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Remote communities: Canadian landscape overview and technical challenges

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Colloque de l'AIEQ 2021

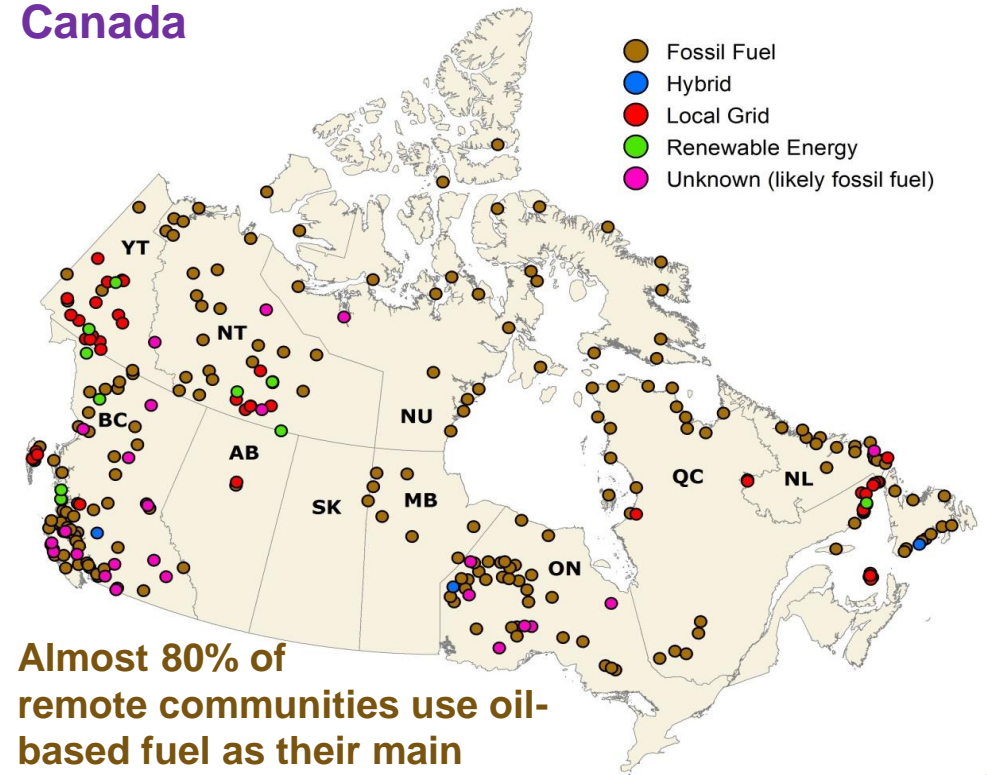
10 mars 2021

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Remote Communities in Canada

- 291 communities (195,000 ppl)
 - Of which 170 are indigenous communities (130,000 ppl)
- Many are inaccessible by road
 - Sea-lift in summer
 - Air-lift in winter
 - Some have “ice” roads for winter delivery

Primary energy source for electricity generation in remote communities in Canada



Almost 80% of remote communities use oil-based fuel as their main electricity source



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Dispelling the Myth – Northern PV Potential

