RENEWABLE ENERGY: CURRENT ENERGY STATUS IN KLFN, TECHNOLOGIES, CHALLENGES & PROJECT DEVELOPMENT

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OUTLINE

- Kasabonika Lake First Nation.
  - Energy status.
  - Path forward.
  - Solutions.
- ecoEII project:
  - Project partners.
  - ecoEII project description.
  - Challenges of Renewable Energy (RE) projects in First Nations.
  - Community energy data required for RE project assessment.
  - RE project development guidelines.
  - Conclusions.

KASABONIKA STATUS

Å Socioeconomic:

» Population: 1,100 people on-reserve.
» K-12 school, 50% youth.
» High unemployment/welfare.
» Need jobs!

Å Energy:

» Current diesel engine plant: 1MW, 600kW, and 400kW.
» Load restrictions starting in 2007: 75% plant capacity.
» Today 90% plant capacity has been reached.
» Brownouts and blackouts frequency has increased.
» 1.5 MW expansion planned started in 2009 but likely to be commissioned until 2016/2017.

PATH FORWARD

- Electrification and energy are the foundations to economic development.
- Diesel-fuel dependency is increasing:
  - Heating.
  - Electricity.
  - Vehicles.
  - Personal use.
- Challenges for economic development:
  - Job creation, training and employment.
  - FN is the largest employer.
  - Government transfers represent 85% of jobs.

SOLUTIONS

- Previous:
  - 1997: Wind turbines (3x) installed by HORCI.
  - 2005: Community Energy Plan (CEP) in collaboration with Pembina Institute (PI) and Shibogama Technical Services (STS).
  - 2007: Community Demand Management by HORCI.
  - 2007: Waterpower site investigation.
  - 2009: R&D project:
    - Wenvor wind turbine project: installed.
    - Hydrogen storage: not implemented.

SOLUTIONS

Å On-going:

- » 2012: ecoEII project with the University of Waterloo.
- » 2013: Solar PV panels, for self-consumption, deployed at the water treatment plant in collaboration with STS.
- » 2014: OPA program: CEP II in collaboration with PI and STS.
- » Multiple use of current facilities.

SOLUTIONS

Å Potential:

» Further wind, solar, and diesel generation mix.

» Heat recovery turbine.

» Net metering and electricity export from renewable energy.

» Transmission line: Wataynikaneyap Power.

Å Constants:

