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Wind-Diesel R&D at Natural Resources Canada

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CLEAN ENERGY TECHNOLOGIES

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Presentation Overview

- Small Wind Market Survey
- Universal Wind Turbine Project
- Wind-Diesel Development
 - Ramea
- Hydrogen Integration at Ramea
- Tuktoyaktuk Project



Small Wind Turbine Market Survey

- Background:
 - Why? SWT market not well-understood
 - Goals:
 - Profile current market for small wind electric turbines
 - Develop an action plan for the development of this market
- Research method
 - Interviews with 23 experts in Canada and the U.S.
 - Manufacturers, utilities, distributors, retailers, researchers and industry associations.
 - Survey to all players in SWT supply chain:
 - Sales data, current and future markets
 - Response rate: 46 of 135 players (34%)
 - Assumed coverage: 75% of market



Small Wind Turbine R&D

- **Universal Small Wind Turbine**
 - **Universal Inverter**
 - Currently tested at WEICan
 - 50, 60 Hz; 3 and 1 phase, AC & DC
 - Work with synchronous (PM) and asynchronous (induction) generators
 - Net-metering and stand-alone
 - **60 kW Direct-Drive Generator**
 - Permanent magnet
 - Gearless



Universal inverter undergoing tests at WEICan

Ramea Wind-Diesel Project

- Community profile:
 - Island is located off Southwest coast of Newfoundland
 - 354 Customers/631 Residents
 - Peak Load - 1,078 kW
 - Annual Energy - 4,201 MWh
 - “Big” Small Community
 - Significant existing infrastructure (Roads, Ferry Terminal, Modern Diesel Plant, etc.)
 - Right size for experimentation
 - Commissioning of first Wind-Diesel demonstration project in Canada in 2004



Isolated Diesel Systems. Source: Nalcor Energy



Ramea Wind-Diesel Project

- Before wind:
 - Energy Supply 100% Diesel
 - 3 x 925 kW Generators
 - Fuel Consumption: 1 Million litres/year
 - Average of 3300 tonnes of emissions per year since 2000: CO₂; NO_x; SO₂
- Ramea currently:
 - Power Purchase Agreement (PPA) with independent power producer to supply wind power
 - In-service Fall 2004
 - 6 x 65 kW Windmatic wind turbines total installed capacity – 390 kW
 - Medium penetration wind-diesel (15%)
 - WDICS - NRCan's unique control system integrates wind with existing diesel generation

