

# LINNOVATION™

## ***THE GAMECHANGER***

*OPERATING WIND POWER PLANTS IN COLD CLIMATE*

Presentation at Winterwind 2021

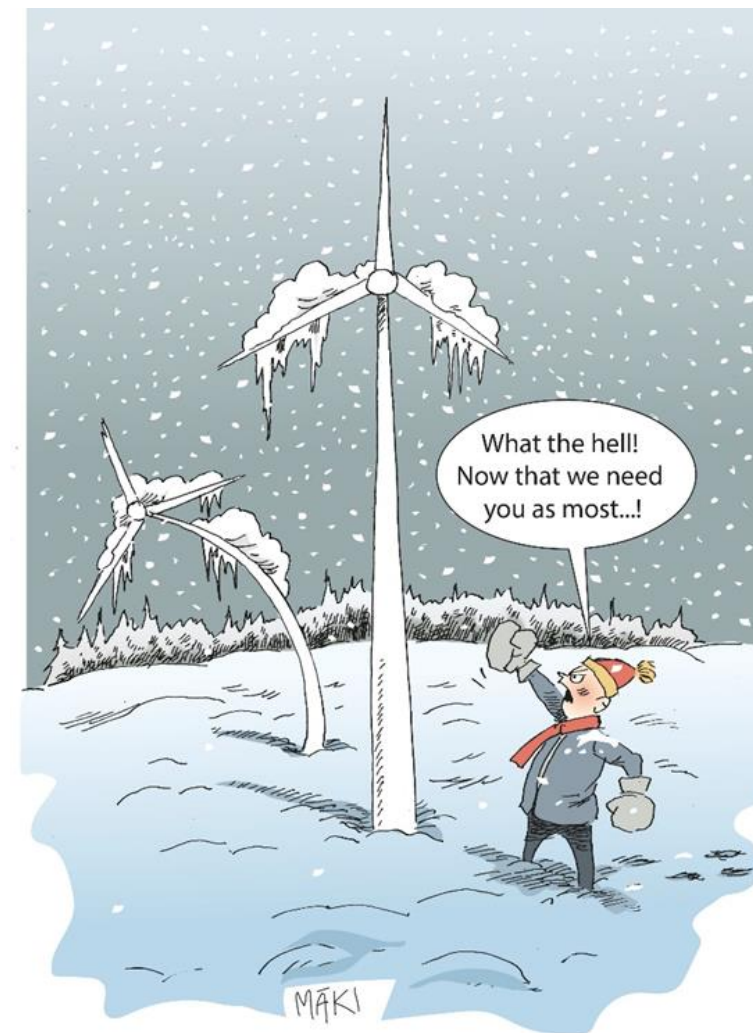
by Sven-Erik Thor

# This presentation deals with:

- **Background and Challenges**
- **No icing/ANTI icing – Intelligent heating system**
- **Operational experiences**
- **Cold weather quality repair system**
  - **Blade repair**
  - **Service platform**
- **Health Safety and Environment**
- **Next steps**

# Challenges - wind power in cold climate

- Severe losses of energy production  
- especially in January this winter
- Blades damaged due to falling ice  
increasing and costly to repair
- Wind park and turbines inaccessible due to falling ice  
– Health Environment Safety – loss of  
production



# ANTI icing system

- Intelligent heating system
- developed and tested since 2014

## Intelligent control system

- each panel individually controlled
- heat concentrated where needed most
- panel works as sensor – no extra sensors
- system will prevent build up of ice which will,
  - reduce ice damages
  - reduce energy consumption
  - reduce risk for injuries to personnel

