Business from technology

Design principles of VTT ice prevention system

Winterwind 2012, 7th-8th of February, Skellefteå

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- Motivation: Icing effects on wind turbines
- Choosing strategy: Why Ice prevention instead of de-icing?
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Motivation: icing effects on wind turbines

- Reduced energy yield

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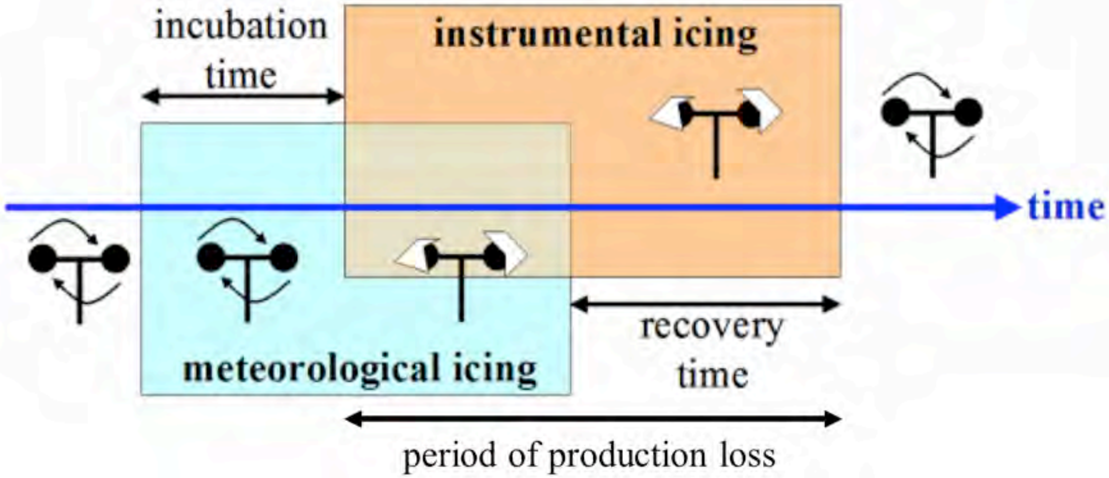
Why Ice prevention instead of de-icing? definition of icing events



Icing event definition according to:
IEA Wind Task 19:
Wind energy in Cold Climates

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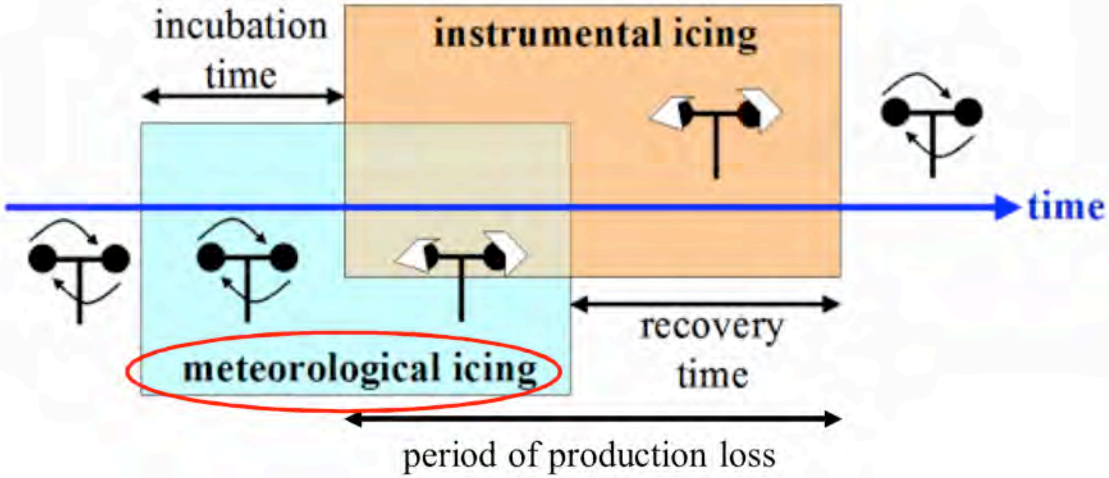

