VTT TECHNICAL RESEARCH CENTRE OF FINLAND LTD

Summary of Winterwind

Winterwind Skellefteå, 8th Feb 2017
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With help of Ville Lehtomäki, Timo Karlsson, Esa Peltola

Starting point – renewables blooming

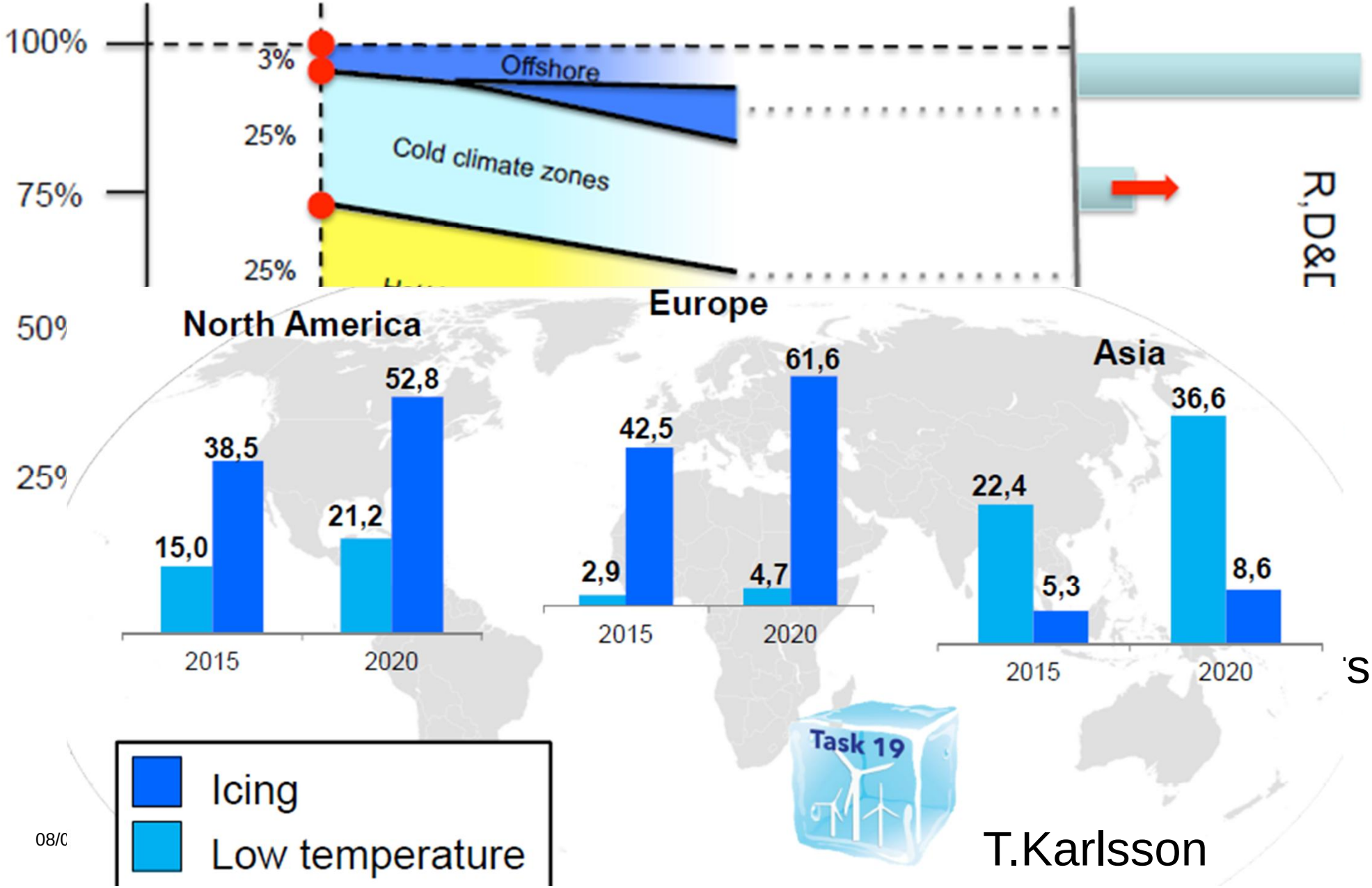
- Solar price dropping dramatically
- Offshore price drops
- Land based wind also reducing in price
- Role of cold climate wind?