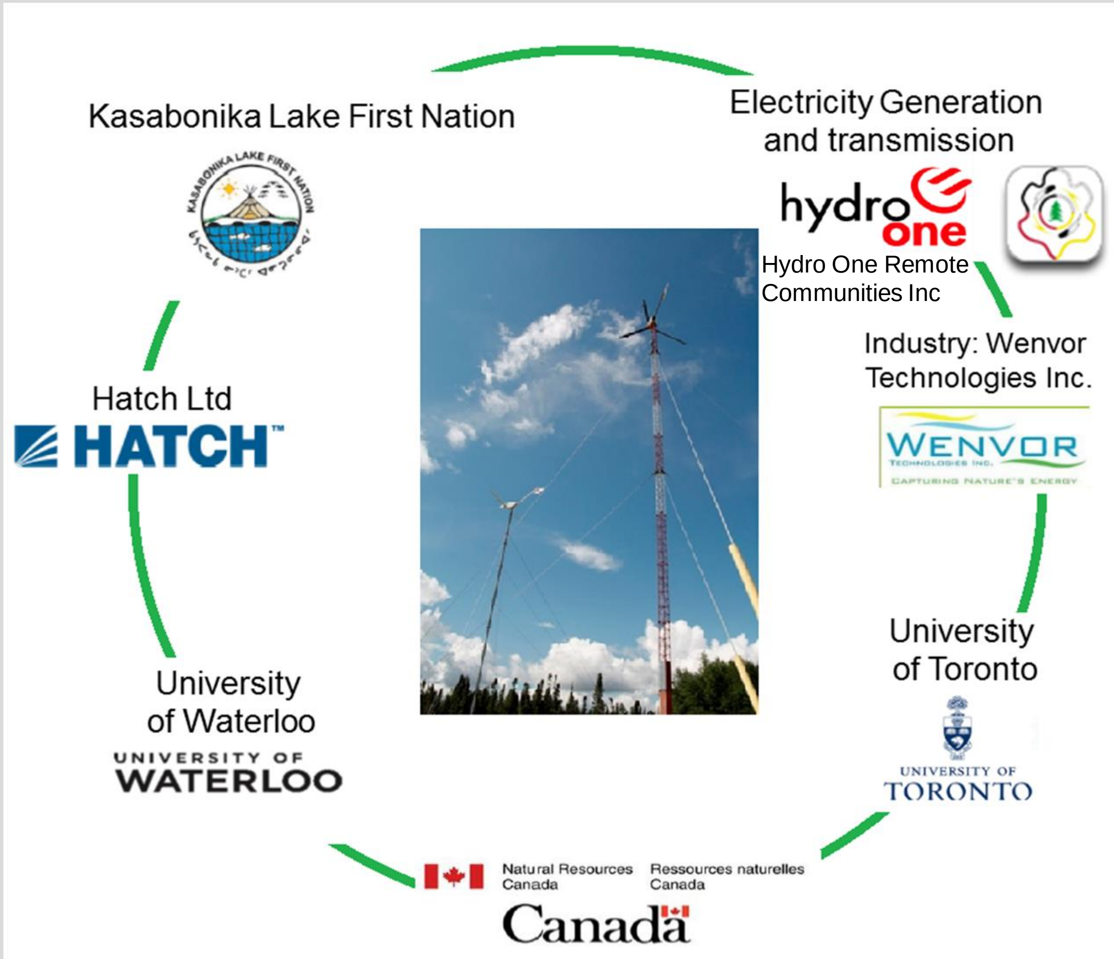
» Expert knowledge and cooperation

Å uWaterloo, U of T, industry, government, and First Nations.

» Capacity building:

Å Membership knowledge, awareness and technical skills.

ECOEII PROJECT PARTNERS



ECOEII DESCRIPTION

- Å EcoEII program objectives:
  - » Creation of high quality jobs, the generation of new economic opportunities and the protection of the environment.
- Å Joint project objectives:
  - » Develop, test and demonstrate a commercially viable utility grade controller for an islanded electrical grid with medium to high penetration renewable generation.
  - » Feasibility and system planning studies, in collaboration with the Kasabonika Lake First Nation (KLFN) community; these studies will address:
    - Å technical,
    - Å economic and
    - Å social aspects.

ECOEII PROJECT DESCRIPTION

A shared vision among project partners:

- Identification of pathways for renewable energy

Expected project results:

- The promotion of RE as a low impact energy source.
- The promotion of lower carbon intensity microgrids.
- The creation of markets for renewable energy microgrid systems.

Source: KLFN community visit, August 2013

RE CHALLENGES IN FIRST NATIONS

Å Decisions on the transformation of the local energy system are influenced by (Foxon, 2011):

- » Technology choices: Wind, solar (photovoltaic, hot water), geothermal, landfill gas and biogas, municipal solid waste (waste-to-energy), small hydropower, and fuel cells.
- » Ecological systems:
  - o Local values, views and traditional knowledge.
  - o Environmental regulations.
- » Institutions:
  - o Local First Nation strategies on their economic development.
  - o HORCI and IPA.
  - o Budgetary, legislative and regulatory constraints.
- » Business strategies: Current business environment may affect decisions (e.g. consolidation in the PV-industry influences PV prices).
- » User practices: Conservation habits, domestic and work habits, performance of buildings, may influence the uptake of renewable energy.

Source: http://www.manitoulin.ca/first-mcleans-wind-turbine-spins-this-week/#sthash.O0XOtEdI.dpuf

Source: https://www.cbt.org/uploads/pdf/GeoffBattersby_AlternateEnergy.pdf

RE CHALLENGES IN FIRST NATIONS

Å Decisions on the deployment of renewable energy at the local level are influenced by:

- » Cost of energy generated depending the resource availability.
- » Jobs and economic development targets.
- » Environmental impact.
- » Energy security and resilience of communities.
- » Transmission and grid integration:
  - o Matching supply and demand through storage.
  - o Demand side management and control.
  - o Access to the provincial grid.

Source: http://www.hydromega.com/production-sites.aspx

Source: http://www.nan.on.ca/upload/documents/energy2012-pr-kevin-mann---shoulderblade-falls.pdf

RE INTEGRATION PLANNING

Å Community Energy Planning (CEP) can assist communities to ñdocument local priorities for how energy should be generated, delivered and used within the community now and into the futureò (Evenson et al., 2013).

Å Steps in RE integration planning:

» Identify community visions of the future of the energy system (as part of the overarching visions for self-reliance and self-governance) based on local needs, values and resources.

» Create baseline studies and energy mapping based on community energy data.

» Create a set of scenarios that examine the impacts of actions (conservation, integration of RE, electricity and heating solutions) towards the different visions, taking into consideration costs, benefits, issues, constraints, risks and uncertainties, interdependencies of assets and local resources.

» Develop a Community Energy Plan, that best fits with the communityôs visions through an iterative reviewing process.

