

# Renewable Energy Microgrid Integration for Remote, Off-grid Cabins in Nunavut

Lead Researcher: Heather Shilton Affiliation: Nunavut Nukkiqsautiit Corporation To support increased infrastructure and energy demands throughout the 20th century, diesel generators were installed in all communities across Inuit Nunangat. This continues to be the case today where new power plants are being installed and/or upgraded with additional diesel fuel generators. While fossil fuels currently support nearly all heat and electricity loads across Inuit Nunangat, there is a strong desire to develop renewable energy sources to mitigate against climate change impacts and improve resiliency. Challenging crises, such as the recent contamination of Iqaluit drinking water with fuel, remind us of the vulnerability and risk in Inuit Nunangat of relying on a single source for critical infrastructure requirements. To help address these challenges, the project herein has three proposed key areas of work: 1. Feasibility assessments and technological evaluations for three key types of house-scale renewable energy systems well-suited to Inuit Nunangat; 2. Integration and performance evaluation of house-scale renewable energy systems and energy storage with demonstration house in Iqaluit, Nunavut; and 3. Development of remedies to barriers of renewable energy adoption in Inuit Nunangat and advancement of socio-economic development. This project will integrate Inuit values, needs and interests with renewable energy technology evaluations and deployment in Inuit Nunangat. Remedies to barriers of renewable energy adoption will be developed in accordance with Inuit Quajimajatuqangit through coordination with the Qikiqtani Inuit Association's Inuit Qaujimajatuqangit department, the parent Inuit birthright organization of the project proponent, Nunavut Nukkiqsautiit Corporation. Inuit representation is embedded in this project by the project definition and leadership, students that will contribute and advance their training, and community members that wish to participate in the project by providing paid services or community engagement with consideration. This project will contribute to Arctic energy resilience through the capacity development and de-risking of technology that will be undertaken. Training opportunities for residents of Inuit Nunangat will be available and increased demand for renewable energy technology installation, operation, and maintenance will lead to community economic development. This project will alleviate the key barriers of renewable energy deployment in Inuit Nunangat to create an easier path to follow for future proponents, regulators, and utilities. Scientific outputs and publications arising out of this work will be adapted and translated to be accessible to a wide audience across Inuit Nunangat. Community engagement throughout the whole project will be conducted to the extent that communities and individuals wish to engage. Project progress and outcomes will be shared at key events with Inuit representation, such as trade shows, conferences, and regional meetings. Addressing the complex set of challenges for renewable energy deployment and operation in Inuit Nunangat requires the combination of work plans detailed in this project description for accelerating impact.

**DΔÄŒ:** Chercheuse principale: Heather ShiltonAffiliation: Nunavut Nukkiqsautiit CorporationPour répondre aux besoins accrus en infrastructure et en énergie tout au long du 20e siècle, des génératrices diesels ont été installées dans toutes les collectivités de l'Inuit Nunangat. Cela continue aujourd'hui, où des centrales électriques nouvelles sont installées et mises à niveau avec des générateurs de carburant diesel supplémentaires. Alors que les combustibles fossiles supportent presque toutes les charges de chaleur et d'électricité dans l'Inuit Nunangat, il existe un désir fort de développer des sources d'énergie renouvelables pour atténuer les impacts du changement climatique et améliorer la résilience. Des crises difficiles, comme la récente contamination de l'eau potable d'Iqaluit par du carburant, rappelle le nous la vulnérabilité et le risque dans l'Inuit Nunangat de dépendre d'une seule source pour les besoins en infrastructures essentielles.Pour aider à relever ces défis, le projet ici propose trois domaines de travail clés:1.Évaluations de faisabilité et technologiques pour trois types principaux des systèmes d'énergie renouvelable à l'échelle de la maison qui sont bien adaptés à l'Inuit Nunangat;2.Intégration et évaluation du rendement des systèmes d'énergie renouvelable et de stockage d'énergie avec une maison de démonstration à l'échelle à Iqaluit, au Nunavut; et3.Élaboration de solutions pour éliminer les obstacles à l'adoption des énergies renouvelables dans l'Inuit Nunangat et faire progresser le développement socioéconomique.Ce projet intégrera les valeurs, les besoins et les intérêts des Inuits aux évaluations et au déploiement des technologies d'énergie renouvelable dans l'Inuit Nunangat. Des solutions pour éliminer les obstacles à l'adoption des énergies renouvelables seront élaborées conformément à l'Inuit Quajimajatuqangit en coordination avec le département Inuit Qaujimajatuqangit de la Qikiqtani Inuit Association, l'organisation inuite mère du promoteur du projet, la Nunavut Nukkiqsautiit Corporation. La représentation Inuite est intégrée à ce projet par la définition du projet, la conduite du projet, les étudiants qui contribueront et feront progresser leur formation, et les membres de la communauté