- IEA projections for global energy 2040-50
  - Even with very conservative assumptions, wind power is needed

Tomas Kåberger

ALL AVAILABLE RENEWABLES NEEDED

Cold climate wind - market



'skens

T.Karlsson

Standards for cold climates

- There is a growing need – industry products
- Research to draw from – need more cumulative knowledge, measurements, lab/field testing

Standardized test program

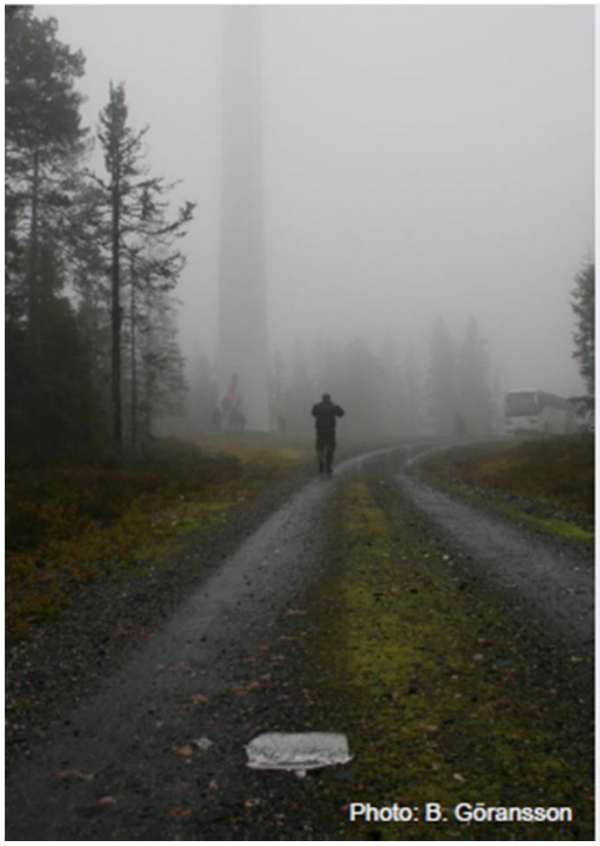
- Validated LWC indirectly with ISO 12494 ice load measurements
- Full program 19h (ISO, LID), reduced program 7h

		ws	T	Target LWC	t	ISO calc. ice mass	Measured ice mass	Tests performed					
Test type	Test	[m/s]	[C]	[g/m^3]	[min]	[g/m]	[g/m]	ISO	LID	RH	WAA	VEC	NRG
Typical icing	1	4	-1	0.2	120	13	14	x	x	x	x	x	x
Typical icing	2	7	-3	0.2	120	54	50	x	x	x	x	x	x
Severe icing	3	8	-5	0.4	120	142	166	x	x				
Severe icing	4	10	-5	0.4	120	220	225	x	x	x	x	x	x
Severe icing	5	10	-5	0.4	240	440	461	x	x				
Extreme icing	6	20	-15	0.2	120	353	449	x	x				

V.Lehtomäki

T.Karlsson

Ice throw – risk



- Still living in a bubble with no accidents
- Public acceptance, living in a populistic world
- 1-1.4 x tip height seen, up to 1-2 kg pieces (0.2 kg lethal).
- Icing days are few but 10-80 ice lumps/event.
- Probability extremely low but can be higher than car accident
- Stop when icing. Use de-icing. Warnings, lights when icing. Education - direction – melting period after icing