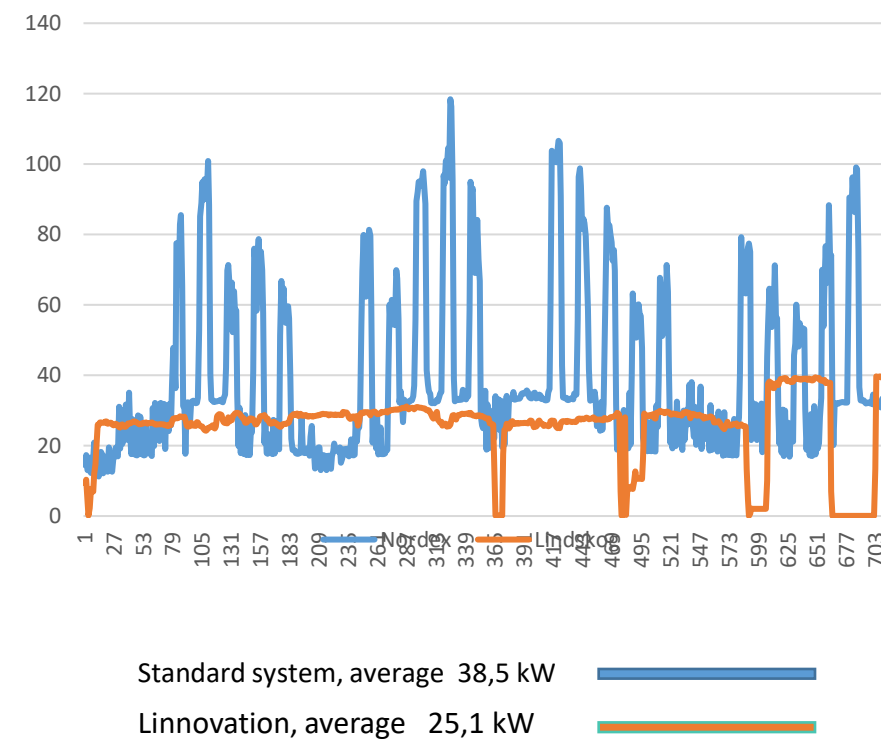


Heat module production line

# ANTI icing system

- Intelligent heating system

- **Low energy consumption**  
-35% compared to standard AIS-system
- **Proven during full scale tests**
- **Patented**
- **Commercial performance verification 21/22**  
- ready for market introduction 2022  
- suitable for retrofit and new production