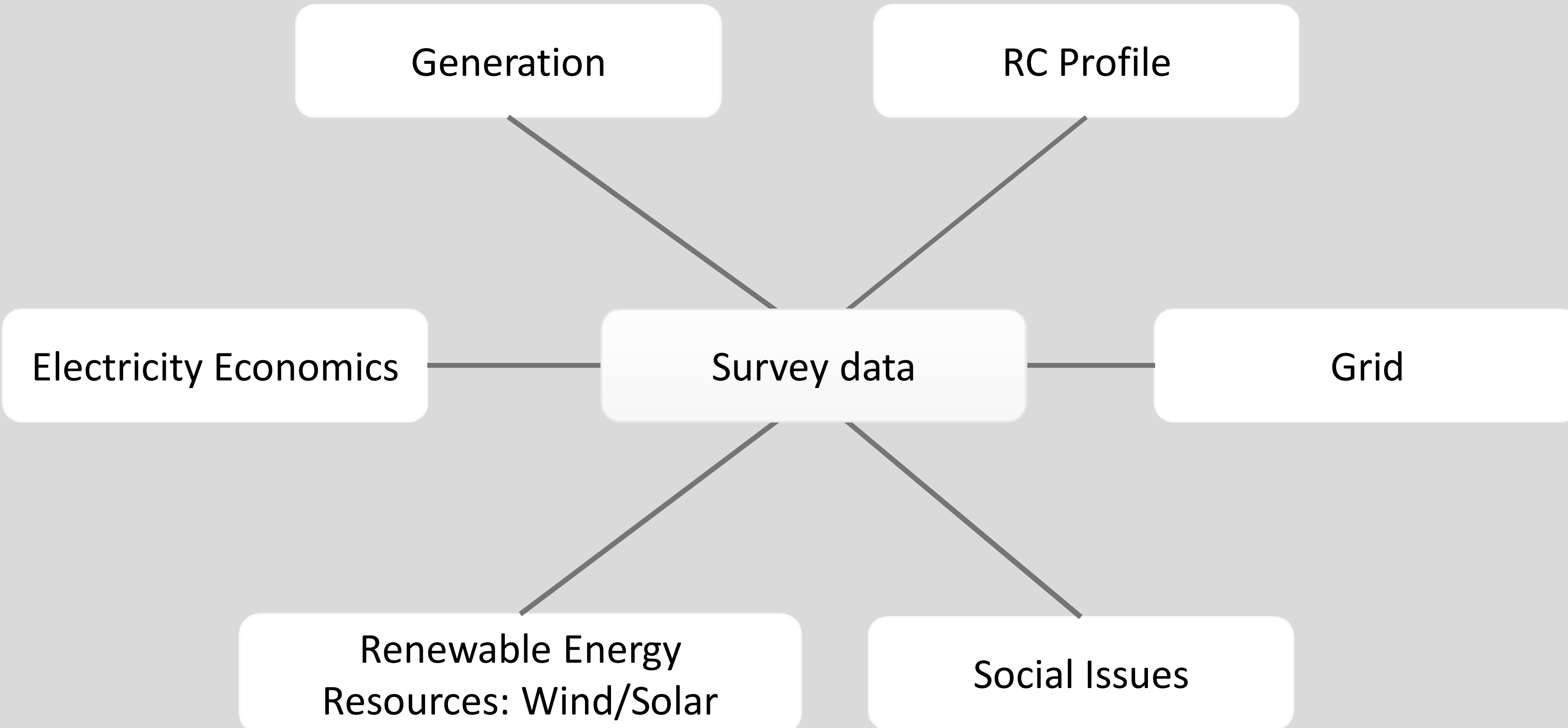
POTENTIAL SOCIOECONOMIC BENEFITS

Å General benefits:
  » Lower carbon intensity.
  » Greater self sufficiency.
  » Increased renewable energy.
  » Economic development.
  » Employment opportunities.

Å For remote communities:
  » Active participation in the engagement process and report on lessons learned regarding social aspects.
  » Improved strategies for community engagement and integration.
  » Opportunity for knowledge transfer and remote community staff training.

Source: KLFN community visit, August 2013

COMMUNITY ENERGY DATA



COMMUNITY ENERGY DATA

Å Remote Community Profile:
- » Annual energy demand and growth.
- » Peak demand and growth.
- » Annual fuel consumption.
- » Rated plant capacity.
- » CO_2 emissions.

Å Generation:
- » Size.
- » Manufacturer and model.
- » Voltage.
- » Generators dispatch strategy.

Å Grid:
- » Distribution system voltage and losses.
- » Single-line diagrams.
- » Time-series data.