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Personnel on site: 4

Days on site: 5  
Total Person days: 20  
Operations Phase: from 2022-05-09 to 2025-03-25

$\Lambda \subset \mathbb{N} \triangleleft \mathbb{N} \hookrightarrow \mathbb{D} \sigma \triangleleft {}^{\mathfrak{b}} \mathbb{D}^c$ 

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Panarctic Communications Datacenter - Privately Owned Building	Equipment installation	Private	No known site history	There is no known archeological/paleontological value	Panarctic Communications Datacenter is located 3.5 KMs from Iqaluit and 1.7 KMs from Apex.
Sylvia Grinnell River	Marine Based Activities	Crown	No known site history - specific locations are not yet identified but known historical sites will be avoided for data collection activities.	There is no known archeological/paleontological value - specific sites are not yet identified but known areas of value will be avoided.	Specific locations are not yet identified but all protected areas will be avoided and all data will be collected using non-invasive equipment & techniques.
Niaqunguk (Apex) River	Marine Based Activities	Crown	No known site history - specific locations are not yet identified but known historical sites will be avoided for data collection activities.	There is no known archeological/paleontological value - specific sites are not yet identified but known areas of value will be avoided.	Specific locations are not yet identified but all protected areas will be avoided and all data will be collected using non-invasive equipment & techniques.
Resolute River	Marine Based Activities	Crown	No known site history - specific locations are not yet identified but known historical sites will be avoided for data collection activities.	There is no known archeological/paleontological value - specific sites are not yet identified but known areas of value will be avoided.	Specific locations are not yet identified but all protected areas will be avoided and all data will be collected using non-invasive equipment & techniques.

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ΔᖅᐁΔᑦ	Jordan Okalik-Musgrove	Nunavut Nukkiksautiit Corporation	2022-05-09
ᐁᑏᑲᑎᑏᑲᖅ	Jackson Lindell	Hamlet	2023-02-09



$\epsilon \Delta^{\frac{1}{2}} r^c$      $\wedge J^{\frac{1}{2}} e D \dot{n}$      $\nabla^{\frac{1}{2}} r^{\frac{1}{2}} C D P L \sqrt{c}$

$a^{\dagger}r^{\alpha}r^{\beta}\Lambda_{\alpha\beta}n^{\mu}\delta\sigma^{\mu\nu}D^{\nu}c$      $\partial\partial\psi^{\rho}r^{\rho}$ :

## North Baffin

## South Baffin

$\Delta^{\alpha} \Gamma^{\beta} \Lambda^{\gamma} \Sigma^{\delta}$

<p>ᐱᓴᔭᔨᕈᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ ᐸᓇᓚᓗᓂᓪግᑦ ᐱᓴᔭᔨᕈᑦ ᐳᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ</p>	<p>ᓄᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ ᐳᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ</p>	<p>ᐸᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ</p>	<p>ᐸᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ / ᐳᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ</p>	<p>ᐸᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ</p>
<p>ᐳᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ, ᐳᓇᓚᓗᓂᓪግᑦ ᐃᓄᕐᐅᒋᓂᓪግᑦ</p>	<p>Scientific Research License is required to carry out the project research activities, including equipment installation for data collection, field surveys and community engagements.</p>	<p>Applied, Decision Pending</p>	<p>2023-02-10</p>	

## Project transportation types

Transportation Type	Equipment	Length of Use
Water	A small boat to be used to carry out field surveys for river flow data.	
Land	Vehicles to be used to get to project locations. Forklift to be used for equipment installation.	