# Heating modules partly mounted





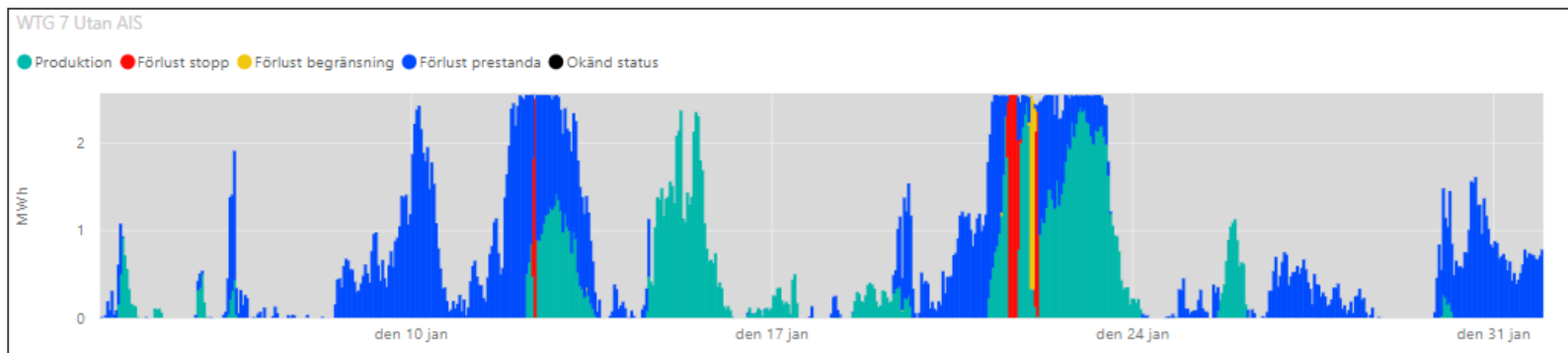
# Linnovation AIS

Test results winter 2020/2021



# Test results winter 2021

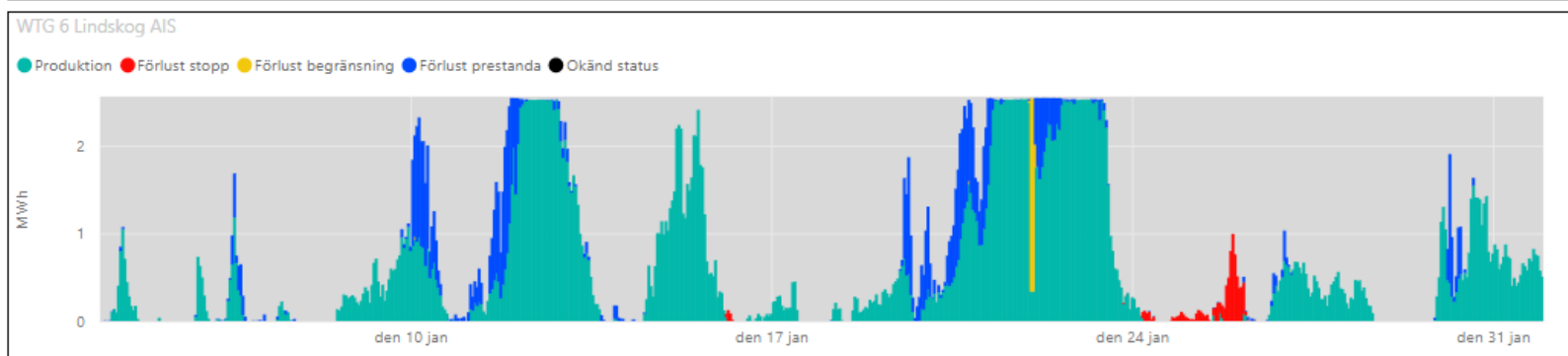
## - Power performance losses January 2021



2021-01-04 2021-01-31

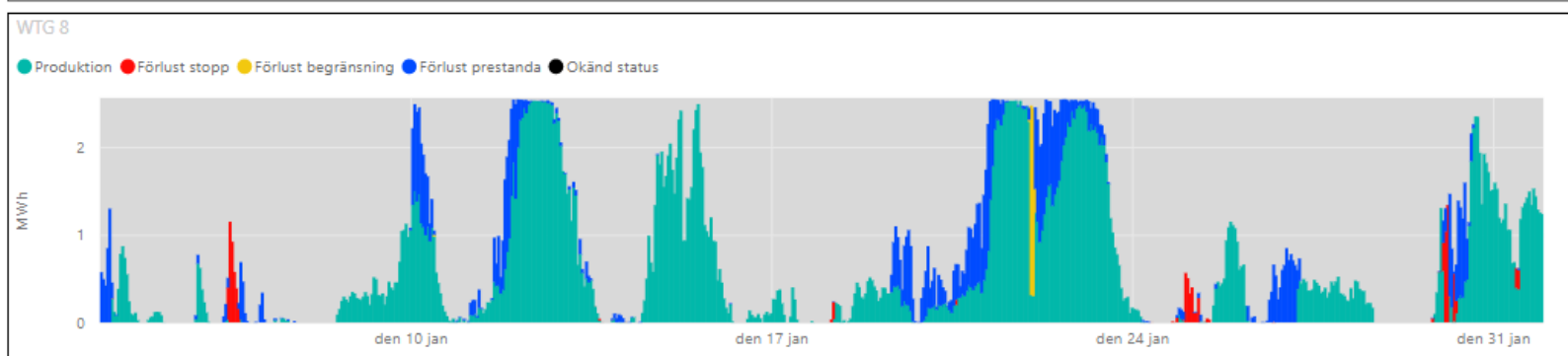
**257,53**  
Prestandaförlust [MWh]