Meteorological icing

- Period with icing weather conditions

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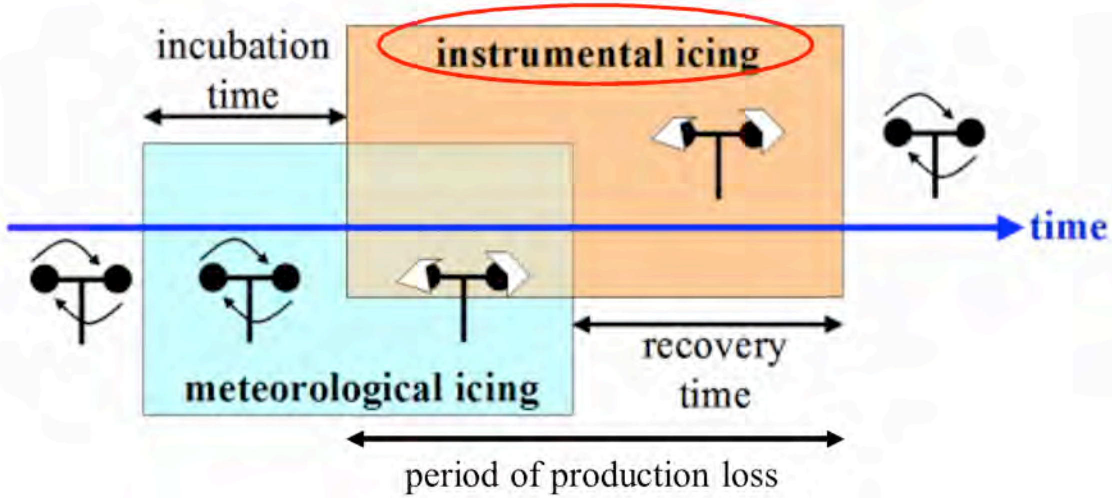

Instrumental icing

- Period when a wind turbine is disturbed by ice (ice on blades or sensors)
- Typically 2 3 times longer than meteorological icing event

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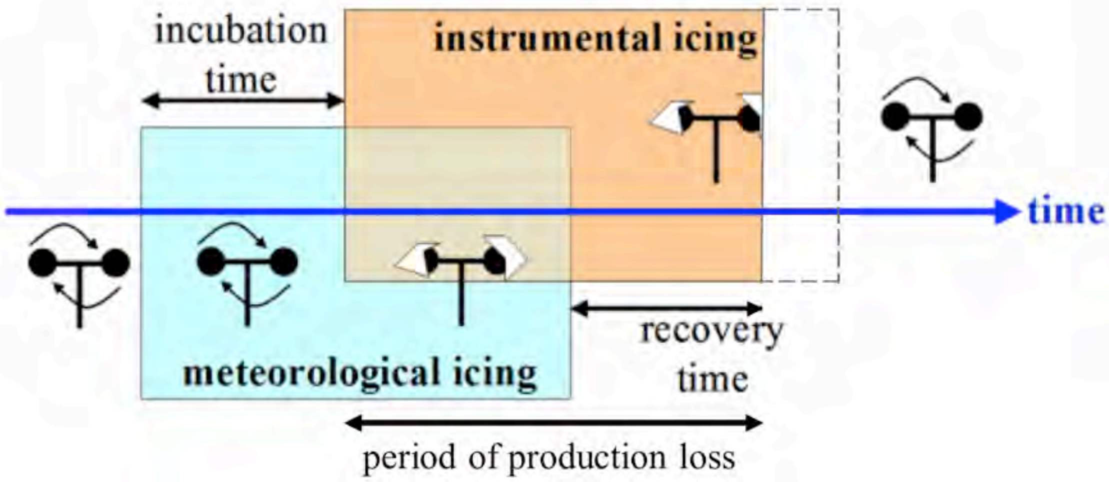

