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CETC CANMET ENERGY TECHNOLOGY CENTRE

Cold Climate Issues and Related R&D Regarding Wind Energy in Canada

Winterwind 2011

Umeå, Sweden, February 9-10, 2011

CLEAN ENERGY TECHNOLOGIES

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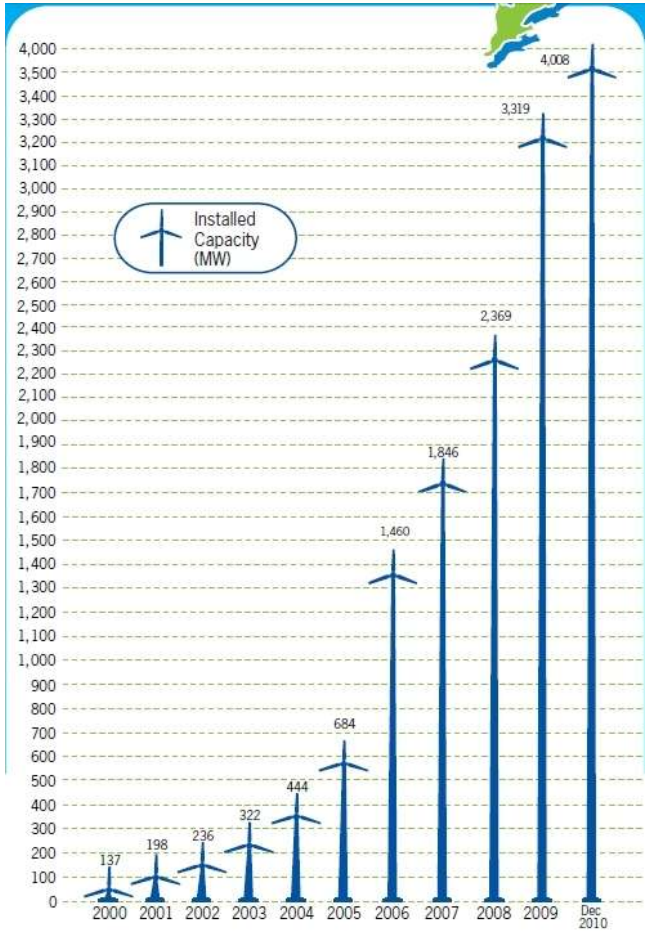
Presentation Outline

- Wind energy markets
- Climatic conditions
- Cold climates R&D projects
- Future activities
- Summary