J.Lunden

R.E.Bredesen

More data confirming safety distance

Ice throw – side note

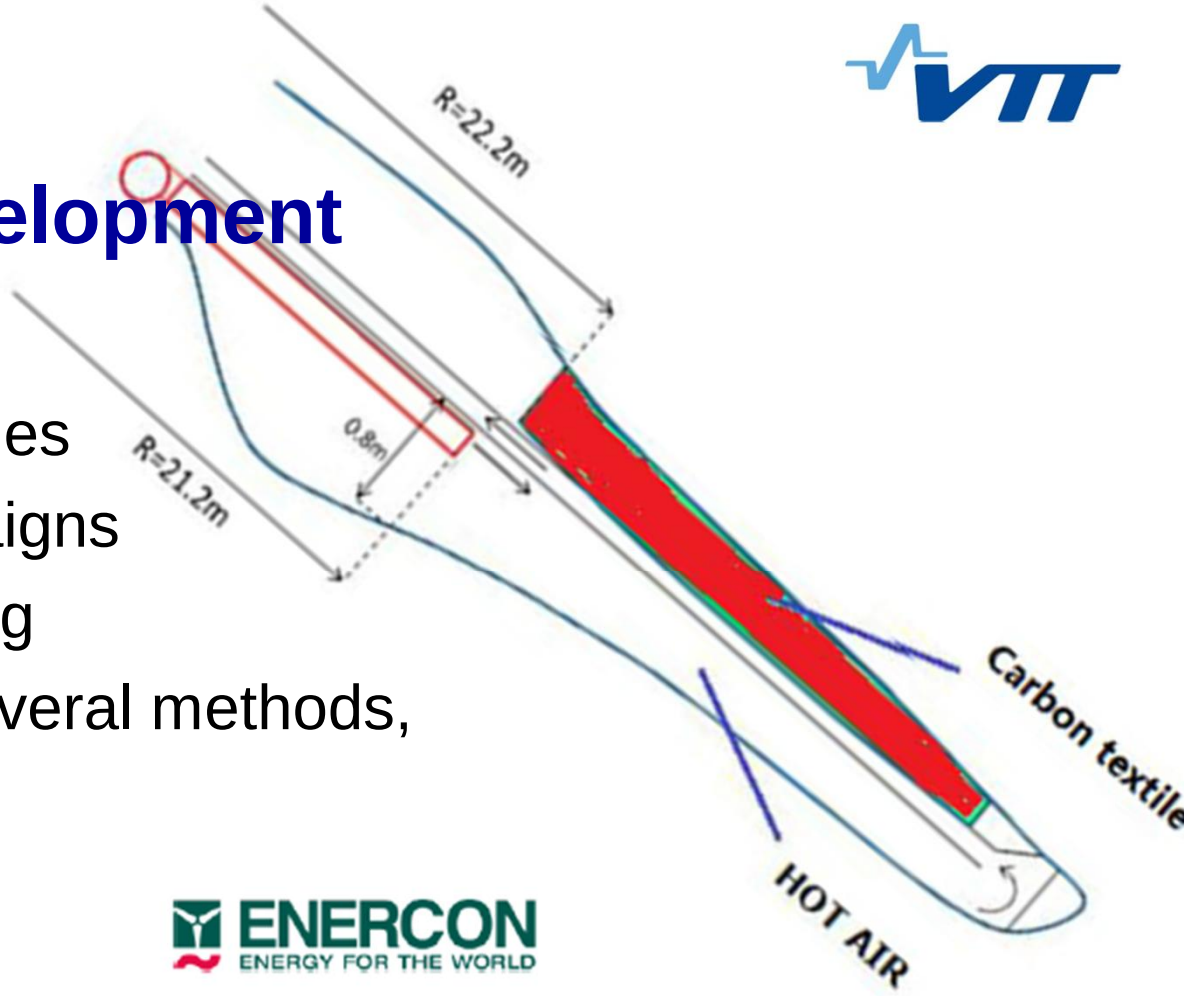
Pens close to ice pieces found near turbines → gloves

Assessing ice throw risk – side note

Norwegians experts on doing risky things

Anti icing, de-icing development

- Manufacturers offering packages
- Experience, monitoring campaigns
- Field/lab tests, also for lightning
- Detecting icing crucial: with several methods, additional to sensors