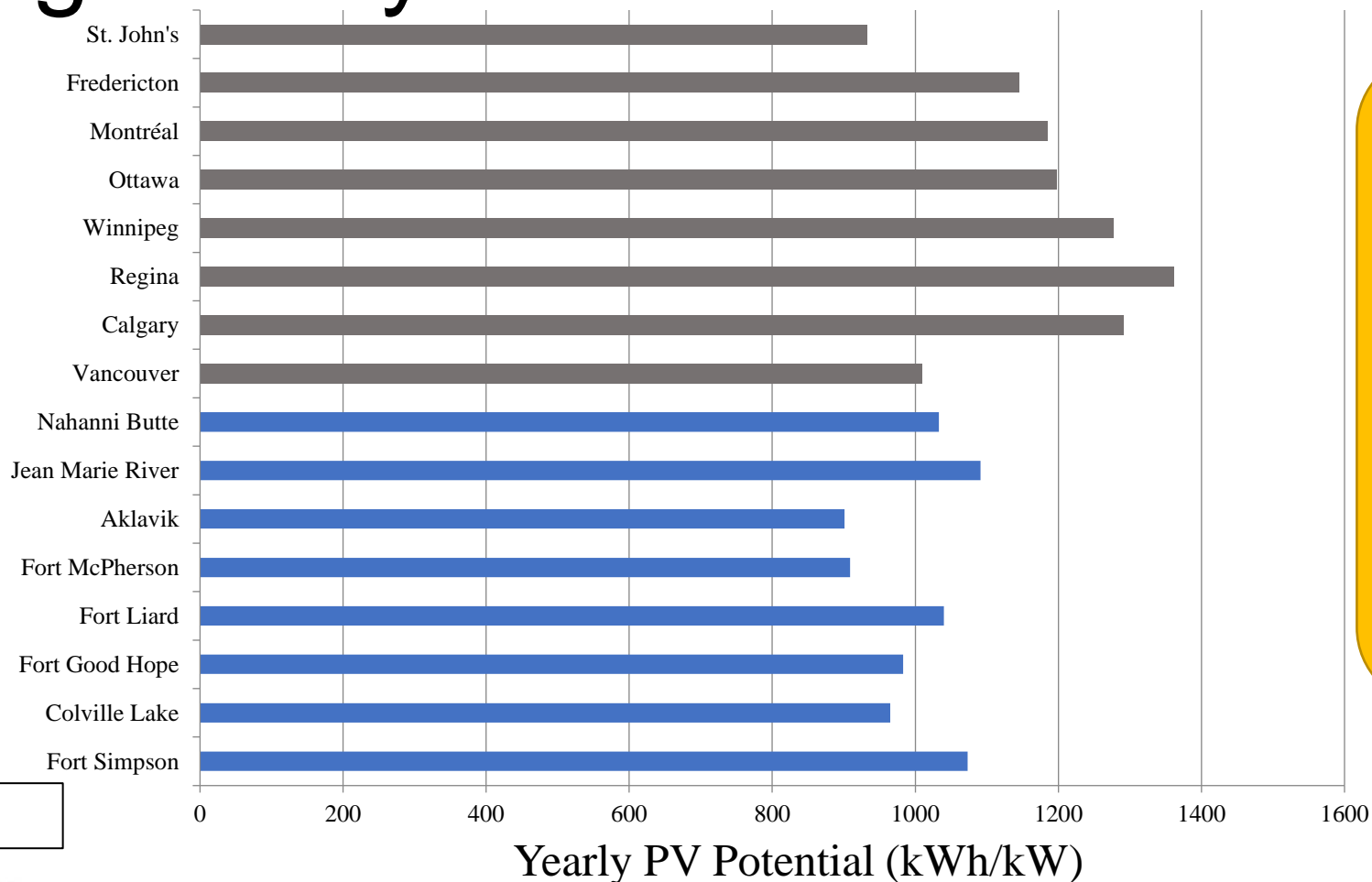
Major Canadian Cities

933 – 1361 kWh/kW

Remote Artic communities

901 – 1091 kWh/kW

~ 15% difference only



Furthermore, the cost of diesel electricity production in the North makes PV a cost-competitive source of electricity
<https://www.ntpc.com/customer-service/residential-service/what-is-my-power-rate>



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Snapshot of Canada's northern microgrid researchers

Public

- CanmetENERGY/NRCan
- Hydro-Quebec
- National Research Council
- Polar Knowledge
- Canadian Armed Forces
- Yukon Energy Corporation
- ...

Private

- Nergica
- Canadian Solar Inc.
- Schneider Electric
- Hatch Labs
- Hedgehog
- Volts Énergies
- ABB Canada
- ...

Academia / Civil Society

- University of Toronto
- Yukon University
- University of Waterloo
- British Columbia Institute of Technology
- Arctic Energy Alliance
- Concordia University
- ...