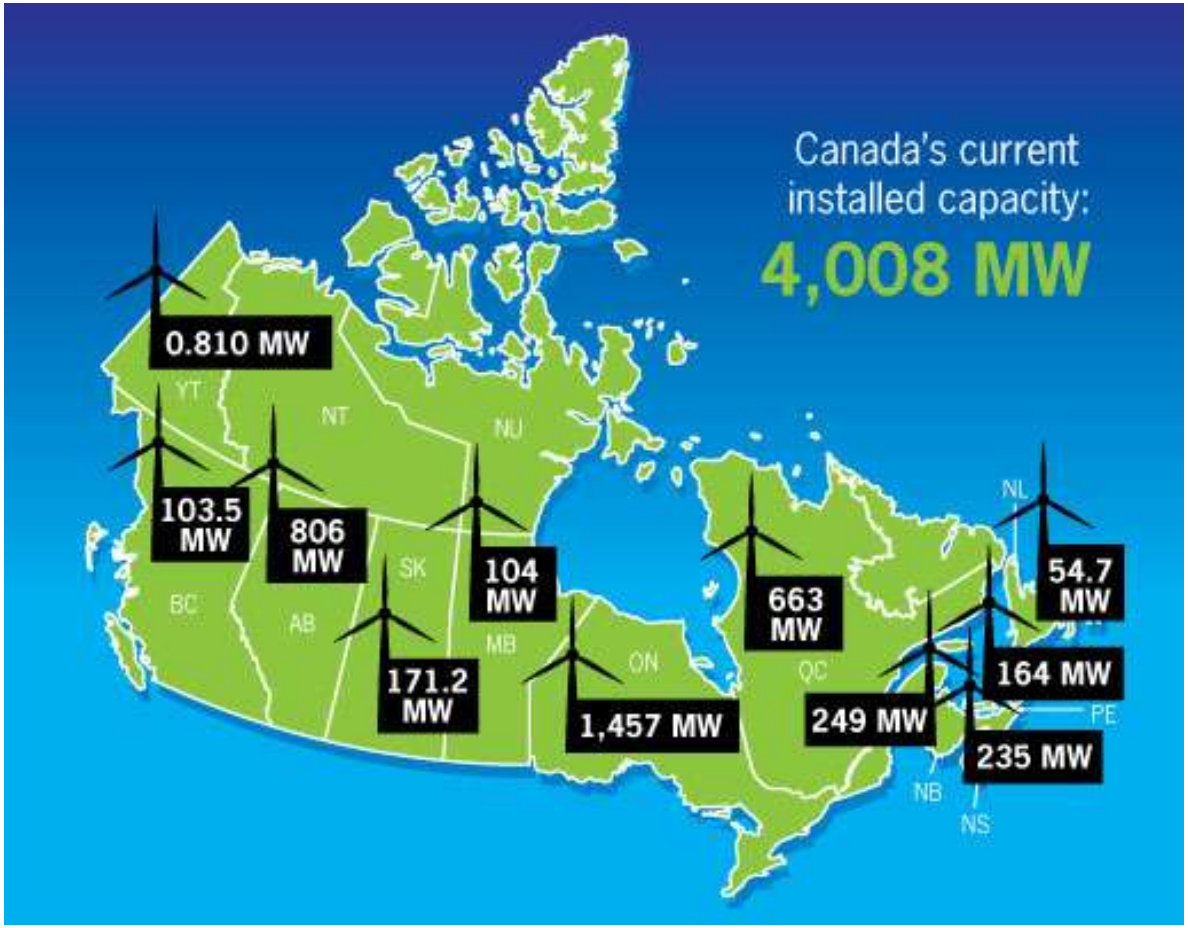
Status of Wind Energy in Canada

- Canada's installed capacity grew by 20% (689 MW)
- Estimated 12.3 TWh produced represented 2.0% of Canada's electricity production
- Provinces targeting 9000 MW+ combined installed capacity by 2015



Growth of Canadian Installed Wind Capacity February 2011 (Source: CanWEA)

Installed Capacity in Canada



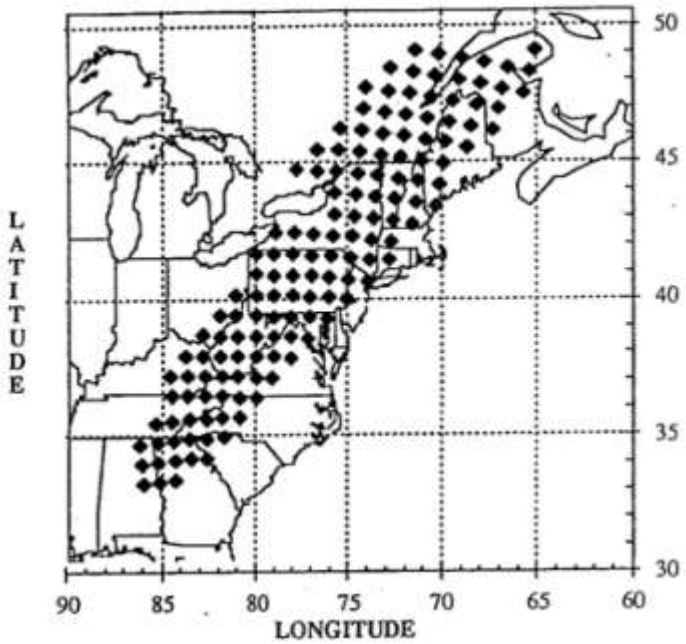
Current Wind Installed Capacity by Province
February 2011 (Source: CanWEA)

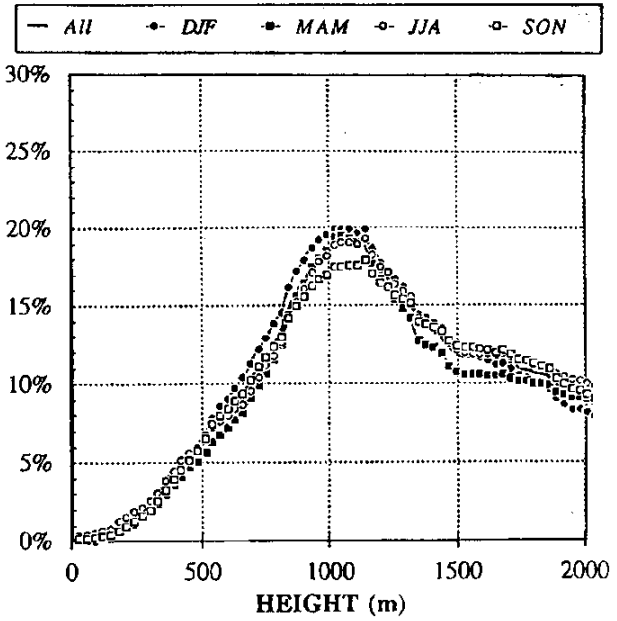
Cold Climate Conditions in Canada

- Low air temperatures
  - Heartland
  - Arctic
- Atmospheric icing :
  - Along the coasts
  - High elevations
  - South central