De-icing = to remove ice from blades after ice has formed

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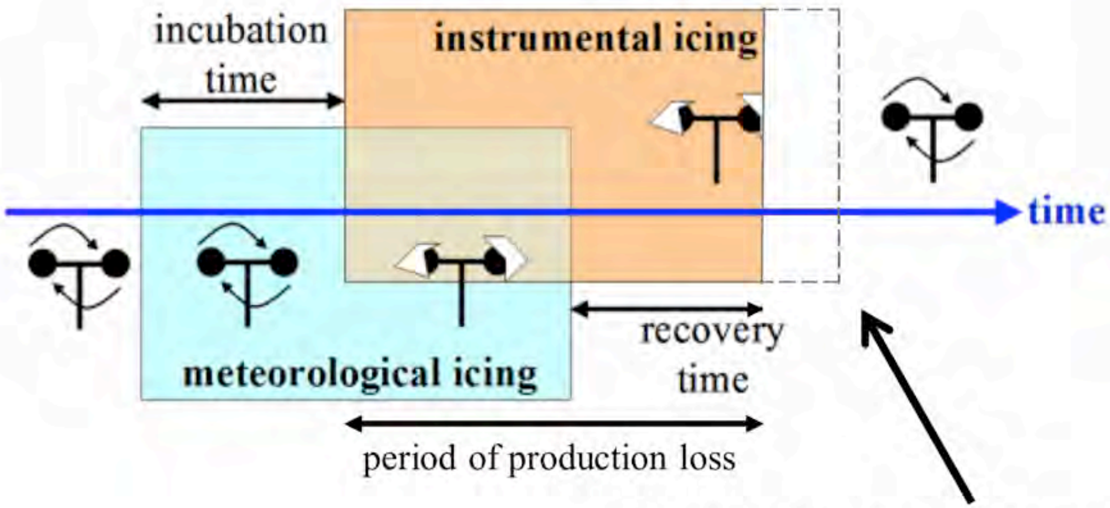

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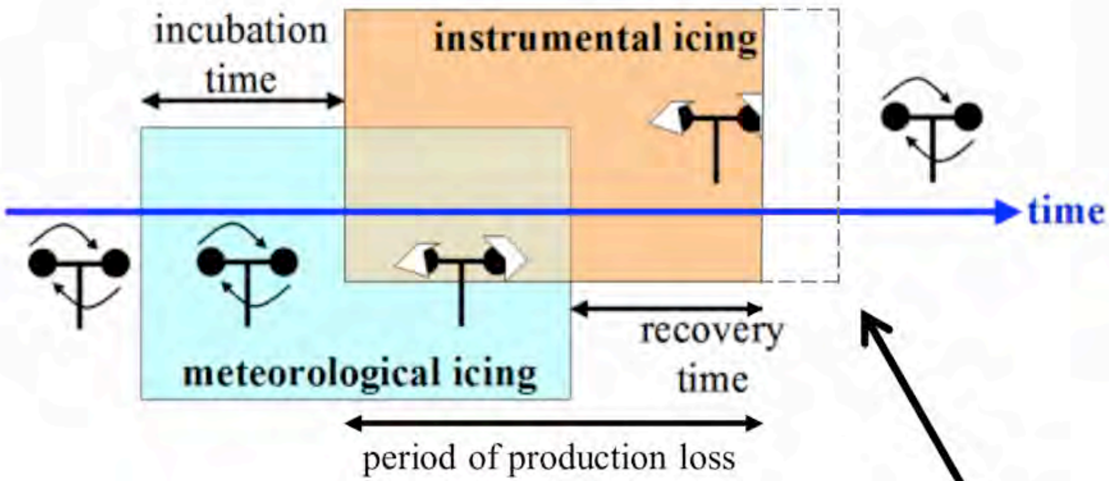

Recovery time shortened with de-icing

De-icing = to remove ice from blades after ice has formed
Turbine operates with iced rotor blades before de-icing

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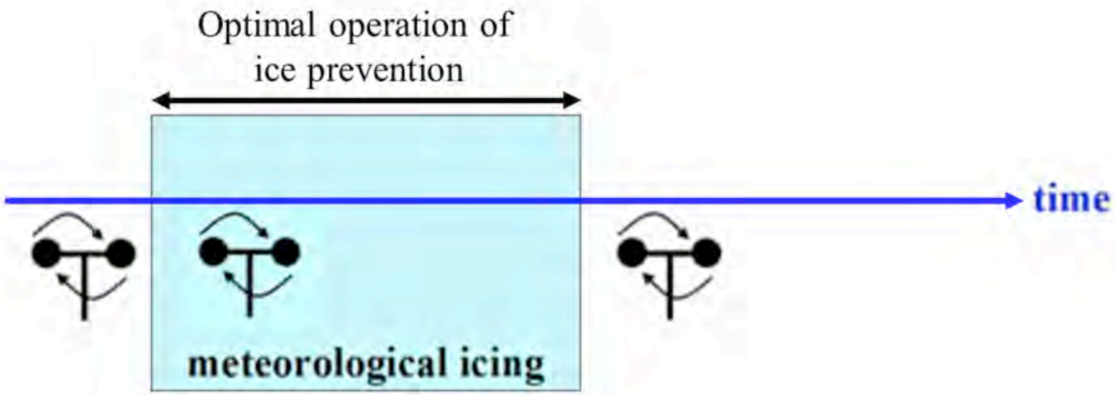

