

# Microgrid Integration Research

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# Outline

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- Microgrid for Remote Communities:
  - General Project description
  - Microgrid structure
  - Integration research
- Research issues:
  - Modeling
  - Control
  - Dispatch
  - Integration

# Microgrid for Remote Communities



Ontario Centres of  
Excellence



Protection, Control & SCADA Systems



imagination at work



CAPTURING NATURE'S ENERGY



# Microgrid for Remote Communities

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- Many communities in Canada and remote communities in the rest of the world are not connected to 'the Grid' and are dependant on other means to supply electrical energy to their community
- Remote Communities in Northern Canada have no road access
- The dominant source of electrical energy for these communities is through diesel fuel burning 'gen sets'
- Diesel fuel must be supplied to these communities
- All of the community supply comes from brief winter road access or by air

# Microgrid for Remote Communities

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- Need for clean, reliable renewable electricity in remote communities of Canada and the world
- Reduce energy costs and cost uncertainty – fuel and transportation
- Energy costs in remote Canadian communities can be many times greater than a grid connected community
- Reduce potential damage to environment from fuel transportation and emissions (gases and particulates)

# Microgrid for Remote Communities

Kasabonika Lake



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Sa Majesté la Reine du chef du Canada, Ressources naturelles Canada.

# Microgrid for Remote Communities

- Existent system: Three Diesel Generators 1000, 600, 400 kW
  - Diesels work well – well-known technology for many years
  - Many are familiar and comfortable with operation
  - Require regular attention (maintenance, service, replacement)



One diesel gen set



Diesel tank farm



# Microgrid for Remote Communities

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- Develop local renewable energy sources (wind, hydro, biomass, geothermal, solar)
- Develop wind turbines specifically for installation and operation in the climatic conditions of the remote community
- Develop energy storage media to supply low wind periods
  - currently planning hydrogen generation, storage and fuel cells
  - many other possibilities
- Develop micro grid controller to integrate and control multiple energy sources
- Engage community in entire process

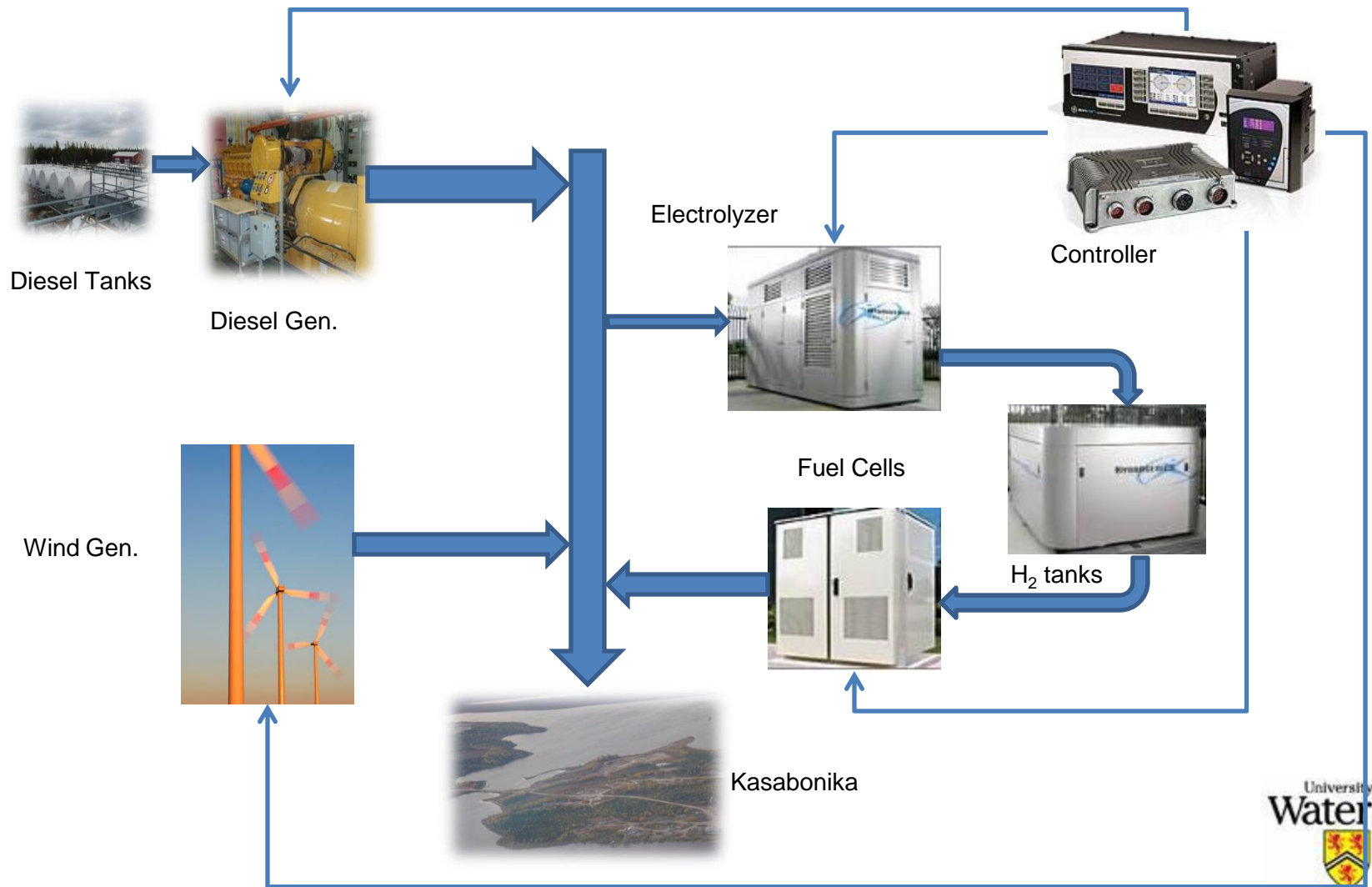


# Microgrid for Remote Communities

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- Multi phase project:
  - Research on components and integration at Waterloo
  - Demonstration site at Hydro One (Owen Sound)
  - Demonstration site at Kasabonika Lake FN
- Research projects in:
  - Wind energy
  - Hydrogen generation/storage/utilization
  - Microgrid
  - Community engagement
- Significant Ontario industry partners
- University of Waterloo expertise and researchers

# Microgrid for Remote Communities



# Microgrid for Remote Communities

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- Microgrid integration research:
  - Modeling of different micro-grid components
  - Wind-gen. simulator studies.
  - Steady-state and dynamic studies.
  - Voltage and frequency control.
  - Operation strategy development.
  - Implementation and evaluation of controller.
  - Improving power management algorithm.
  - Testing, verifying and improving controller.

# Microgrid Integration Research

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- Microgrid models:
  - Components.
  - System.
- Power system studies of microgrids:
  - Power flow.
  - Voltage stability: regulation and loadability.
  - Eigenvalue analyses.
  - Transient stability.
- Operation:
  - Voltage and frequency regulation and control.
  - Optimal dispatch.
  - Protection.
  - Interaction with main power system for grid-connected microgrids.
- Economics and interplay with electricity markets.