COMMUNITY ENERGY DATA

Å Electricity economics:

» Electricity rates and types of customers.
» Energy cost prior to subsidies.
» Subsidies per customer type.
» Off-grid RE programs.

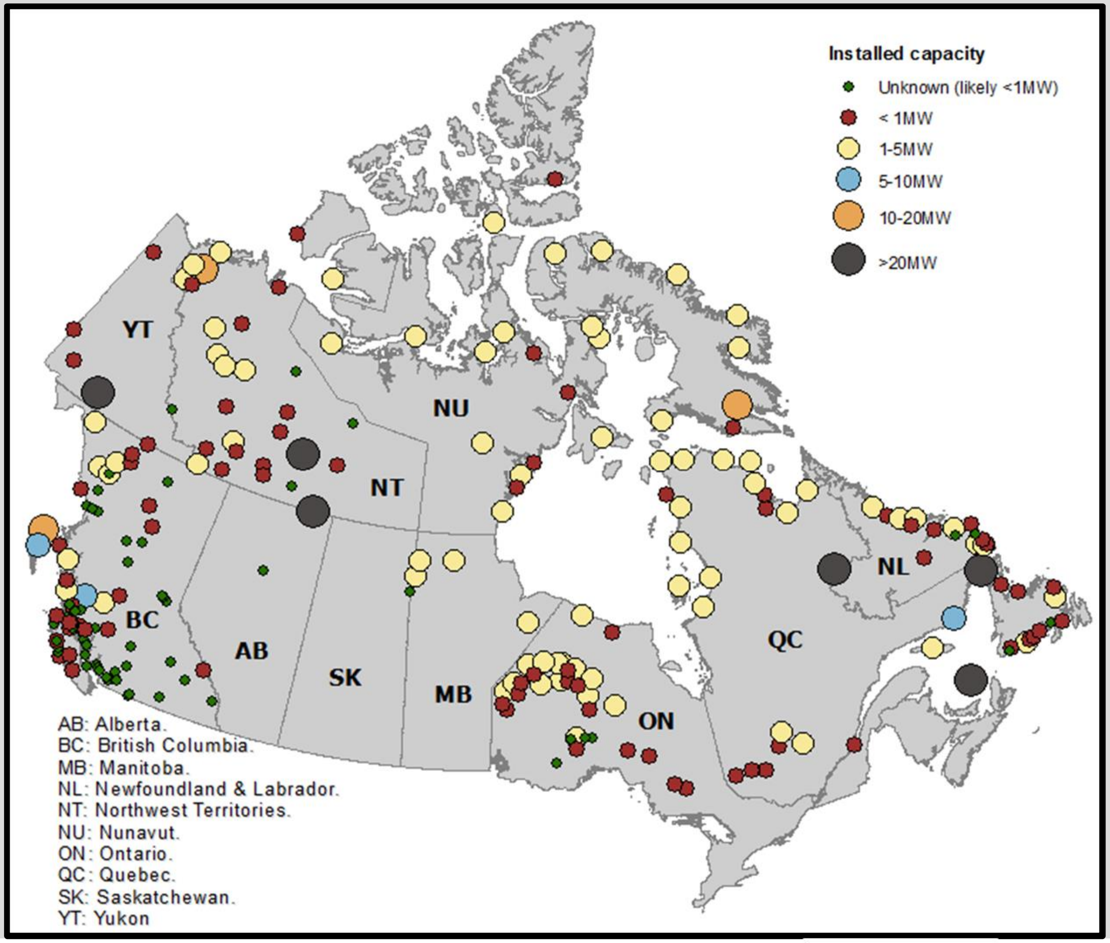
Å Renewable energy resources:

» Wind speed 1-hr resolution data.
» Solar irradiation 1-hr resolution data.