**No AIS system**



**67,35**  
Prestandaförlust [MWh]

**Linnovation system**

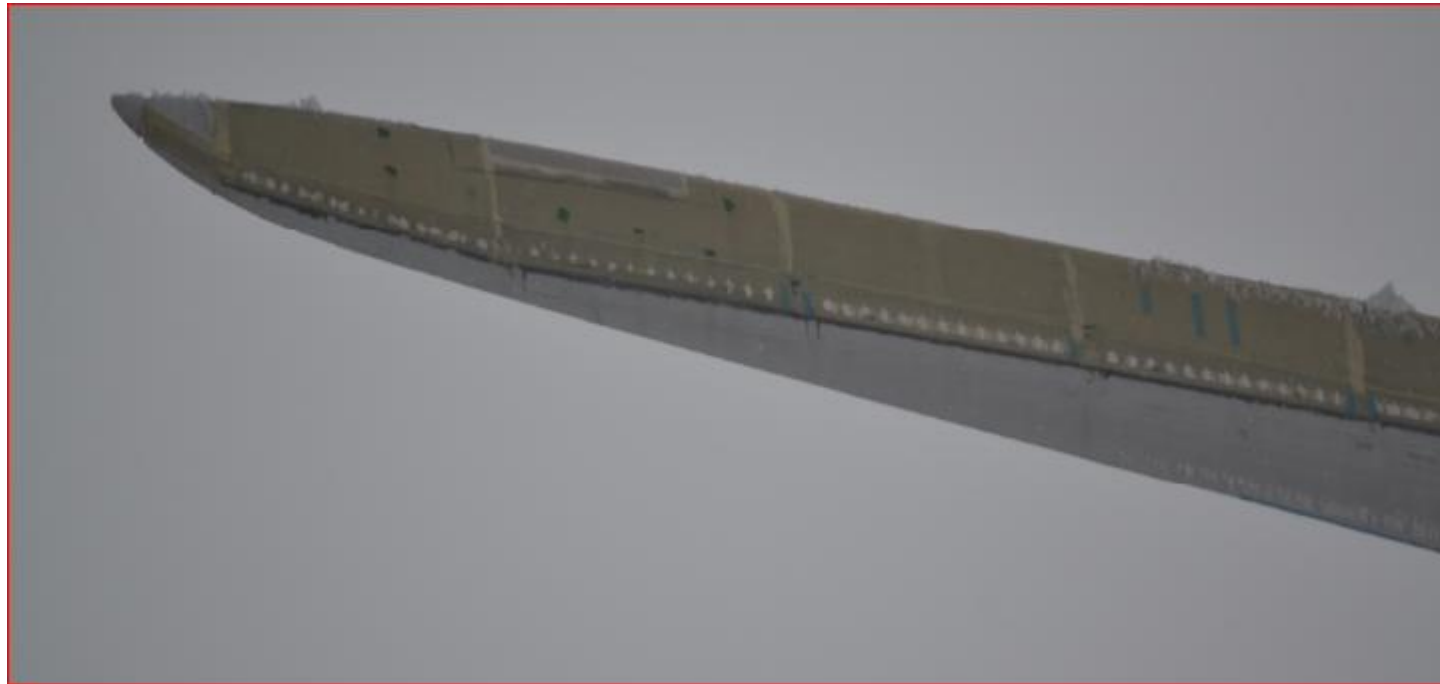


**82,68**  
Prestandaförlust [MWh]

**Standard AIS System**



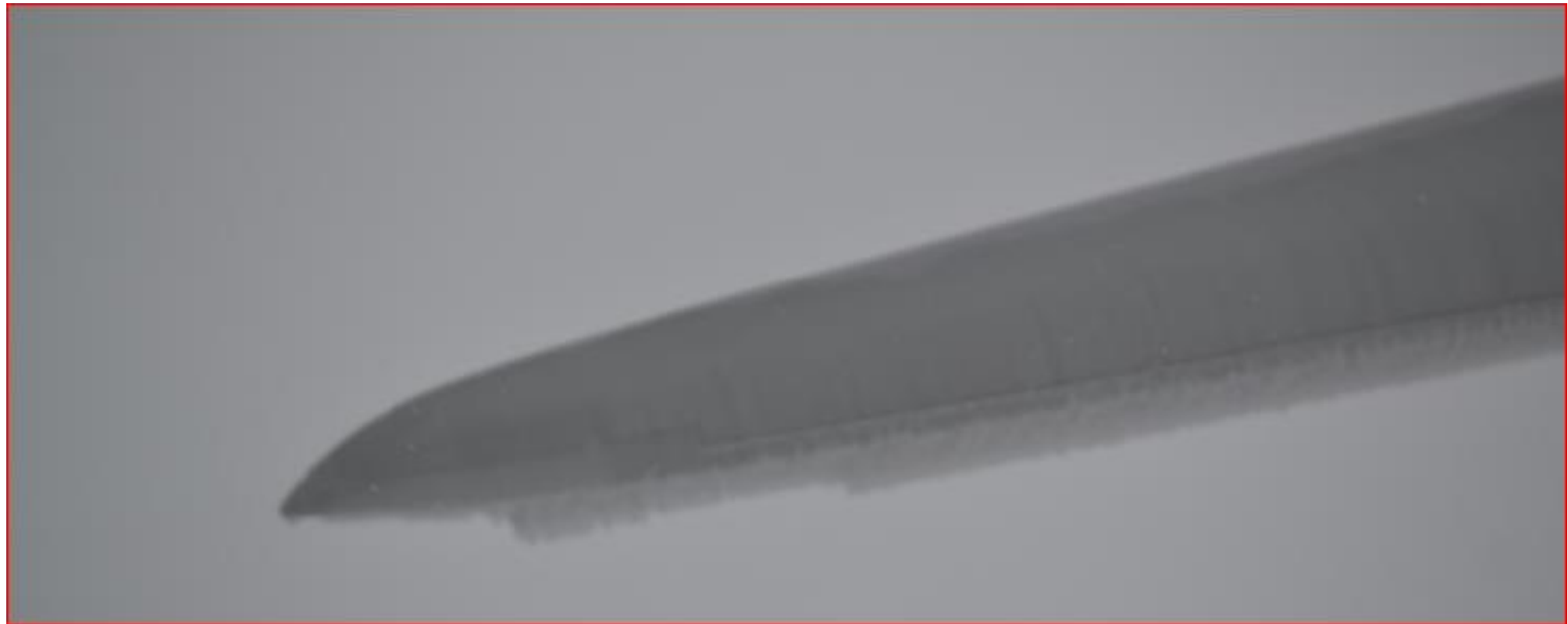
# Linnovation ANTI-icing system



## One module out of order



# Another turbine blade without ANTI-icing system



# Test results winter 2020/2021

## - Other conclusions

- **Low energy consumption**
  - during heating through efficient copper
  - during periods with now ice events
- **Efficient ice protection even if one or more panels are turned off**
  - ensures system operation
- **No hotspots in Linnovation-panels**
- **Damages on heating panels easy to repair**
- **System designed for easy service and repairs**

# Health Safety and Environment

## Challenges:

- Risk of personal injuries due to falling ice.
- Wind turbines not accessible
  - Even small problems will stop turbines
- Risk of poor reputation for wind power industry



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**Linnovation AIS will solve these challenges**

# Cold weather quality repair system

- Increasing number of turbines in cold climate.
- Larger turbines
- Large proportion of blades in cold climate damaged by ice



*How will the industry manage to repair all blade damages during short summer?*



# Cold weather quality repair system

- Linnovation heating panels suitable for repair in cold weather.
- Verified repair method
  - Controlled curing process
  - Full documentation of repair
  - High and even quality
- Industrial method
  - Repair multiple damages parallel
  - Specially developed service platform
    - Weatherproof work
    - Reduced wind sensitivity

# Summary

- The AIS system has been tested and verified in real life with good results.
- A new method for blade repairs with heating panels and service platform will be ready during 2021.
- **The new wind power system ready for market introduction 2022**
- *Miscellaneous*
  - *A number of spin off projects based on the same technology has been identified and demonstrated*



# Acknowledgment

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# LINNOVATION™



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