Rime Ice in Eastern North America

- Realtime Nephanalysis (RTNEPH) survey on clouds presence in the Appalachian domain between 1985 and 1987 sponsored by the U.S. Air Force



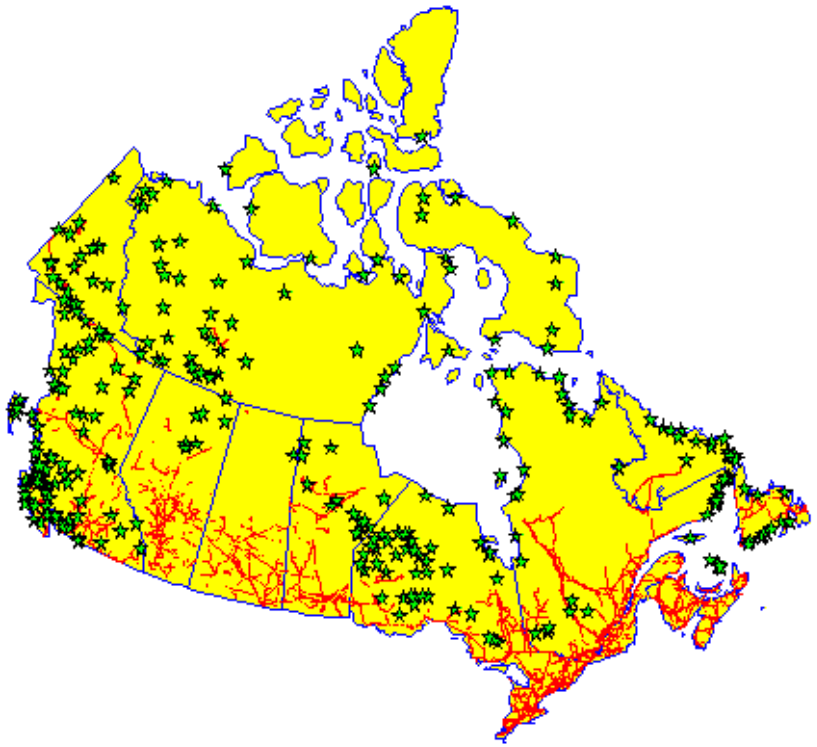


Source of illustrations: Bailey, B.H. (1990) The Potential for Icing of Wind Turbines in the Northeastern U.S., Windpower 1990: 286-291