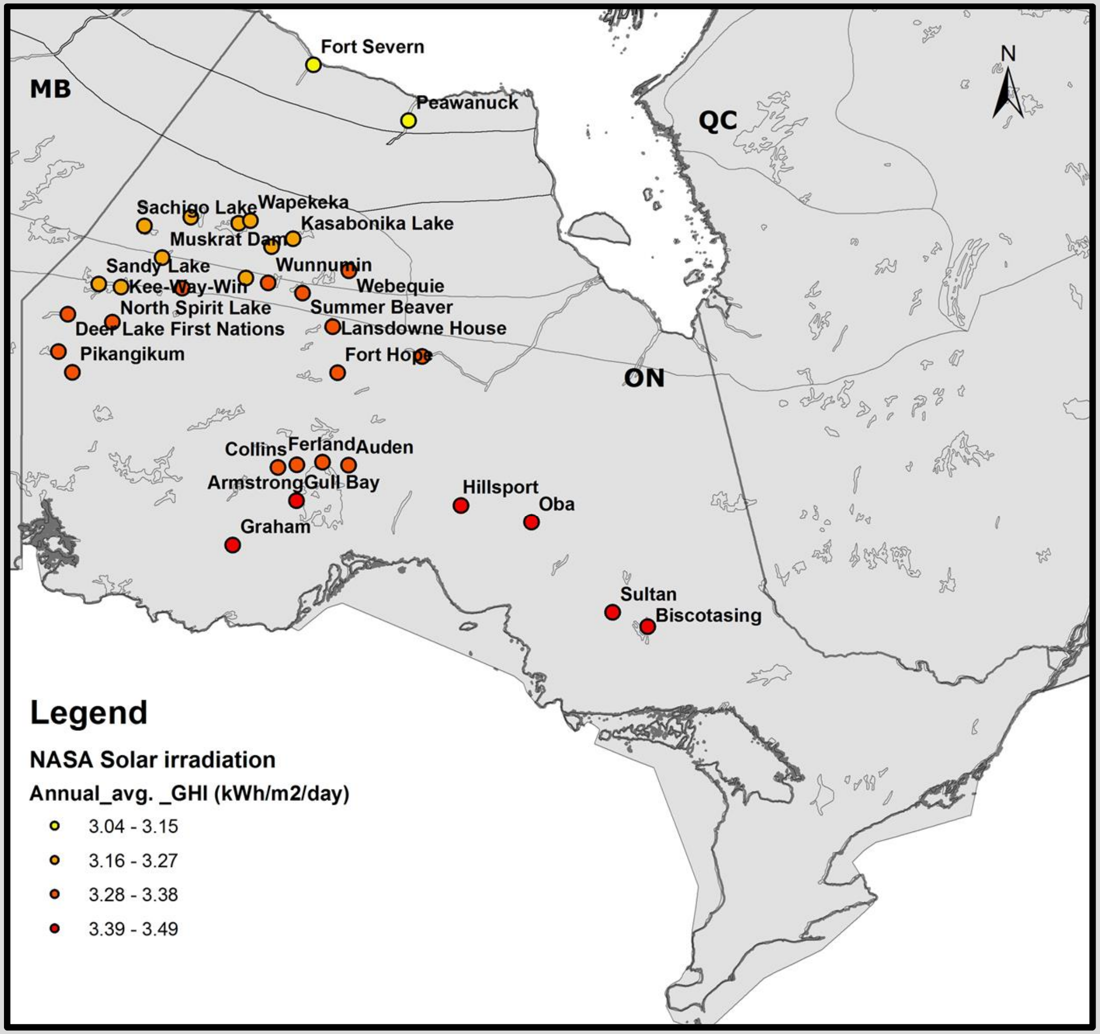
Å Social issues:

» RE impacts (e.g. environmental impacts).
» Electrification impact (e.g. load restriction).

