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FINNISH EXPERIENCE IN WIND ENERGY APPLICATIONS IN ARCTIC CONDITIONS

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Arctic environment and wind power

- Cold climate conditions vary considerably
 - Lapland and high latitudes are something other than the Alps since there the likelihood of long cold periods is high compared to Central Europe
 - Low annual average temperature and icing means considerable production losses
 - Blade icing is one issue, there are many other cold climate challenges in addition
- Real experience from cold climate is still limited, as the majority of the projects has been more experimental than commercial in nature
- Wind resources are good in Lapland, 2,500...3,000 full load hours could be expected compared with 1,800...2,500 full load hours in southern Finland
- Best winds in winter, when demand is at the highest
- Power demand low in Lapland, existing grids sufficient for the first mid size projects; long transmission lines necessary later

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Can the technology meet the challenge -1

CHALLENGES TO BE FACED:

- Finding the real wind conditions – difficult wind measurements
- Production losses due to blade icing
- Steel resistance in very low temperatures
- Electronics in low temperatures
- Maintenance behind long distances and roads closed by snow



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Can the technology meet the challenge - 2

ARE THE TURBINE MANUFACTURERS INTERESTED AT ALL:

- Where is the market? If in Canada and Sweden, is the market big enough in present market situation to appeal to turbine manufacturers?
- Low profitability in Norway, Finland, Russia – will the market grow?
- Is the market segregated:
 - How useful are Alpine solutions in Lapland?
 - Are robust solutions for Lapland economically justified in the Alpine region?



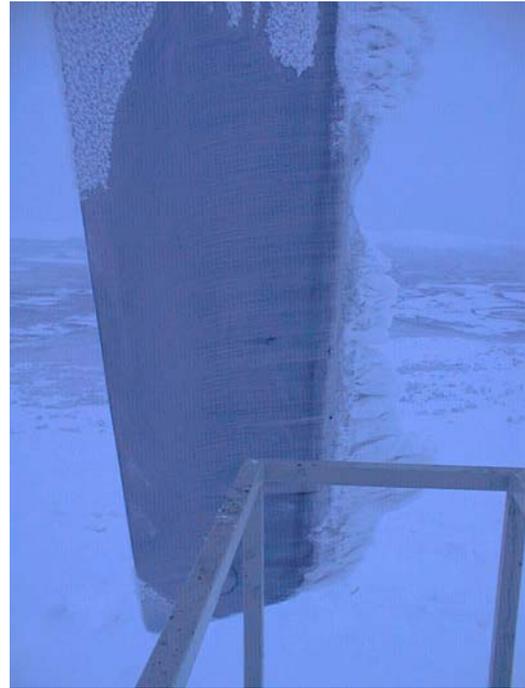
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Development in Finland

STATUS IN FINLAND

- Present installed capacity in Lapland below 5 MW, units 10 years old
- Only few sites over 10 MW identified and considered in Lapland region
- Existing projects indicate good wind resources but difficulties in harvesting the potential, i.e. up to 20 % better winds found compared with the south

Photo : T Laakso



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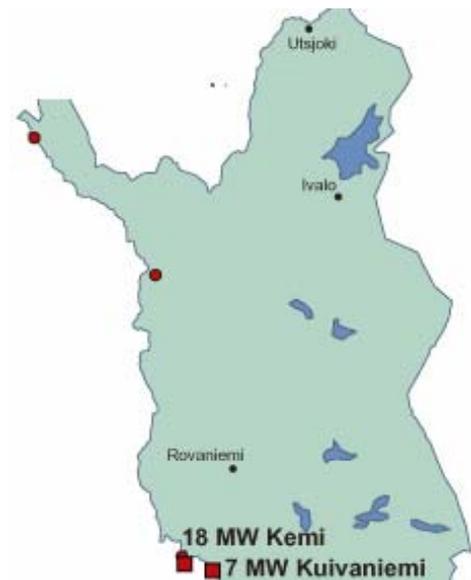
Development in Finland – Bottlenecks or Opportunities

BOTTLENECKS & CHALLENGES

- Temperature can stay clearly below zero for weeks >> blade icing meaning up to 80 % production losses during that period is possible
- Cold climate adapted turbine versions, tailored electronics or preferably full nacelle heating should be applied
- Better turbine availability than so far experienced needed due to long distances and challenging sites access
- Project development more sophisticated, cold climate know-how a must

OPPORTUNITIES

- Good sites available



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What the project developer needs to remember

SITE SELECTION

- **Grid connection costs**
- **Service access**
- **Assessment of the effect of icing – higher winds on the fjelds or perhaps better productivity in less humid valleys and passes**

WIND POTENTIAL SURVEYS

- **Good expertise in wind measurements needed (anemometer choice, data collection security, met mast service)**
- **Correct methods in production forecasts (terrain conditions, icing losses, service losses)**