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Federal Funding Programs

Natural Resources Canada (NRCan)

Energy Innovation Program	Ongoing	\$52.9M / year
Program of Energy Research and Development	Ongoing	\$35M / year
Clean Growth Program	2017-2021	\$155M
Impact Canada		
• Indigenous Off-Diesel Initiative	2019-2023	\$20M
• Power Forward Challenge	2018-2021	\$20M
• Charging the Future Challenge	2019-2021	\$4.5M
Green Infrastructure II		
• Smart Grids	2018-2022	\$100M
• Electric Vehicle (EV) Infrastructure Demonstrations	2018-2022	\$30M
• EV & Alternative Fuel Infrastructure Deployment Initiative	2018-2022	\$80M
• Emerging Renewable Power Program	2018-2023	\$200M
• Energy Efficient Buildings RD&D	2018-2026	\$182M
• Clean Energy for Rural and Remote Communities	2018-2026	\$220M

Natural Sciences and Engineering Research Council Canada (NSERC)

NSERC Energy Storage Technology Network (NESTNet)	2015-2020	\$5.2M
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Sustainable Development Technology Canada (SDTC)

Sustainable Development Technology Fund	Ongoing	\$400M
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Innovation, Science, and Economic Development Canada (ISED)

Strategic Innovation Fund	2017-2022	\$1,260M
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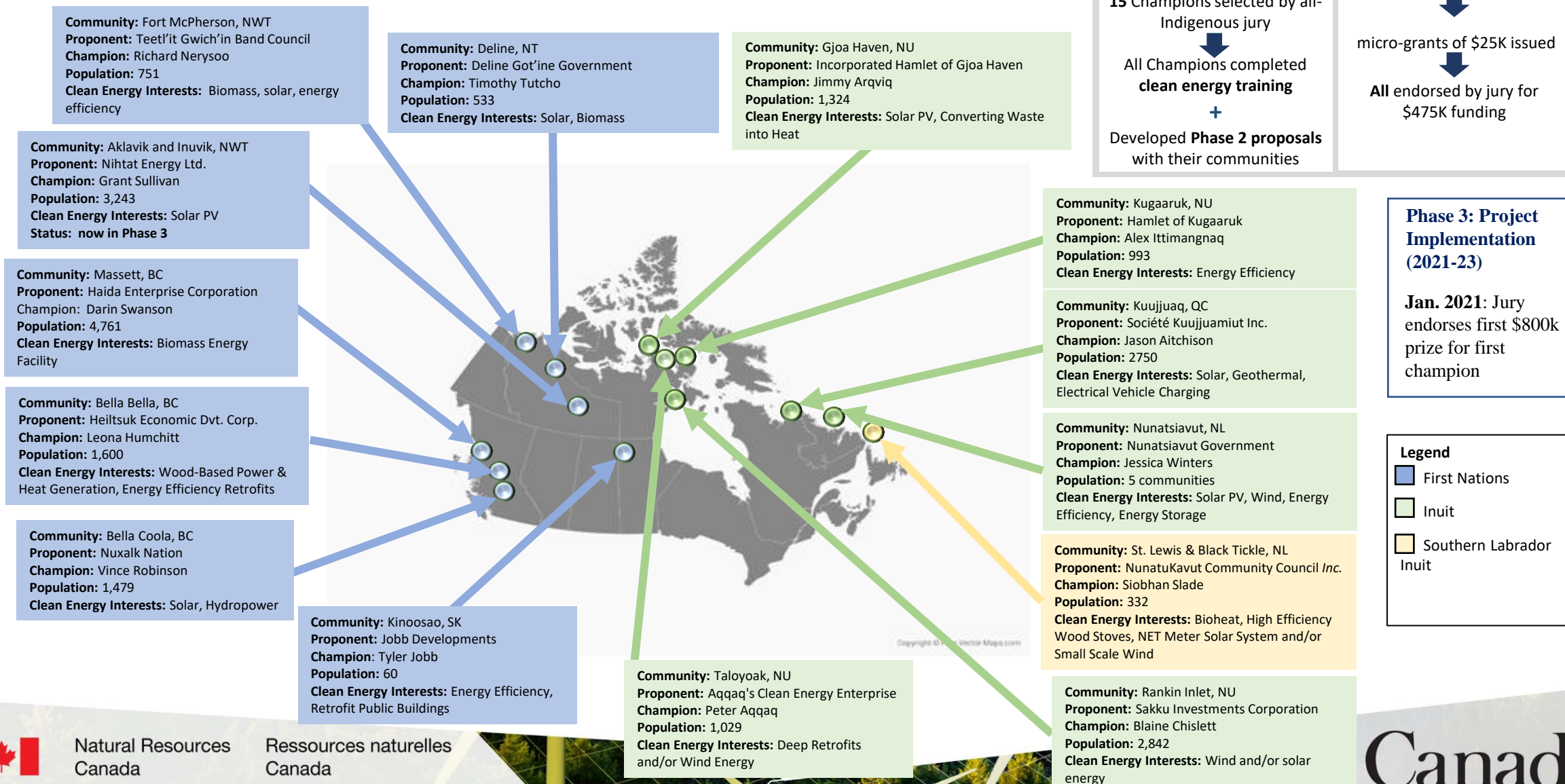
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Impact Canada Indigenous Off-Diesel Initiative