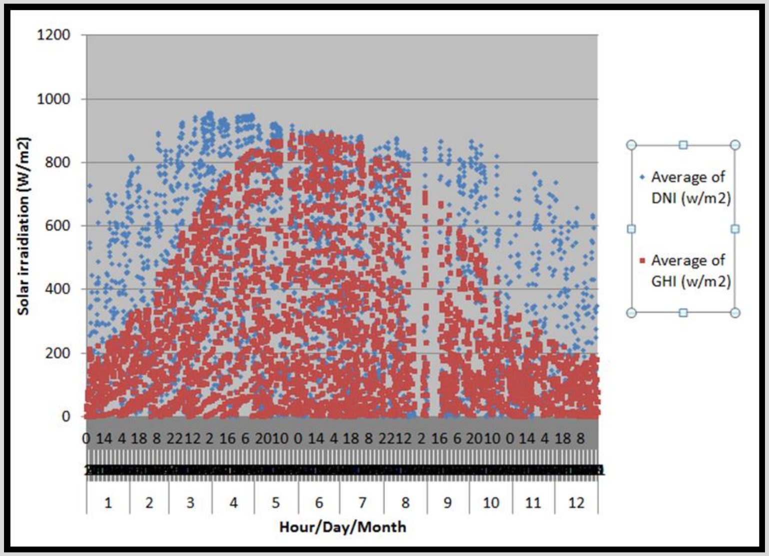
ELECTRIC INSTALLED CAPACITY MAP FOR NORTHERN AND REMOTE COMMUNITIES



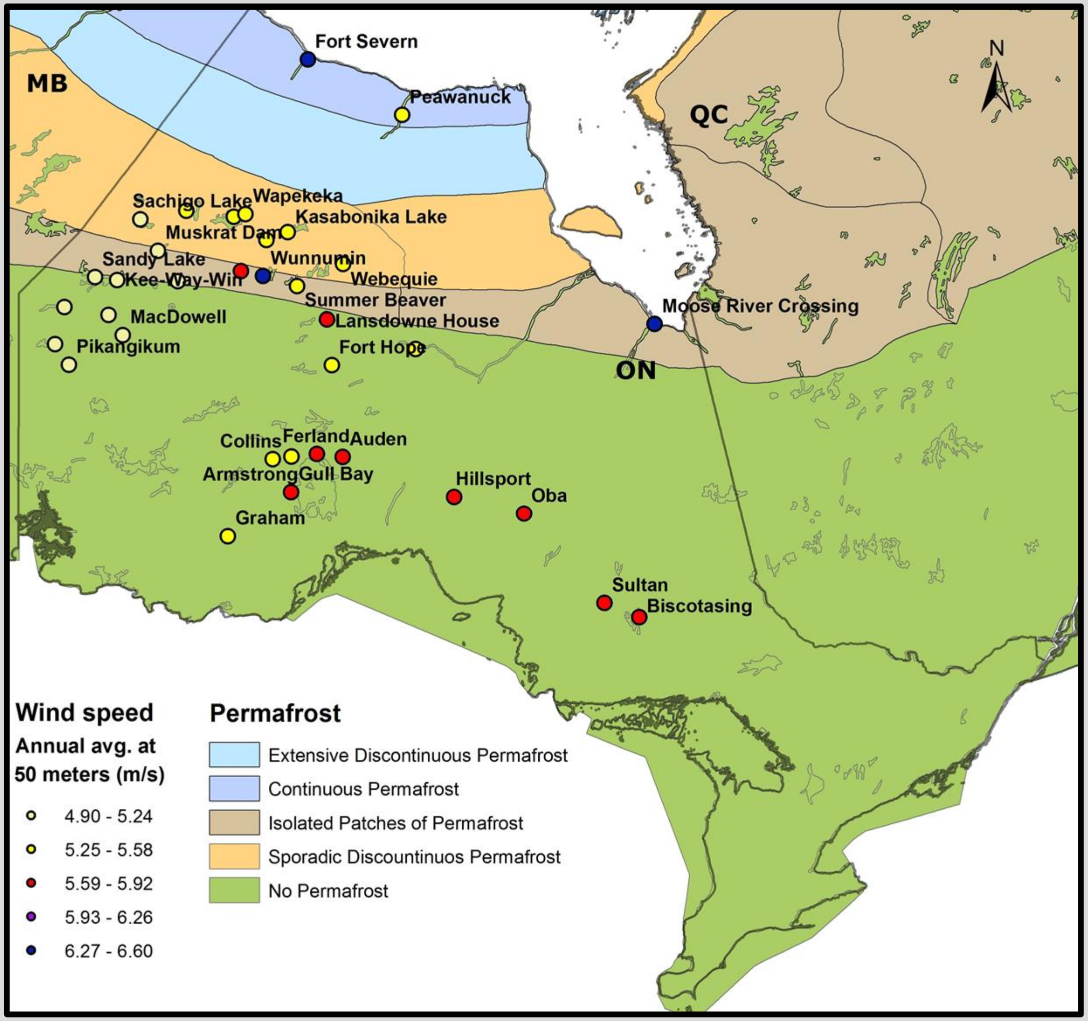
ONTARIO SOLAR RESOURCE MAP



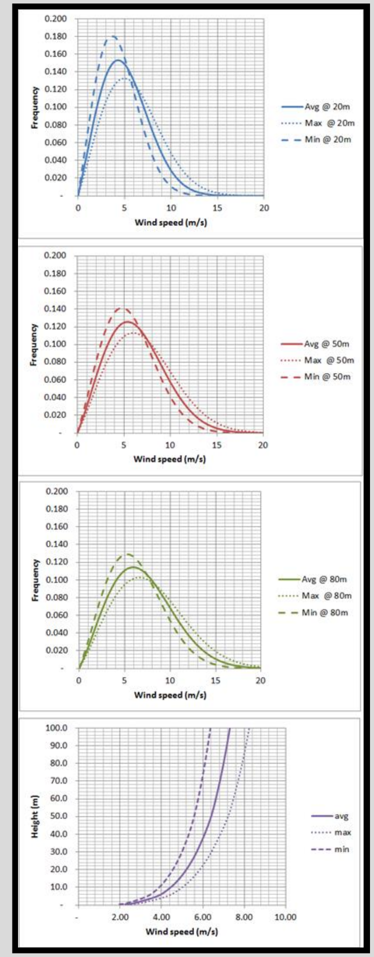
KLFN data for one-year.