Island Town of Ramea



Wind farm in Ramea



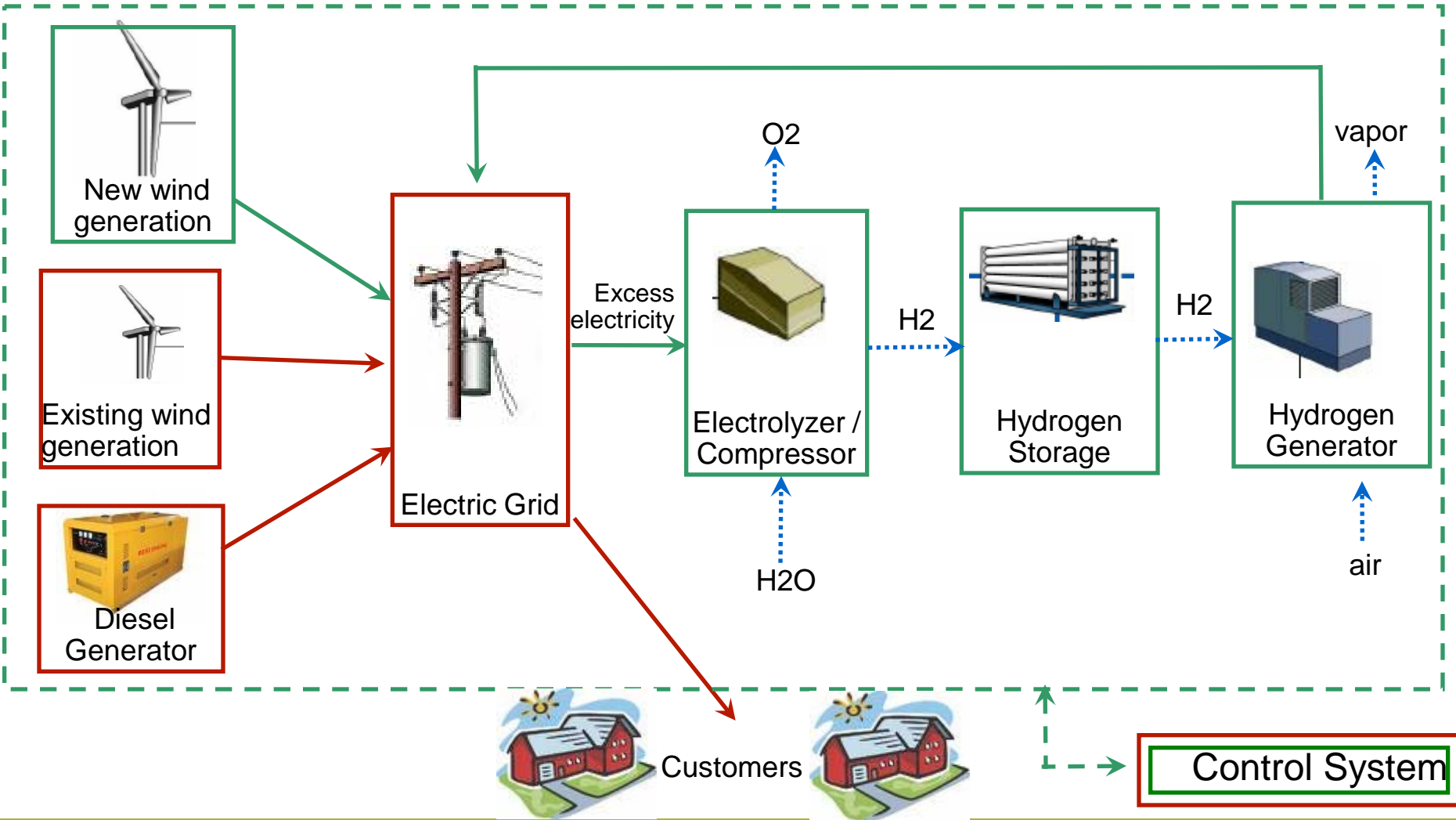
Ramea Wind-Diesel Project

- The Need for storage:

- Existing Wind-Diesel Configuration
- Annual Wind Energy Available 1025 MWh
(based on 390 MW Wind Farm & 30% Annual Capacity Factor)
- Annual Wind Energy Absorbed - 420 MWh
(based on 2005 Operating Statistics)
- **Wasted Wind Energy 605 MWh**
- > 50% of the Wind Energy in the current configuration is 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 WHD Project



Ramea WHD Project

- Environmental benefits:
 - Initial WHD Demonstration in Ramea
 - Will displace additional 425,000 kWh of diesel energy production
 - Will save 120,000 litres of fuel
 - 320 tonnes/year carbon dioxide (CO₂), 6.8 tonnes/year nitrogen oxide (NO_x), 0.43 tonnes/year sulphur dioxide (SO₂)



NRCan Hydrogen Generator

- Known, reliable internal combustion technology
- Lower cost than fuel cell
- Previous operator experience



HEC 250 kW H₂ Genset

NRCan Hydrogen Generator

- 250 kW (4+1 engines, 4 x 62.5 kW)
- Supplied by Hydrogen Engine Center Canada
- Based on 4.9 L (300 in³) in-line 'straight 6' Ford engine
- Post-testing: Loaned and delivered to Nalcor Energy



Interior View of HEC 250 kW H₂ Genset



Observations

- Identifying funding to cover both development and implementation is a difficult hurdle
- It could provide a viable option for reducing the amount of diesel fuel used in remote communities with good wind resources.
- A successful implementation of the project could demonstrate a clean energy option not only for the remote communities in Canada but also for those around the world subject to high energy and transportation prices
- Introducing wind with hydrogen storage and power generation technologies will diversify local energy supply thus enhancing energy security



Tuktoyaktuk

- Instrument a wind turbine for the upcoming wind project in Tuktoyaktuk, NT
- Rationale for the project:
 - Several wind-diesel projects have been attempted in Northern Canada since the 1980's with limited success
 - Utilities have been distrustful of wind
 - Nonetheless, the potential for benefits exist
 - Document the challenges of the North and address the issues appropriately



Tuktoyaktuk

- Funding provided to document:
 - Atmospheric conditions
 - Condition of components
 - Gearbox, lubricants, generator, control panels
 - Parameters
 - Temperature
 - Vibrations
 - Operational status
 - Production data
 - Availability of turbines
- Monitor foundations built in permafrost
- Better assess the potential for wind-diesel in the North



Summary

- NRCan has been supporting wind-diesel initiatives
 - Market survey and components
 - Instrumental in developing control system
- To augment wind penetration in wind-diesel projects, storage must be addressed
- The Tuktoyaktuk project will provide operational data that will be useful in the planning of upcoming projects



More Information

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Thank You!