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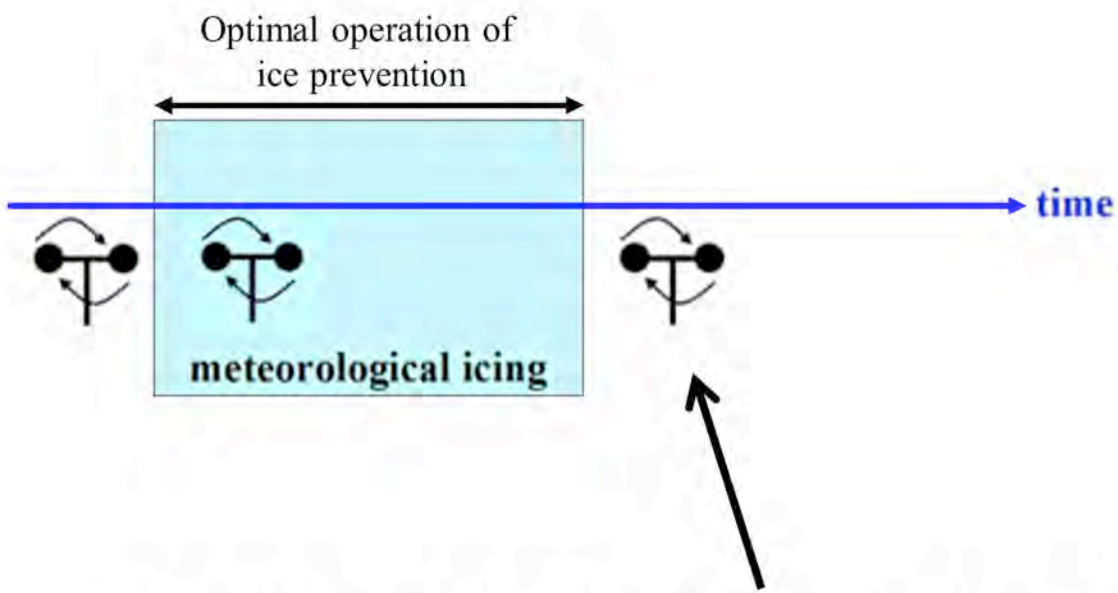

Instrumental icing can be <u>avoided</u> by efficient ice prevention!

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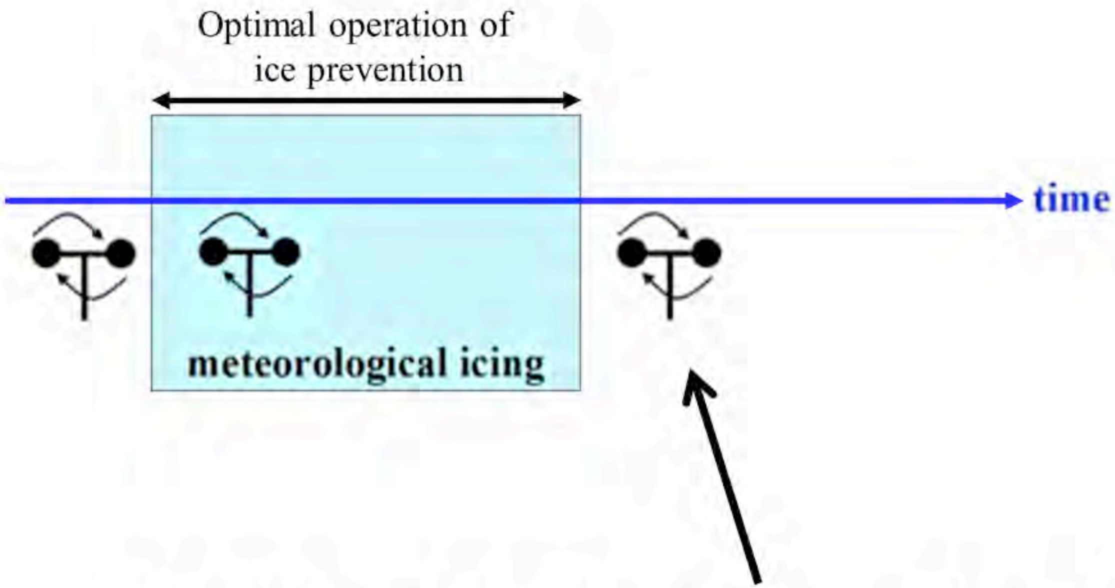

Instrumental icing can be <u>avoided</u> by efficient ice prevention!