ONTARIO WIND SPEED MAP



KLFN site data for 20/50/80m heights.



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UNIVERSITY OF WATERLOO

SOLAR TECHNOLOGY OVERVIEW

Å Technologies:
- » Solar photovoltaic.
- » Solar thermal.

Å Advantages for Remote Communities:
- » Modular.
- » Relatively easy transportation, installation and maintenance.
- » Very low operation and maintenance (O&M) cost.
- » Solar PV costs have been falling considerably.
- » Personnel from the community can likely install the full system with proper training and supervision.

Å Disadvantages:
- » Solar irradiation is usually not coincidental with energy peaks, meaning energy storage technologies need to also be considered.
- » High capital costs; however, solar technology prices have recently experienced significant decrease.

WIND TECHNOLOGY OVERVIEW

Å Technologies:

- » Small wind turbines (<100kW).
- » Large wind turbines (>100kW).

Å Advantages for Remote Communities:

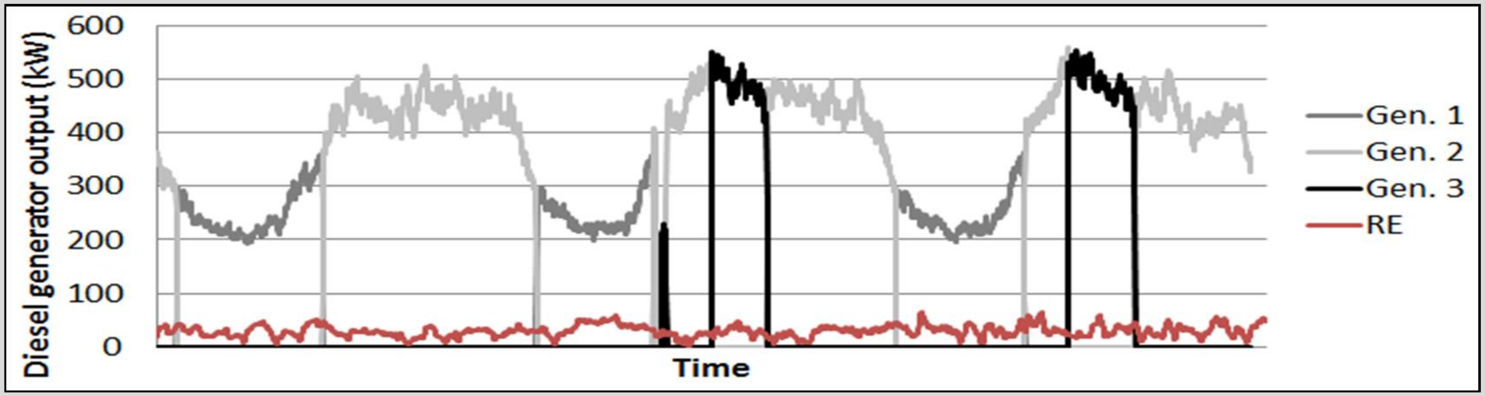
- » If the site is properly assessed, wind turbine can/will generate more energy per unit of installed capacity when compared to solar.
- » Windier seasons might match better with higher consumption levels.

Å Disadvantages:

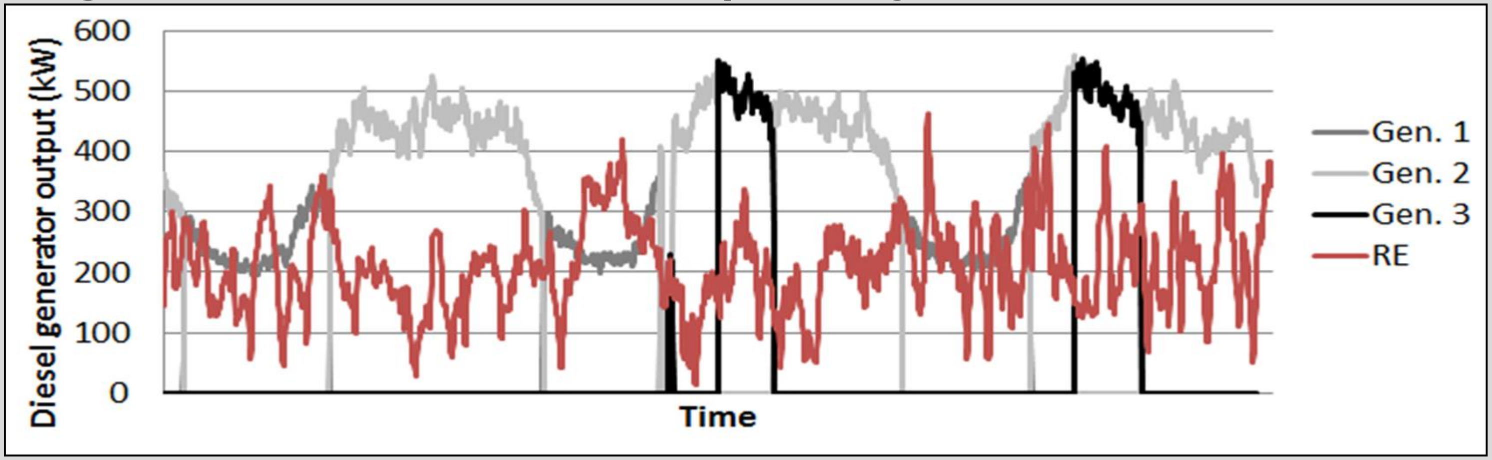
- » Difficult/expensive transportation, installation, and operation.
- » Size of turbine to be deployed depends on the available road access (e.g. roadsôweight limit and availability based on time).
- » Specialized skills required.
- » On-site wind measurements are rarely available.