14 Participating Communities/regions



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NRCan's Clean Energy for Rural and Remote Communities (CERRC)

Program Objective: promote a transition to a more sustainable and clean energy future by supporting projects that reduce reliance on diesel in Canada's rural and remote communities and industrial sites.

Four main program components:

- BioHeat (\$55M) for biomass heating, district heating, and combined heat and power systems
- Demonstration (\$60M) for innovative clean energy projects (e.g. renewables, efficiency, smart grid)
- Deployment (\$90M) for commercially available renewable energy technologies for electricity
- Capacity Building (\$10M) for energy literacy, skills training, and project planning in rural and remote communities.

Results:

- CERRC is funding **88 projects** across **131 communities**, of which, **123 communities are Indigenous**.
- CERRC was highly oversubscribed - approximately **\$1.1B in proposed unfunded projects** across the country

Impact Canada – Off Diesel Initiative (\$20M): Complements CERRC – takes an 'outcomes-based approach' to support capacity building in 15 Indigenous remote communities

2030 Target: The Mandate Letter has directed the Minister of Natural Resources Canada to work with other departments to *“support the transition of Indigenous communities from reliance on diesel-fueled power to clean, renewable and reliable energy by 2030.”*



Distribution by Tech Type



- Biomass-Heat
- Capacity Building
- Solar
- Multiple/Other Innovative Tech
- Wind
- Combined Heat-Power
- Hydro
- Energy Storage



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Canada's Contribution to *Mission Innovation (MI) Innovation Challenge #2 (IC2): Off-Grid Access to Electricity*

Two funding programs:

- The Impact Canada Off-Diesel Initiative
- The Clean Energy for Rural & Remote Communities program

CanmetENERGY: domestic R&D

- Reduce diesel consumption in remote and northern microgrids
- Increase renewable energy access and resiliency.
- Example: building knowledge of optimal design and operation of remote microgrids (e.g. load and generation mix)

CanmetENERGY: international collaborations:

- IEA PVPS Task 18 – Off-Grid and Edge-of-Grid PV Systems
- IEC TS 62257 – Renewable Energy and Hybrid System for Rural Electrification



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CanmetENERGY-Varennnes in the North

1. Develop integration scenarios ranging from minimal to full renewable

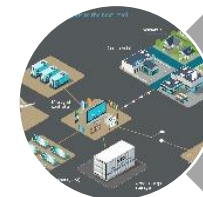
2. Develop archetypes of communities and associated diesel reduction solutions

3. Investigate the application of advanced techniques to optimize energy management systems

- Artificial intelligence
- Batteries
- Flexible loads
- Advanced inverter functions to optimize diesel

4. Lead a technical expert working group and support related science initiatives

Achieving our objectives through:



Scientific knowledge



Techno-economic analyses



Demonstration support



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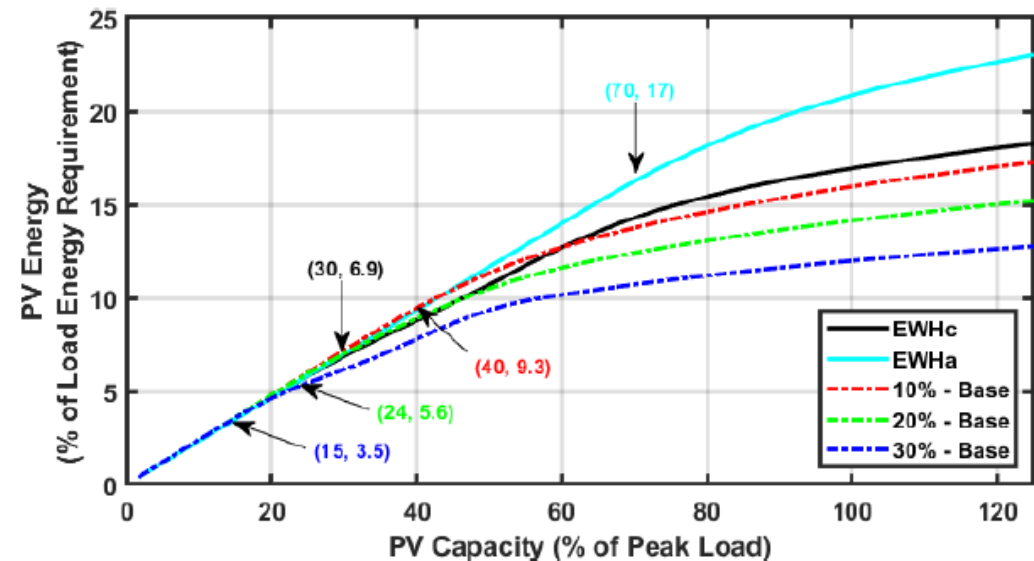
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1. Integration Scenarios Ranging from Minimal to Full Renewable

- Probabilistic analysis of RE integration in large remote communities (Cambridge Bay)
- Generic Study for small PV-Diesel Hybrid Microgrid

**Solar PV energy contribution
with varying PV capacity**



Scientific
Knowledge



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2. Diesel Reduction Solutions in Remote Communities

- Collaboration with **Nergica** in Gaspé to study the potential of **solar PV in Nunavik**
- Open network white paper on **PV integration in cold climates**
- Working with **Hydro-Québec** Distribution's Autonomous Network Division and partners regarding PV integration research activities and Nunavik communities

Communities in Nunavik



Case Study: Colville Lake

- Solar PV Battery-Diesel Integration
- 135 kW of solar PV, 200 kWh lithium-ion batteries
 - Housed in ISO 20-foot container to withstand extreme arctic conditions down to -50°C
- Target annual savings of between 12,000 and 15,000 litres of diesel per year
 - Goal of reducing diesel engine runtime by up to 25% during winter and up to 75% during peak summer
 - Optimize operation in diesel saving and diesel-off mode during the summer months