ENERCON
ENERGY FOR THE WORLD

DongFang

NORDEX

SIEMENS
Ingenuity for life

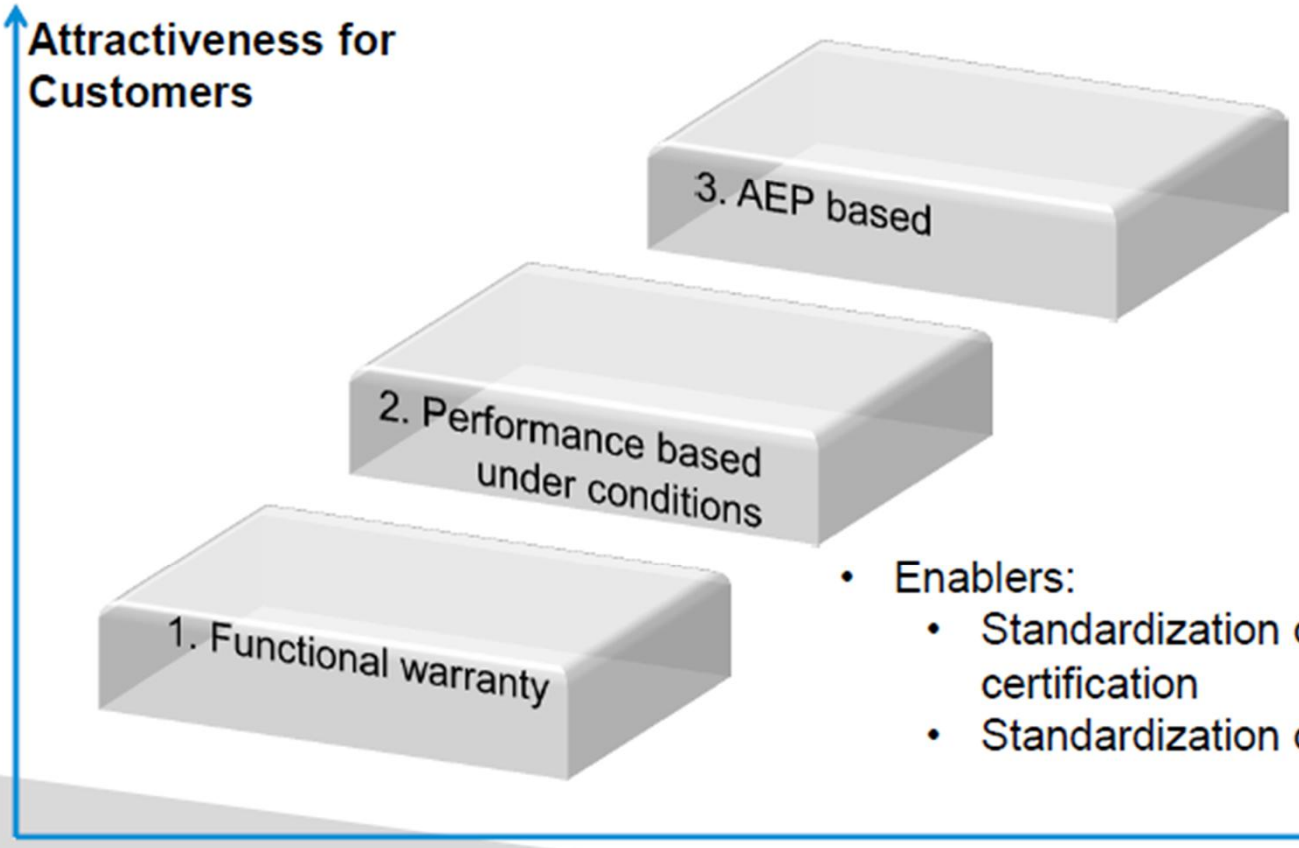
Vestas

Anti icing, de-icing development

- Several systems with track record - guarantees?

De-icing Warranty: Attractiveness vs risk

Market conceptual warranty plan; Supplier path to meet Customers requirements



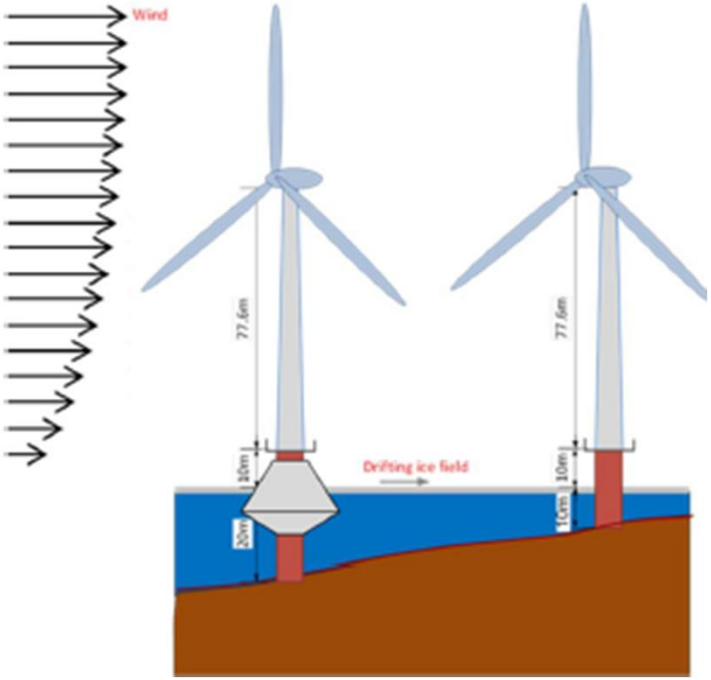
Vestas

- Enablers:
  - Standardization of product certification
  - Standardization of warranty test

Offshore cold climate

- Foundations for ice infested waters
- Access

P.Jordaens



S.Rissanen

Offshore sexy → offshore

In cold climates super sexy?

