



# Wind-Hydrogen-Diesel Energy Project

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### **Presentation Outline**

- Newfoundland & Labrador Hydro
- Three Regions Three Strategies
- Ramea
- Ramea Wind-Hydrogen-Diesel Energy Project
- Questions





### **Newfoundland and Labrador Hydro**



## Who are we?

- 4<sup>th</sup> largest power utility in Canada
- Installed generating capacity: 7307 MW
- Operate one of the world's largest underground hydropower station
- Generate and transmit over 80% of the province's electrical energy
- Have expanded operations into wind generation, oil and gas, and research and development



## **Key Areas of Focus**

- Focused on safety, environment, conservation, operational excellence and our ongoing community investment in NL
- Safety performance is paramount to our business
  - Our objective zero injuries
- Responsibility to protect our environment in concert with our operations (ISO 14001 certified)
- Committed to helping all electricity consumers conserve energy







### **Newfoundland and Labrador Wind**

Three Regions  $\rightarrow$  Three Strategies



### **Labrador Wind Potential**

- NL Hydro is investigating potential for large scale wind development in Labrador
- Currently monitoring resources to determine potential
- Project is tied to Lower
  Churchill hydroelectric project
- Focus on Labrador wind is on export markets due to small domestic market





### **Newfoundland's Wind Resource**

- Feasibility study completed in 2002
  - NL has world-class wind resource
  - Better in coastal areas
  - Potentials for many 100's of MW
- Limited in the amount of wind that can be absorbed into the Island system
- Currently 54MW in development to be in operation by end of 2008
- Will replace 300,000 barrels of oil annually (equal to 32,000 vehicles) and reduce emissions from thermal generation by 15%

Focus is to displace fuel and meet new load





### **Isolated Communities**

- 6 systems on the island,15 in Labrador
- Currently dependent on diesel fuel
- Create a renewable future

Focus is on research & development activities to reduce diesel consumption







#### Ramea Energy Supply Past, Present, Future



## Ramea Community Profile (2007)

- Island community on Southwest coast
- No mainland connection (1.5 hour ferry ride)
- 613 residents
- Peak Load -1,199 kW
- Energy 4,454 MWh
  - 4,191 MWh diesel
  - 263 MWh wind





### Ramea – Past (Prior to 2004)

- Energy Supply 100% Diesel
  - ✤ 3 x 925kW Generators
  - Fuel Consumption:
    1.1 Million litres/year
- Average of 3300 tonnes of emissions per year since 2000
  - Carbon Dioxide, Nitrous Oxides, Sulphur Oxides





## Ramea – Present (Since 2004)

- Site of Wind-Diesel Demonstration Project
- Power Purchase Agreement (PPA) with Independent Power Producer (IPP) Frontier Power Systems to supply wind power
- Statistics
  - In-service Fall 2004
  - 6 x 65 kW Windmatic wind turbines
  - Total installed capacity 390 kW
  - Medium penetration wind-diesel





## **Demonstration Project Operating Highlights**

- Since 2004:
  - 1,200,000 kWh of wind power purchased
  - Represents approximately 10% of Ramea's energy requirements
  - Offset over 325,000 litres of fuel & 930 tonnes of pollution
- Limits to existing installation:
  - Will likely not achieve more than 15% of requirement
- High wind periods do not match high load periods - resulting in excess energy not used; sent to "dump load"





## Why Storage?

- Existing Wind-Diesel Configuration
  - annual wind energy available......1025 MWh (based on 390 kW wind farm & 30% annual capacity factor)
  - annual wind energy absorbed...... <u>- 400 MWh</u> (based on 2005-07 operating statistics)
  - wasted wind energy ...... 625 MWh
- More than 50% of the wind energy in the current configuration has been wasted because it can not be absorbed into the isolated diesel grid. This energy (and more!) will be used to power the hydrogen creation system and contribute to the firm power requirements of the community.





#### Ramea – Future

- Site of Wind-Hydrogen-Diesel Energy Solution R&D Project
- Install high penetration wind system
- Excess wind energy is used to produce hydrogen
- Hydrogen
  - Burned emission free in internal combustion engine
  - Dispatchable, similar to diesel, but without the environmental impacts
- When the wind dies down will have a renewable energy source





#### **Wind-Hydrogen-Diesel Energy System for Ramea**



## Ramea WHD Project Partners and Collaborators

#### Joint Industry/Government/ University Initiative

- Newfoundland and Labrador Hydro
- Natural Resources Canada
- Memorial University
- University of New Brunswick
- Atlantic Canada Opportunities Agency





## **System Modelling & Equipment Selection**

Equipment Type	Sizing
Hydrogen Genset	250kW
Hydrogen Electrolyser	162 kW
Hydrogen Storage	2000m <sup>3</sup> @ 145psi
Wind Turbines	3-100kW

- Modeling completed by NL Hydro in HOMER
- Working with Memorial University: simultaneously running independent model
- Component supply tendering ongoing

## **Preliminary Economics**

- Potential to offer a cost competitive alternative to diesel generation for remote/isolated systems.
- Environmental accounting will further enhance the economic attractiveness
- Will position NL Hydro to be a leader in capitalizing on the commercial potential of the system.
- NL Hydro has, and will continue to, leverage both private and public partners to lessen the capital burden of the demonstration phase of the WHD Energy Solution.







## **Environmental Benefits**

#### Initial WHD Demonstration in Ramea

- Additional 425,000 kWh of diesel energy production displaced
  - 110,000 litres of fuel saved annually
  - 320 tonnes/year carbon dioxide (CO<sub>2</sub>)
  - 6 tonnes/year nitrogen oxide (NO<sub>x</sub>)
  - 0.4 tonnes/year sulphur dioxide (SO<sub>2</sub>)

#### 1<sup>st</sup> Full Scale WHD Implementation

- 1,000,000 kWh of diesel energy production displaced
  - 270,000 litres of fuel saved
  - 750 tonnes/year CO<sub>2</sub>, 16 tonnes/year NO<sub>x</sub>, 1 tonnes/year SO<sub>2</sub>



### **Opportunities & Challenges**

#### Opportunities

- Be one of the first in world for large scale isolated wind/hydrogen/diesel
- Intellectual property development
- Reduce (ultimately replace!) reliance on diesel fuel
- Reduce pollution

#### Challenges

- Effective integration of multiple energy sources
- Commercialization