Ice prevention (anti-icing) = to prevent ice formation on blades Turbine operates without ice on rotor blades

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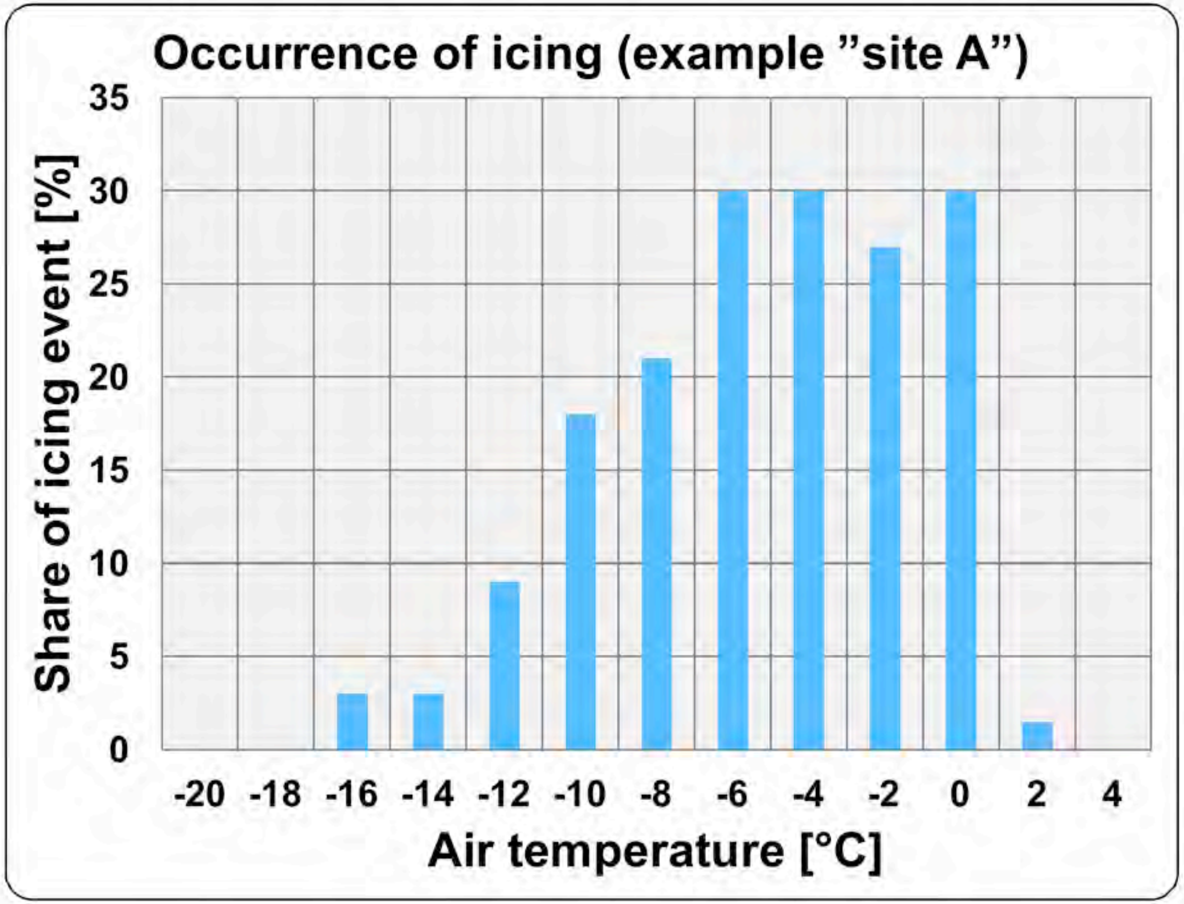

