

Global cold climate wind energy market potential

Winterwind 2014

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IEA Wind Task 19

VTT Technical Research Centre of Finland

Shareholders of the study

- IEA Wind **Task 19 – Wind Energy in Cold Climates**, a research group defined by IEA Wind Executive Committee, dedicated to increase the knowledge of wind energy in cold climates in the member countries



- BTM Consulting, a part of Navigant, publishing annual report **”World Market Update – International Wind Energy Development and Forecast”**
 - Contacted IEA Wind Task 19 to conduct a market study of CC wind energy
 - Published in World Market Update 2012, in spring 2013



Background

Motivation and Challenges

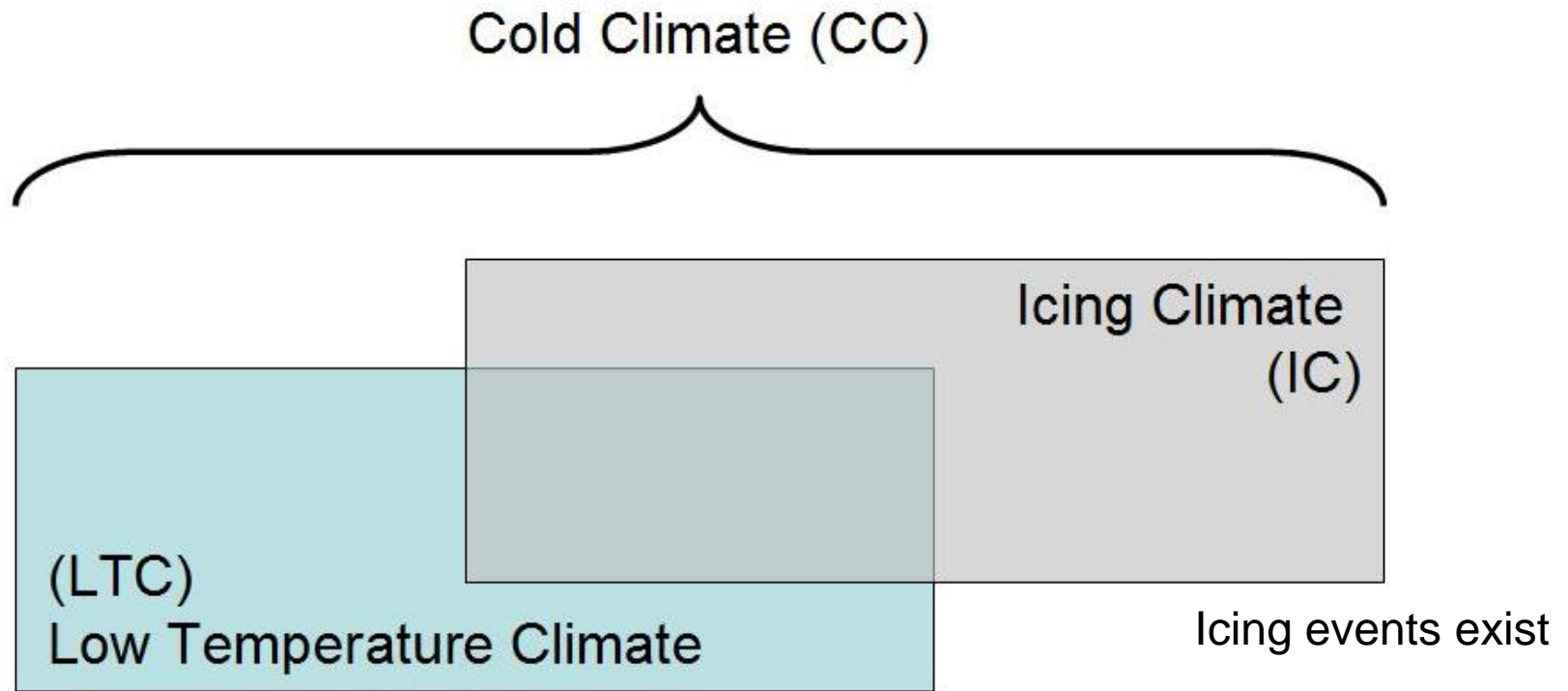
Why to build wind power in Cold Climate (CC) areas?