ENVIRONMENTAL ASSESSMENTS

- **Can you really get permits?**

TECHNICAL SPECIFICATIONS

- **Shopping list versus realism**

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Visible future – Pöyry view

- **Successful demonstration of commercial cold climate technology that can cope with climate conditions of Lapland is missing**
- **Cold climate development will not gather interest before real success stories**
- **Lapland market remains marginal >> big manufacturers leave it to niche suppliers**
- **Blade icing needs to be solved prior to more serious project development; but is heating the best or the only way?**

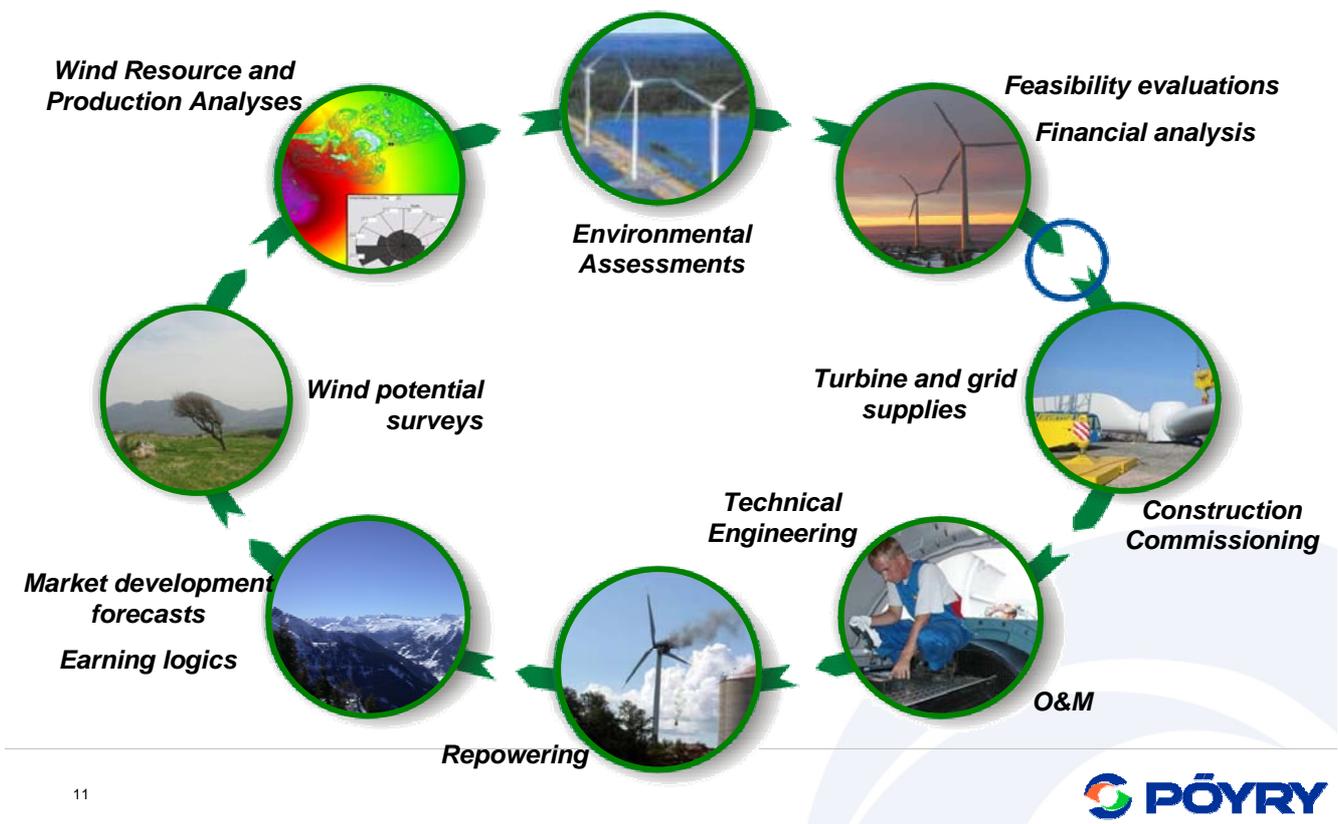


- **First projects will be in easily accessible valleys and in less challenging climate conditions**
- **Developers that have actual cold climate experience are in key position considering future cold climate wind project**
- **Cherry picking- an opportunity**

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Pöyry in arctic wind power - 1



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Pöyry in arctic wind power - 2

- Know-how on cold climate wind turbine technology
- Methods for the evaluation of cold climate effects on a project
- Experience from renewable energy business and project development
 - earning logic
 - site identification
 - pricing models, etc.
- Experienced staff with long international experience in cold climate wind energy projects
- Routines for the preparation of EIAs
- Turbine experts with experience of arctic turbine design
- Ongoing project development activity covers also European high elevated mountain areas

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- Core operations based on three know-how clusters: energy, forest industry and infrastructure & environment
- In Energy: EUR 200 million per year, 1700 energy experts in over 25 countries



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