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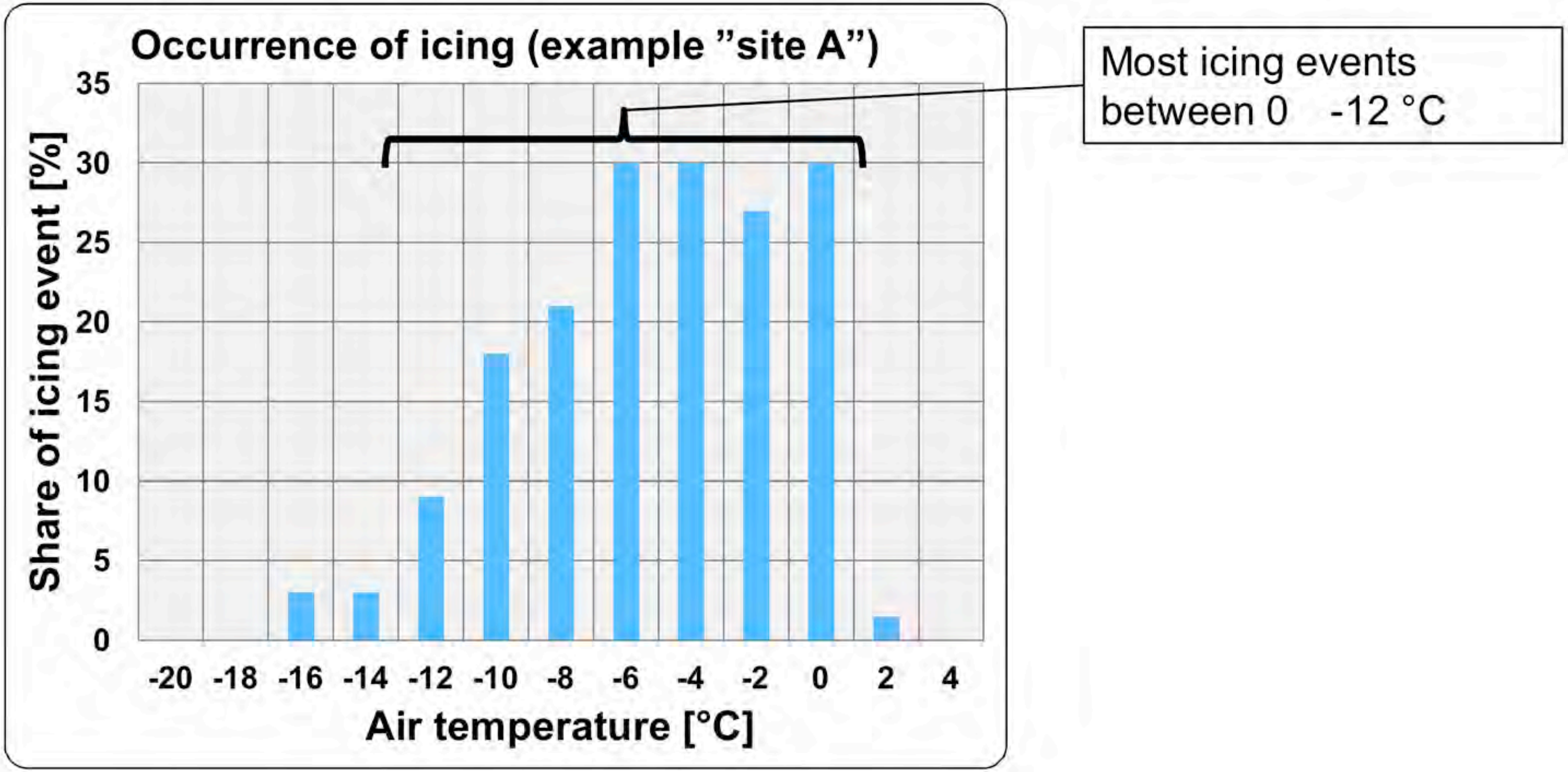