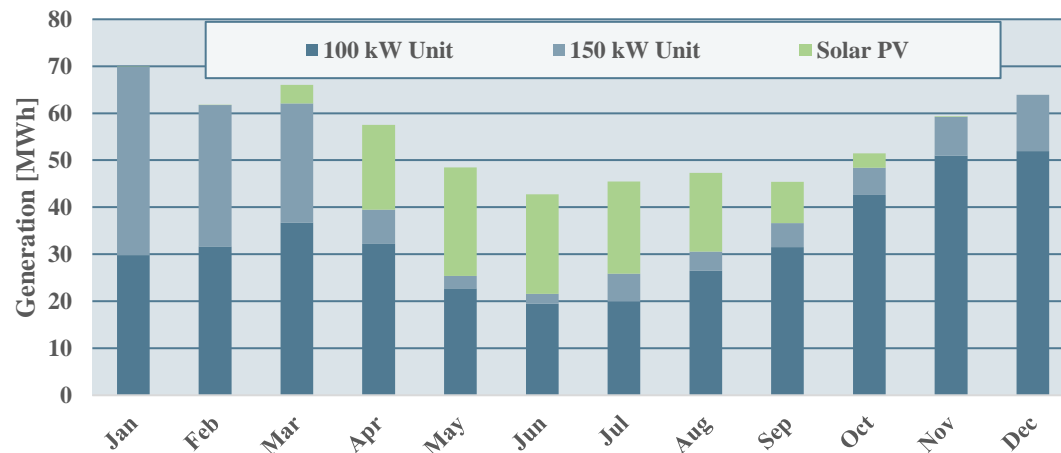
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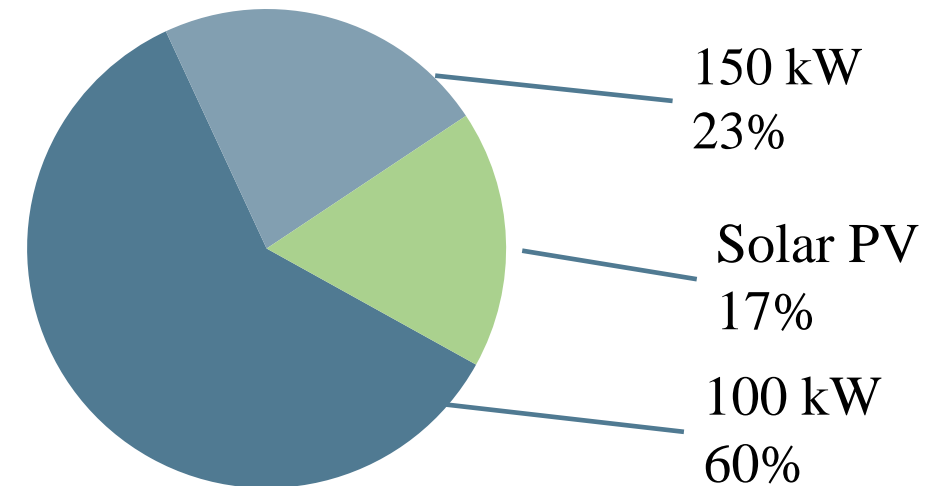
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3. Investigate the application of advanced techniques to optimize energy management systems

Monthly Energy Generation by Source



Annual Energy Generation Mix



- Total annual generation is 640 MWh with a total fuel consumption of 151,000 L
- Solar PV contributes to over 31,000 L of diesel fuel savings



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4. Technical Expert Working Group on Remote Grids

★ Remote Microgrids

last edited by  Yves.Poissant@RNCAN-NRCAN.gc.ca 1 week, 1 day ago

 Page history

Welcome to the NRCAN Technical Expert Interest Group for Remote Grids Bienvenue au Groupe d'intérêt des experts techniques de RNCAN sur les réseaux éloignés

The objectives of this interest group are as follows: / Les objectifs de ce groupe d'intérêt sont les suivants:

- To share expertise and lessons learnt from past and active remote microgrid projects. / Partager l'expertise et les leçons tirées de projets antérieurs et actuels.
- To identify R&D gaps and needs in the area of remote microgrids. / Identifier les lacunes et les besoins de R&D dans le domaine des micro-réseaux éloignés.
- To identify and establish collaboration amongst group members. / Identifier et établir une collaboration entre les membres du groupe.

This website is a collaboration wiki for participants in the NRCAN Technical Expert Interest Group for Remote Microgrids. To access meeting presentations and summaries, please click on the "Meetings" folder on the right or the link to "Pages & Files" above. / Ce site est un wiki de collaboration pour les participants au Groupe d'intérêt d'experts techniques de RNCAN sur les micro-réseaux éloignés. Pour accéder aux présentations et aux résumés, veuillez cliquer sur le répertoire << Meetings >> à droite ou sur l'onglet <<Pages & Files>> ci-haut.

Activities / Activités: Periodic teleconferences and remote microgrid conferences. / Téléconférences périodiques et conférences sur les micro-réseaux éloignés.

Last Teleconference / Dernière téléconférence: [February 10th 2021 / 10 février 2021](#)


Next Teleconference / Prochaine téléconférence: May 2021 / mai 2021

For more info, please visit:

<http://remotemicrogrids.pbworks.com/w/page/93428723/Remote%20Microgrids>

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Announcements / Annonces

"Electricity for All: Issues, Challenges, and Solutions for Energy-Disadvantaged Communities"

Free Webinar Complements of the Proceedings of the IEEE September 2019 Special Issue
Oct. 18, 2019, 12-1pm EST

This webinar will provide an overview of the main issues,



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