- Typically good wind resources in CC areas
- CC areas are often sparsely populated which makes these areas favourable for wind energy production

	Challenge in CC	Consequence
Project lifetime ↓	Increased uncertainty of Annual Energy Production (AEP) estimate	Higher cost of capital
	Additional requirements for turbine technology and infrastructure	Higher investment cost
	Adverse weather conditions	Short weather window for construction
	Icing of rotor blades	-Reduced energy yield, 2-15% AEP losses -Risk of losing power purchase agreement -Increase in O&M costs



Definition of CC: Low temperature climate and icing climate



Temperatures below the operational limits of standard wind turbines exist

Approach

Goal and approach

- Goal was to quantify
 - The existing capacity installed in CC areas
 - The forecasted capacity to be installed in CC areas in the coming 5 years

- Approach
 - Global wind power plant database (the Wind Power: www.thewindpower.net)
 - Global weather database developed by VTT
 - based on surface weather observations, typically near airports
 - 15 years of data
 - Forecasted capacity: relative to BTM's forecast



Description of data and criteria used in market size analysis

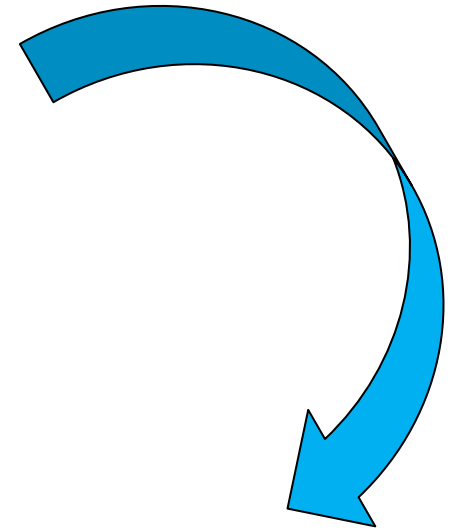
	Data	Criteria
Wind power plant database	Wind power plant location	Distance to weather station ≤ 100 km
	Total capacity of wind power plant	Capacity data available
	Turbine size	Calculated: wind power plant capacity/number of turbines
Weather database	Weather station location	Location data available
	Minimum temperature measured at ground level	If minimum temperature at ground level $\leq -25^{\circ}\text{C}$.
	Number of in-cloud icing days annually at 90 m AGL	If turbine size $\leq 1.5\text{MW}$, then no. of icing at 90m
	Number of in-cloud icing days annually at 150 m AGL	If turbine size $> 1.5\text{MW}$, then no. of icing at 150m



Ice class simplification

Original by Task 19

IEA Ice class	Meteorological icing	Instrumental icing	Production loss
	% of year	% of year	% of annual production
5	>10	>20	> 20
4	5-10	10-30	10-25
3	3-5	6-15	3-12
2	0.5-3	1-9	0.5-5
1	0-0.5	<1.5	0 - 0.5



Used in market study

Class	Description	Corresponding IEA Ice Class
Moderate to heavy icing risk	Icing occurs ≥ 3 weeks	IEA Ice class 3 and above
Light icing risk	Icing occurs 1-2 weeks annually	IEA Ice class 2
No icing risk	Icing occurs < 1 week annually	IEA Ice class 1