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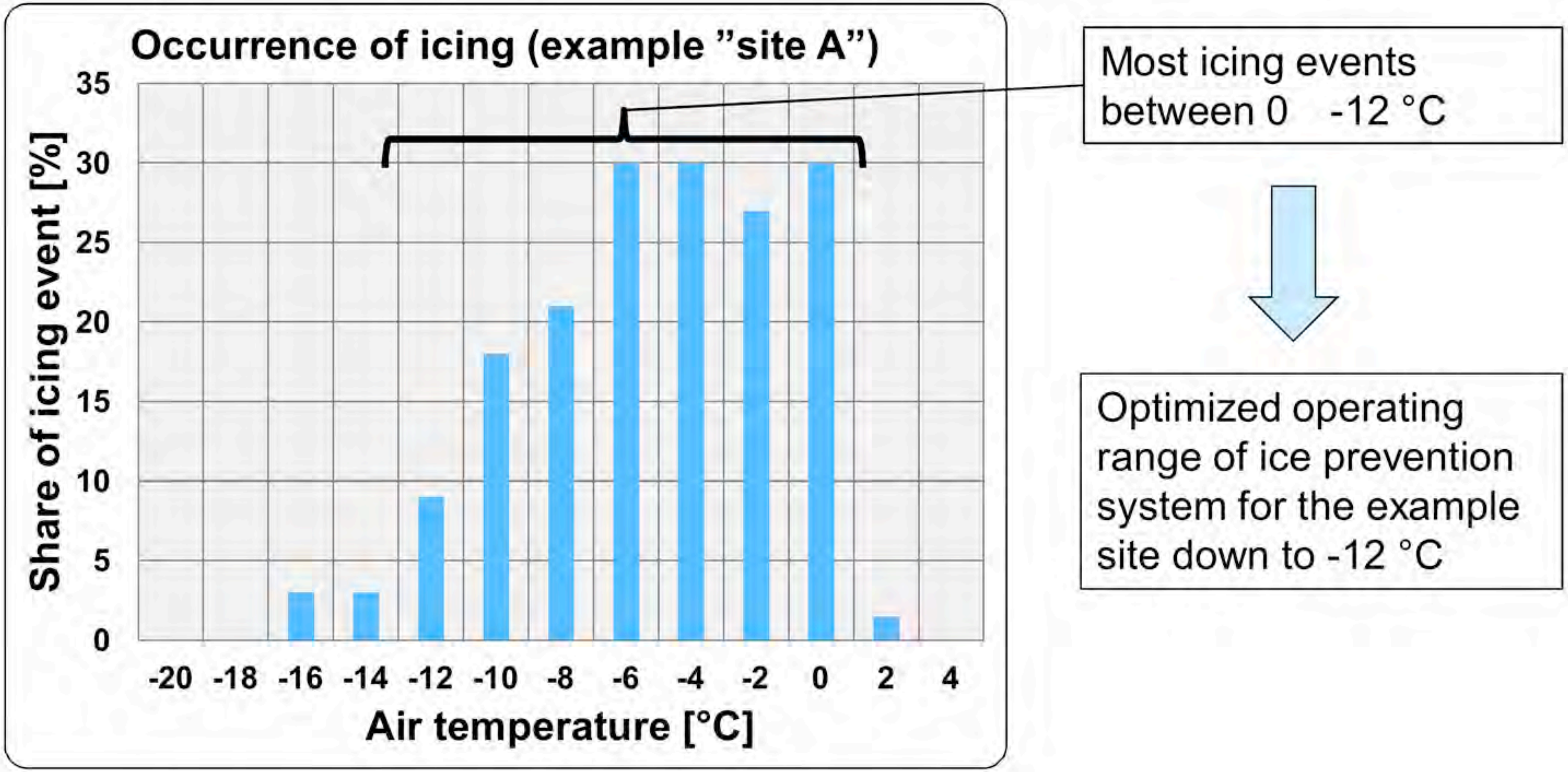

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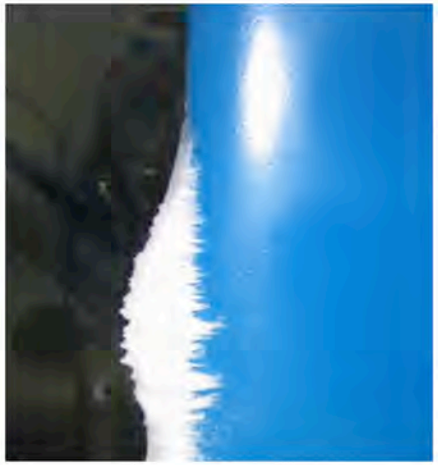
- Heating power calculations compared to wind tunnel experiments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- Average heating power minimal compared to produced power of turbine
  - Ice prevention is activated by ice detection only when icing conditions exist
- Power reserve needed for harsh conditions to maintain ice prevention capabilities
- Typical ENERGY consumption 0,5   2% of turbines AEP (depending on site wind conditions)

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