>11 m/s + ice-signal → 3 \* 15 kW

Thermistor measure blade temp

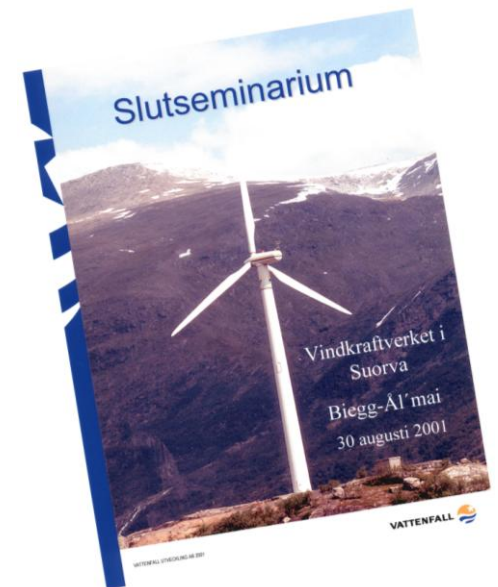
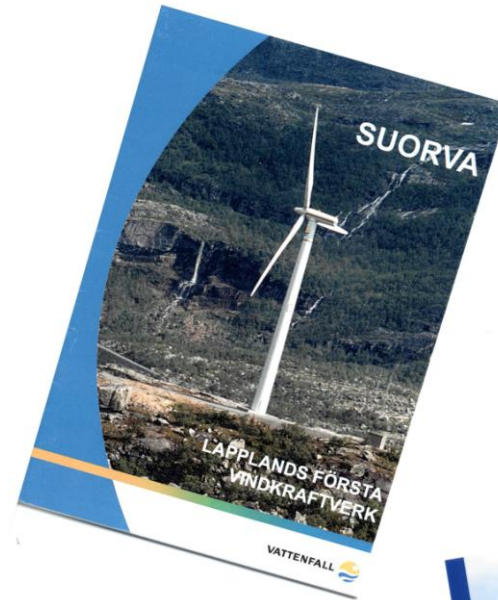
Gearbox heated 4 kW when <-15 °

# Evaluation 1998 - 2001



# Evaluation 1998 to 2001

Meteorology  
Environment  
Acoustics  
Acceptance  
Power performance  
Ice and Loads  
Operation & maintenance  
Restoration plan



# Experience 1998 to 2014

# Experience – Consumption of Heating Energy

Production 1999-2013  
21,7 GWh or 1,45 GWh/year

Energy for heating  
380 MWh

**1,7 % of total production**



During winter season 2008/09 blade heating system was in operation constantly due to ice detector failure

# Experience – Causes of Failure / Standstill

Remote turbine → longer calling-up time than usual

Service by nearby hydro technicians, b-priority

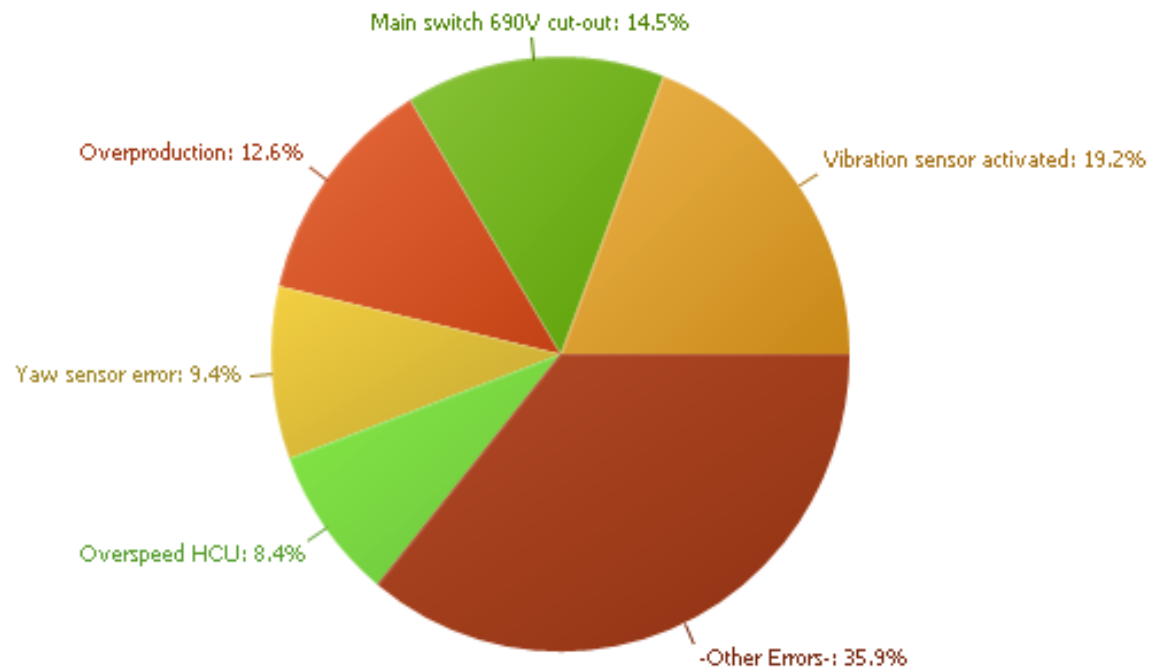
Small turbine, b-priority

Some spare parts have long delivery time



# Experience – Common Failures

Percentage per error of total downtime 2010- Jan 2014



# The future

# The Future

Suorva Turbine

The Suorva Site

Cold Climate Wind in General