Results



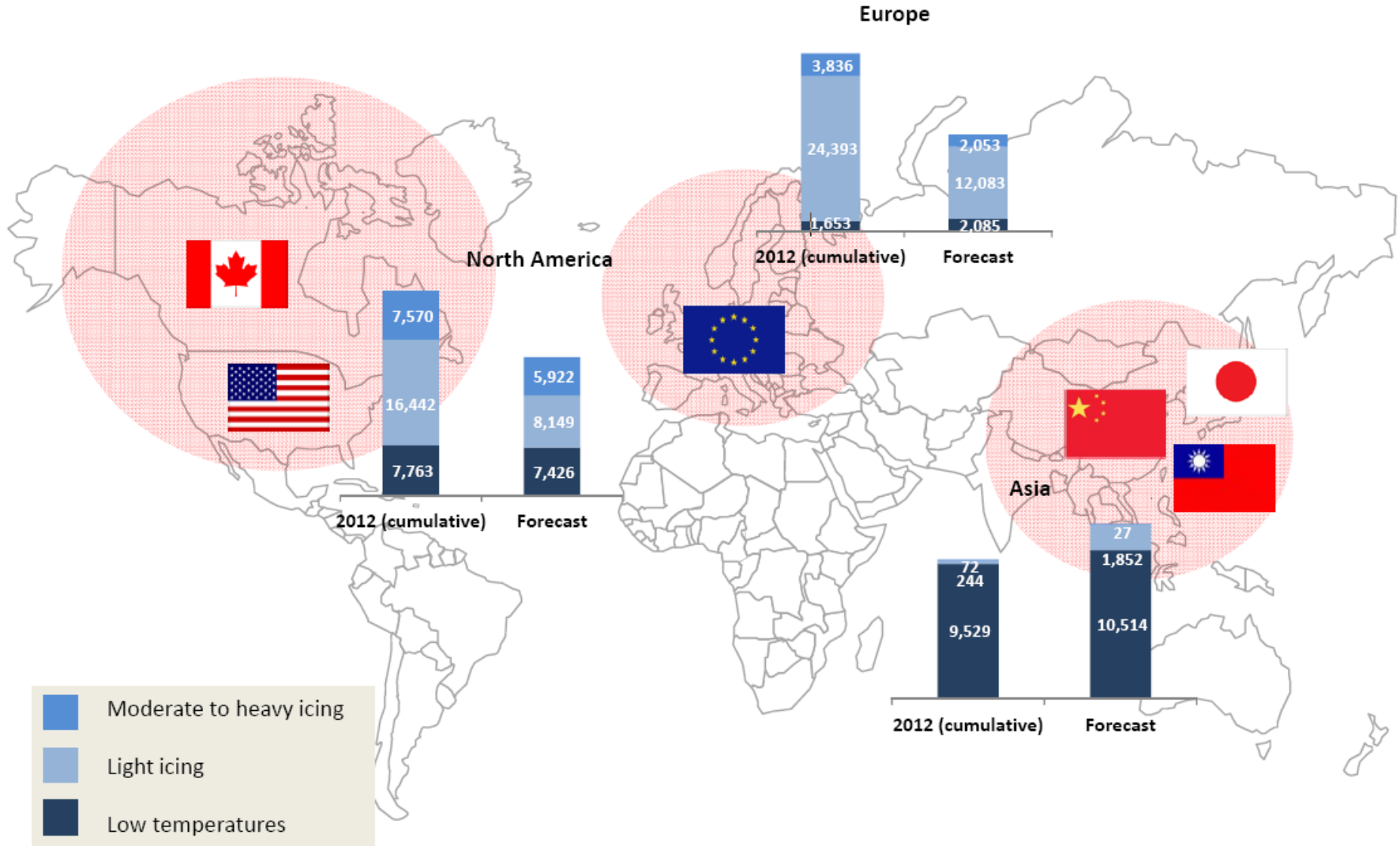
Total installed and forecasted capacity in Cold Climates

Cumulative installed capacity by end of 2012 [MW]			Forecasted capacity 2013-17 [MW]		
Low temperature	Light icing: safety risk, some economic risk	Moderate to heavy icing: economic and safety risk	Low temperature	Light icing: safety risk, some economic risk	Moderate to heavy icing: economic and safety risk
18,945	41,079	11,478	20,025	22,083	8,003
Total 69,000 (*)			Total 45,000 – 50,000		

(*) The total capacity is less than the sum of individual capacities because some of the sites have both low temperatures and icing conditions.



Installed and forecasted capacity in the world



For full country/regional breakdown see table 5.