Related

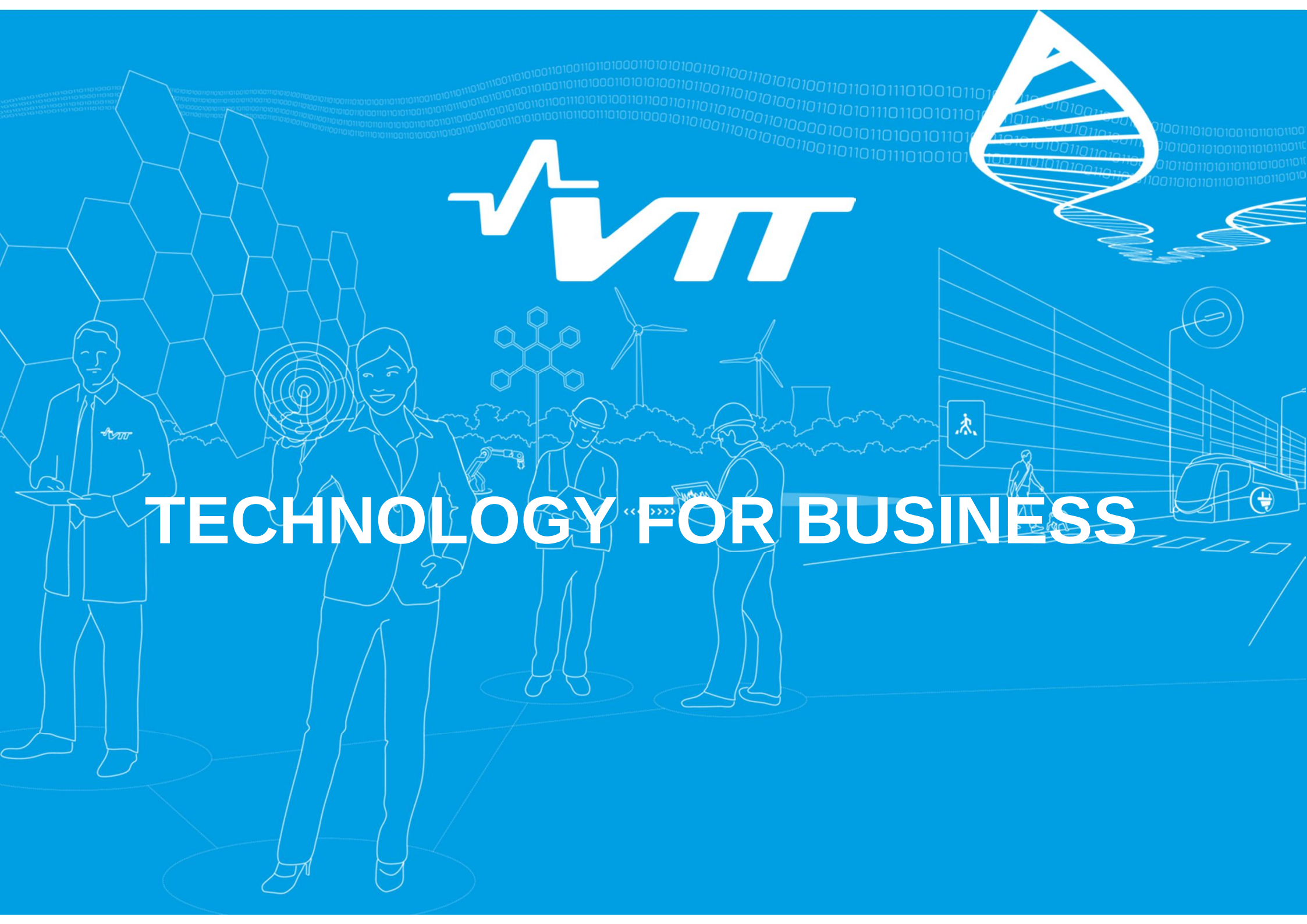
- Noise – impact on ice on vibrations. Impact of snow on dampening noise. Using acoustics as ice detection.
- O&M, big data, lifetime extension
- Hydrid plants for remote off-grid
- Wind integration challenges, keeping the turbines running when electricity needed, with no sudden surprises of icing events
- Transmission and substation icing

Some things remain the same

Next steps

- More efforts, larger projects/collaboration – getting cold climate/icing in the research agenda
- Towards standardisation
- Continue with offering and track record for anti/de-icing – towards guarantees?
- Continue with health and safety /ice throw statistics to confirm safety distances

Go out, tell our CC story!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