Severe Icing

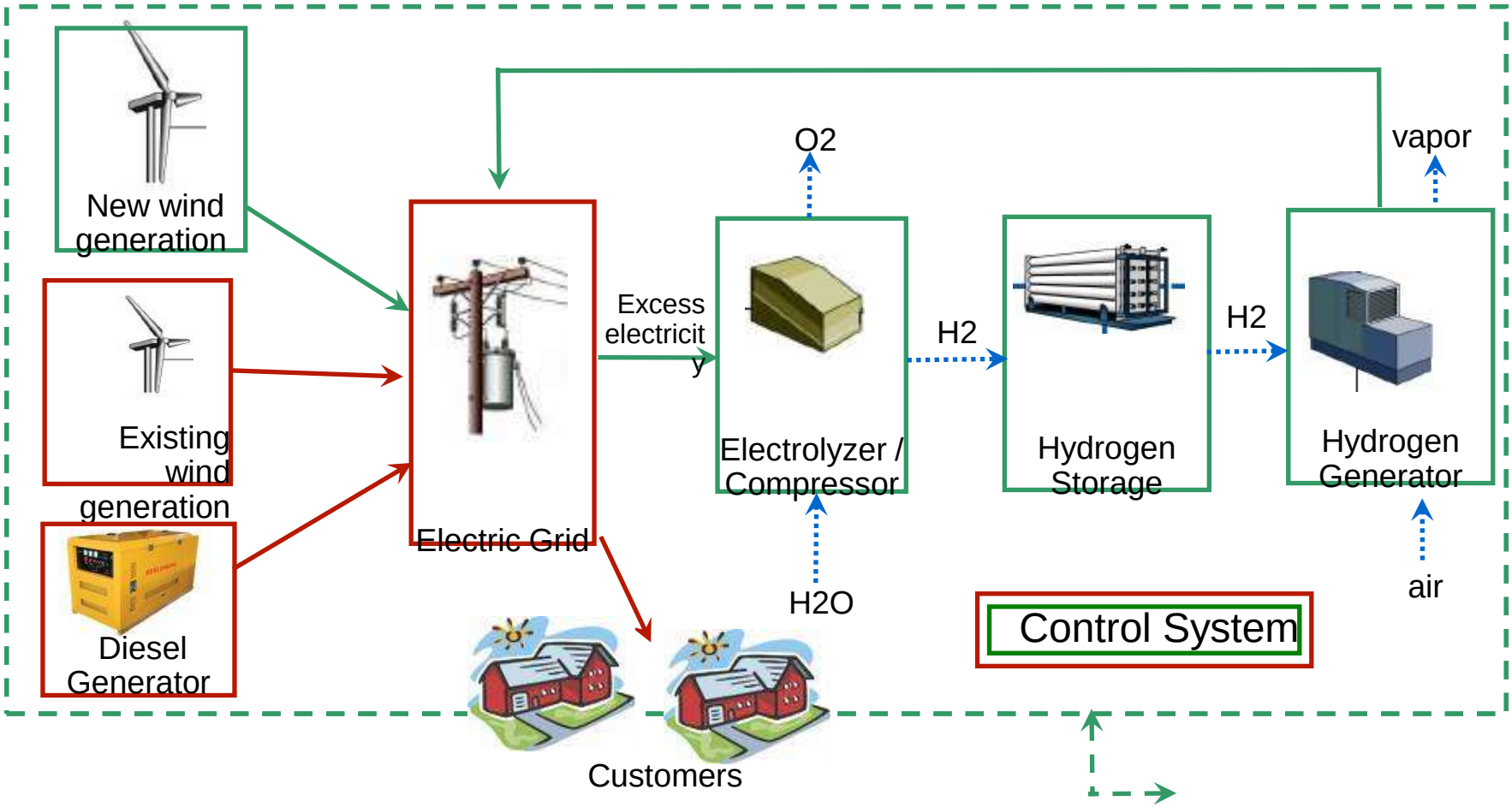
Remote Communities in Canada

- 310 Remote communities in Canada
  - Not connected to the grid
  - Powered by Diesel generators
  - 163 with wind energy potential
  - High penetration installation potential of 347 MW
  - First successful wind-diesel in Ramea in 2004
  - Wind in remote communities: sounds promising but progress is slow



Remote communities in Canada. (Source: NRCan)

Wind-Diesel-Hydrogen Development in Ramea, NL



Wind-Diesel-Hydrogen

- First wind turbines installed in 2004
- New capacity added for hydrogen storage
- Wind capacity
  - 690 kW:
    - 6 x 65-kW Windmatic
    - 3 x 100-kW Northern Power 100

65-kW wind turbines in Ramea, NF

Components

- Incorporation of hydrogen to Ramea wind-diesel system
  - Electrolyzer
    - 324 kW, (30 Nm^3/h)
  - Storage
    - 3×1000 Nm^3 @ 10 bars (145 psi)
  - Hydrogen genset
    - Internal combustion engine – 250 kW
- Possible research study on interaction between wind turbines and wireless communications

Electrolyzer

Wind-Diesel-Hydrogen Installation

Hydrogen Storage Tanks

Future Activities

- Tower instrumentation
- Characterization of
  - icing
  - wind speed and direction
  - air temperature
  - humidity
  - duration of icing
  - correlation between the above
    - Identify the amount of energy at low air temperatures and during icing events

Climatological Information in Support of Cold Climate Issues

- Use of climatological information for renewable energy applications
  - Work using the NWP meso-scale modelling approach is still in the early stages with no concrete results yet
    - Early efforts in this work contributed to the update of design icing thickness due to freezing rain for the 2010 CSA electrical transmission line standard
    - Work is underway at EC to estimate ice accretion from frozen wet snow
    - NWP approach will be especially important for rime icing in exposed coastal and high elevation locations
      - where there are few standard meteorological observations

Summary

- Wind energy in cold climate is definitely an issue in Canada
  - Cold air temperature affects a majority of the country
  - Best wind resources are often located in ice prone areas
  - A lot remains to be known about rime icing
  - Glaze ice will be an issue for offshore projects
  - Production loss due to icing difficult to evaluate
  - Cold climate wind energy R&D infrastructures in Canada are developing (TechnoCentre éolien & WESNet)