## Project accomodation types

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Survey Boat (Locally Rented)	1	N/A	To carry out data collection in rivers
Acoustic Doppler Current Profiler (ADCP)	1	0.3 m x 0.2 m x 0.2 m	To measure water velocity and depth of rivers
Real time kinematic global positioning system (RTK-GPS)	1	1 m x 0.5 m x 0.5 m	To access location services
Vehicle (To be rented locally)	1	N/A	To get to project locations
Solar PV Panels	20	1.6 m x 1 m x 0.1 m	For Solar PV Installations
1 kW Battery Stack and Auxiliary Equipment	1	1.5m x 1m x 1m	To study battery storage performance
Water Tanks	4	1.6m x 1m x 0.8m	To store salt water electrolyte used in the battery
Forklift (to be rented locally)	1	N/A	To install battery and electrolyte tanks

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Gasoline	fuel	1	100	100	Liters	For use in the survey boat and rental vehicle
H2SO4	hazardous	1	3	3	Liters	For use in the battery electrolye
NaOH	hazardous	1	4	4	Kg	For use in battery electrolye
Na2SO4	hazardous	1	150	150	Kg	For use in battery electrolyte
Non-volatile, biodegradable alcohol based solvent	hazardous	1	300	300	Liters	For use in battery electrolye

ΔL<sup>9b</sup> ΔD<sup>9b</sup> CD<sup>9b</sup> ΔL<sup>9b</sup> ΔD<sup>9b</sup>

$\mathcal{D}^c \rightarrow \mathcal{C} \dot{\mathcal{I}}^{\mathfrak{f}_b} \mathcal{A} \mathcal{D}^{\mathfrak{f}_b} \mathcal{C} \mathcal{D}^{\mathfrak{f}_b} \mathcal{A}^{\mathfrak{f}_b} \mathcal{D}^{\mathfrak{f}_b}$	$\mathfrak{f}_b \rightarrow \mathfrak{f}_b \Delta \Gamma^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{A}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b}$	$\mathfrak{a} \mathcal{P}^c \Delta \Gamma^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b} \mathcal{A}^{\mathfrak{f}_b} \mathcal{C}^{\mathfrak{f}_b}$
0		



$\triangleleft^b C d^c$ 
$$\Delta^b C d_{\sigma} \sim \sigma \Delta^a \sigma^a$$
[illegible]
$$4^{\circ} \cap \Gamma \supset C \circ^c \supset C \quad 4^b \supset^b C \supset \Gamma L \downarrow^c$$

There are no envisioned environmental impacts from this project. The equipment installed for the research project is non-intrusive, temporary equipment and will be shipped back after the end of the project. Leftover battery electrolyte solutions will be shipped back in the battery tanks and will be re-used, or disposed of locally in Ontario.

## **Additional Information**

**SECTION A1: Project Info**

**SECTION A2: Allweather Road**

**SECTION A3: Winter Road**

**SECTION B1: Project Info**

**SECTION B2: Exploration Activity**

**SECTION B3: Geosciences**

**SECTION B4: Drilling**

**SECTION B5: Stripping**

**SECTION B6: Underground Activity**

**SECTION B7: Waste Rock**

**SECTION B8: Stockpiles**

**SECTION B9: Mine Development**

**SECTION B10: Geology**

**SECTION B11: Mine**

**SECTION B12: Mill**

**SECTION C1: Pits**

**SECTION D1: Facility**

**SECTION D2: Facility Construction**

**SECTION D3: Facility Operation**

**SECTION D4: Vessel Use**

**SECTION E1: Offshore Survey**

**SECTION E2: Nearshore Survey**

**SECTION E3: Vessel Use**

**SECTION F1: Site Cleanup**

**SECTION G1: Well Authorization**

There are no envisioned environmental impacts from this project. The equipment installed for the research project is non-intrusive, temporary equipment and will be shipped back after the end of the project.

## Impacts

$\mathbf{e} \rightarrow \mathbf{e} \Delta^{\mathfrak{c}_b} \mathbf{C} \triangleright \sigma^{\mathfrak{c}_b} \mathbf{r}^{\mathbf{C}}$      $\mathbf{d} \in \mathbf{N} \triangleright \mathbf{C} \dot{\sigma}^{\mathbf{C}} \mathbf{C}^{\mathbf{C}}$      $\mathbf{d}^{\mathbf{b}} \Delta^{\mathfrak{c}_b} \mathbf{C} \triangleright \mathbf{r}^{\mathbf{L}} \mathbf{r}^{\mathbf{C}}$

[illegible][illegible]

1 point	Panarctic Communications Datacenter - Privately Owned Building
2 point	Sylvia Grinnell River
3 point	Niaqunguk (Apex) River
4 point	Resolute River

- |         |  |
|---------|--|
| 1 point | Panarctic Communications Datacenter - Privately Owned Building |
| 2 point | Sylvia Grinnell River  |
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| 4 point | Resolute River   |