Markets

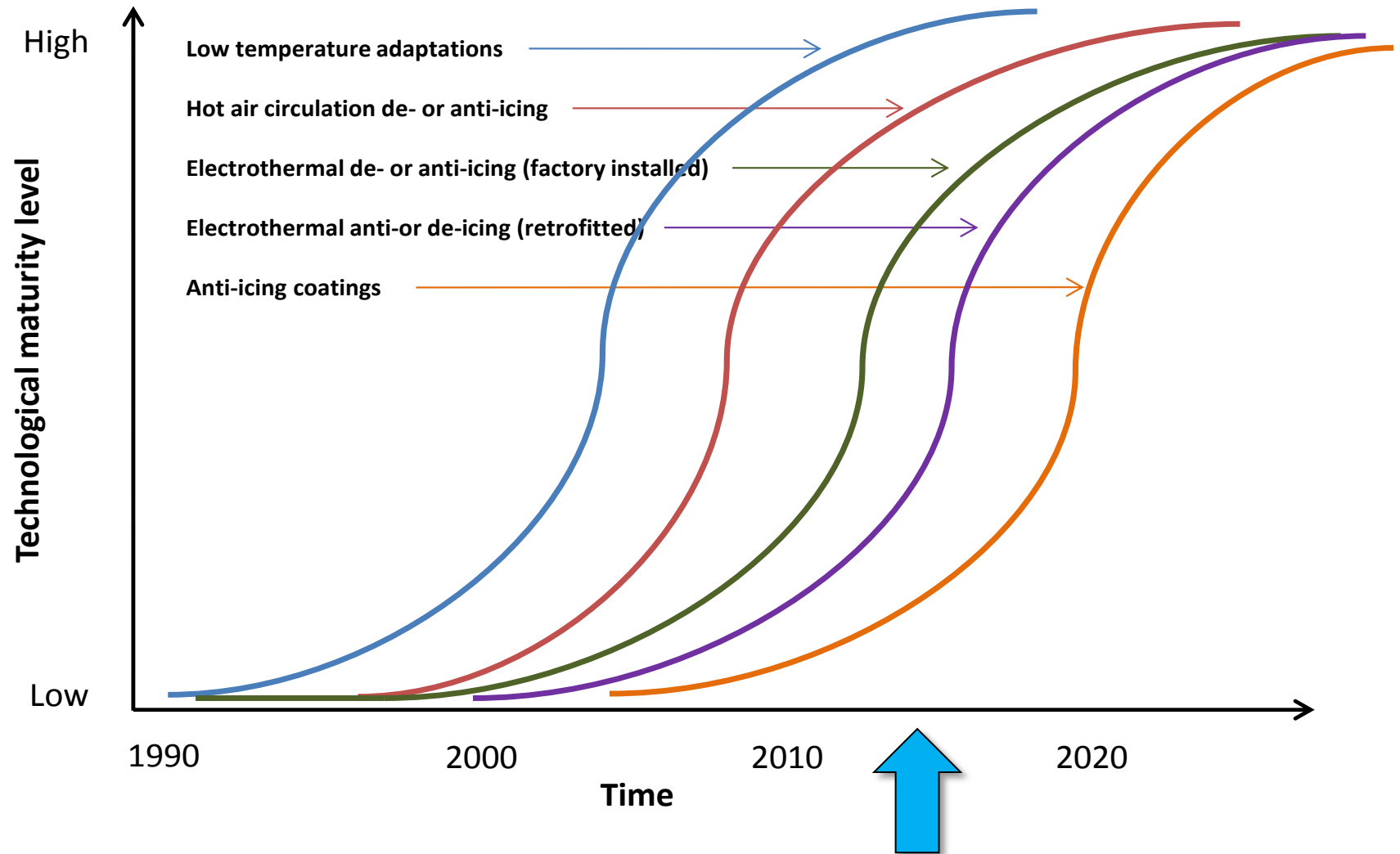
Cumulative installed capacity by end of 2012 [MW]	Forecasted capacity 2013-17 [MW]
Total 69,000 (*)	Total 45,000 – 50,000

- O&M services
- Retrofitted anti- or de-icing system
- Repowering
- Ice detection technologies

- New turbine installations with anti- or de-icing
- Ice detection technologies
- Services for CC project development



Technologies for CC turbines



Conclusions

- **Remarkable** market, 60 GW installed, 50 GW forecasted near future, for CC dedicated
 - technology suppliers: turbines, sensors, equipments,...
 - service suppliers: project development, installations, O&M,...

- **Awareness** of CC challenges is increasing → demand for CC technologies and services increases

- **R&D needs** to increase the maturity of technologies & practices
 - Reliability of ice detection
 - Anti- & de-icing technologies
 - Standardized method for production loss assessment
 - ...



Questions?

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