RE TECHNICAL CHALLENGES

Å Low RE installed capacity



Å High RE installed capacity



RE IMPLEMENTATION STEPS

Å Implementation of RE projects:
- » Solar PV farms.
- » Wind farms.
- » Micro hydro-electric systems.

Å Key development phases:
- » Feasibility.
- » Planning, integration with grid/microgrid and financing.
- » Construction.
- » Implementation and commissioning.

Å Operation and management:
- » Operating and Monitoring.
- » Routine Maintenance.
- » Sinking Funds.
- » Expansion.

RE IMPLEMENTATION STEPS

- Key development phases:
  - Feasibility:
    - Assess optimum renewable source (e.g. wind, solar, water regimes; equipment accessibility) and assess site.
    - Liaise and engage with local utility company.
    - Produce comprehensive feasibility study report : decide Go or No Go.
    - If Go, produce and agree project development plan and budget.
  - Planning, integration with grid/microgrid, and financing:
    - Hire an RE-experienced project manager for duration of entire project.
    - Identify financing sources and secure financing.
    - Procure land as required.
    - Liaise with local utility company.
    - Quantify equipment requirements, obtain quotes (including robust warranties).
    - Produce and agree construction plan and budget.

RE IMPLEMENTATION STEPS

» Construction:
- Å Liaise with local utility company.
- Å Schedule equipment purchase and delivery; schedule and agree contractorsôon-site dates and accommodation.
- Å Build renewable energy facility according to plan.
- Å Produce and agree implementation/commissioning plan and budget.

» Implementation and commissioning:
- Å Liaise with local utility company and coordinate activities.
- Å Liaise with contractors engaged in implementation and commissioning activities.
- Å Complete full system and grid/microgrid integration testing.
- Å Sign-off RE system between project owner, utility and contractors.
- Å Produce and agree operation and management plan and budget.
- Å Set-up and train RE system management team.

RE IMPLEMENTATION STEPS

- Operation and management:
  - Operating and monitoring:
    - Secure contracts with RE system manager and RE system maintenance operatives.
    - Liaise with local utility company.
    - Monitor and record RE system performance; resolve any performance issues.
    - Review (amend and agree as necessary - experience), plan and budget with RE system management team.
  - Routine maintenance:
    - Liaise with local utility company (regular communication, plan RE and grid/microgrid outages).
    - Monitor equipment.
    - Lubricate/clean equipment according to plan and budget.
    - Resolve any equipment performance issues with vendors according to warranty agreement.

RE IMPLEMENTATION STEPS

- Sinking Funds:
  - RE equipment will undergo regular wear and tear, and occasional mishap.
  - Short-, medium- and long-term budgets need to be agreed.
  - Liaise with local utility company (plan RE outages).
  - These budgets can come from:
    - Revenues from a power purchase agreement with the local utility.
    - Savings from utility expenses via a net metering contract.
- Expansion
  - It is likely that a RE system will require expansion, or a similar system created nearby (or a different RE source).
  - Local community skills and experience gained in developing the initial system can allow the community to employ its own members for future project development .

CONCLUSIONS

Å Aim of the project:

» Engage communities.
» Align project with community goals.
» Explore the integration of renewables.
» Promote greater energy self-reliance with renewables.
» Identify alternative pathways for energy generated through renewable energy technologies.

Å Importance of the project:

» Maximize environmental and socioeconomic benefits for First Nations and remote communities.
» Better understand market evolution for microgrid technology.
» Planning, investment and ownership models.

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