Original research article

Off-grid energy sustainability in Nunatukavut, Labrador: Centering Inuit voices on heat insecurity in diesel-powered communities

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\textsuperscript{1} An off-grid community is defined as: (1) any community not connected to the North American electricity grid nor the piped natural gas network, and; (2) any permanent settlement (at least five years) with more than 10 dwellings [2].

\textsuperscript{2} Indigenous in the Canadian context refers to all individuals who self-identify (i.e. status and non-status) as First Nations, Métis, or Inuit [44]. See Joseph [46] for further reading.

https://doi.org/10.1016/j.erss.2019.101382

Received 6 July 2019; Received in revised form 19 November 2019; Accepted 21 November 2019

1. Introduction

The Canadian electricity industry is based nearly entirely upon low-carbon energy sources. It is the second largest producer of hydroelectricity in the world with an installed capacity of over 78,000 megawatts [MW]. In 2016, hydroelectricity provided 59 per cent of the national electricity supply. In addition, Canada relied on nuclear-generation for 14.6% of generation, and on non-hydro renewables (wind, solar, biomass) for 8.2% per cent of electricity generation. The small remaining portion is generated via fossil fuels, divided among coal and natural gas (18.9 per cent combined), and a small amount of oil/diesel (0.5 per cent) [1]. There are important regional (provincial) differences in electricity generation in Canada. For instance, Alberta relied on coal and natural gas for 87.7% of generation in 2016, while Ontario, Quebec, and British Columbia relied on low-carbon sources for 91.7%, 99.8%, and 98.4% of electricity generation, respectively [1].

The dominant role of low-carbon sources is reversed in most off-grid communities in Canada.\textsuperscript{1} There are 259 off-grid communities located throughout the country, with a total population of approximately 193,000. Although Indigenous Peoples in Canada represent 4.9% of the total population, approximately 65% (n = 169) of off-grid communities identify as Indigenous [2,89].\textsuperscript{2} The majority of off-grid communities (73%, or n = 190), have their own fossil fuel power plants, totaling over 500MW of installed capacity. Most of these systems are diesel-fueled, with a small number having natural gas or heavy fuel oil [2]. For comparison, there is 154MW of renewable energy capacity in off-grid energy systems, despite the fact that the majority of on-grid communities identify as First Nations, Inuit, or Métis (65% or n = 169). By partnering with the NunatuKavut Community Council (NCC), this research aims to privilege the perspectives of NunatuKavut Inuit who live in the diesel-dependent communities of Black Tickle, St. Lewis, and Norman Bay in southeast Labrador. Our mixed-methods research involved community-member interviews (n = 75) and key informant interviews (n = 7). A key finding is that community-members value socio-economic contributions of diesel-generation such as employment, reliability, familiarity, and contributions to community-resilience – as well as expressing concern about environmental degradation and the risk of fuel spills affecting livelihoods. Primary energy-system concerns relate to heat insecurity, and energy systems dependent on external control, support, and imports. By privileging voices of Inuit in these diesel-dependent communities, we were able to locate community identified strengths associated with local energy systems, while shifting focus to what community-members perceive as the most pressing energy-related challenges in their communities.
grid communities, which is mostly small hydropower projects [3].

The province of Newfoundland and Labrador [NL], represents a national microcosm of diesel-dependence in off-grid communities. In 2016, hydropower accounted for 95% of the province's on-grid electricity-generation capacity (7,703MW) [3]. The electricity-generation-mix differs dramatically in off-grid communities throughout NL, where 21 of 27 communities are exclusively dependent on diesel-generation, with an installed generation capacity of approximately 39MW. Of the 27 off-grid communities in NL, 15 are Indigenous [2]. Given the similarities between NL's electricity-generation mix, and the rest of Canada's (i.e. large-hydro dependent on-grid, and diesel-dependent off-grid), the province serves as a compelling area for case-study research on off-grid energy sustainability. It has been argued that diesel-generation poses substantial sustainability challenges for off-grid communities throughout Canada. Most of the existing research has been from technoeconomic perspectives. These studies typically examine the feasibility of renewable energy resources in off-grid communities, and model the high costs and greenhouse gas emissions associated with existing diesel-systems [5–8]. Very limited research has reported how community members themselves perceive and experience the impacts of off-grid energy systems [9]. Likewise, the majority of off-grid communities in the country identify as First Nations, Inuit, or Métis, and there are even fewer examples of research which seeks to meaningfully integrate Indigenous Knowledge and perspectives on the topic. Our research seeks to address these gaps in the existing literature.

This paper is the result of a long-standing community-based participatory research [CBPR] partnership between the researchers and the NunatuKavut Community Council [NCC], the governance body which represents Inuit in NunatuKavut, Labrador. CBPR integrates community values and autonomy throughout all stages of the research process, and emphasizes co-ownership of data, shared decision-making power, co-learning, and methods of knowledge dissemination which are beneficial for all involved parties [10,47]. CBPR literature argues that research should be initiated by community, allowing for research which begins with a topic of importance to the community and not driven by the researcher's agenda [10,48]. Respecting the community-initiation principle of CBPR, we describe the development of this research project. The relationship between NCC and the lead-author began in 2015, when NCC and existing university partners sought to hire a graduate level student to assist with ongoing research tasks. As trust developed in the relationship, the lead-author was asked by NCC to help apply for funding and to collaboratively implement a research project to address the community priority of water insecurity [49]. Upon completion of this project, and several years of relationship building, the lead author was again asked to support an emerging research priority: the sustainability of local energy systems. The lead-author was tasked with finding relevant funding opportunities, and worked with NCC staff to identify knowledge gaps and to design research questions, which were compatible with NCC's priorities for advancing community sustainability.

This priority was part of NCC's Community Governance and Sustainability Initiative [CGSI], launched in 2017 by co-author Amy Hudson. The goal of the initiative was and is to support three pilot communities on NunatuKavut's Southeast coast (Black Tickle, Norman Bay, and St. Lewis/Fox Harbour) to "identify and build on existing community strengths and assets, to foster community engagement in creating a strong future and to develop a sustainability plan for their community" (p. 1) [11]. The role of the researchers was to support NCC staff and community-members in expanding the initiative to consider and address energy-related challenges in the pilot communities. By partnering with the NunatuKavut Community Council, the primary objective of our CBPR project is to integrate Inuit perspectives and determine how existing energy-systems [based on diesel-generation and home heat] impact the sustainability of off-grid communities in southern Labrador. The project was funded by a SSHRC Engage Research Grant. The funding agency was not involved in research design, data collection, analysis, or the interpretation of results.

1.1. Study setting: NunatuKavut, Labrador

Translated from Inuittitut, NunatuKavut means “Our Ancient Land” and it is the traditional territory of NunatuKavut Inuit. The NunatuKavut Community Council is an Inuit governing organization that represents the rights of approximately 6000 Inuit who belong to South and Central Labrador [12]. NunatuKavut spans a vast territory, within which several communities are off-grid and diesel-dependent, located along the southeast coast of Labrador. Three of these communities are represented in this research [Fig. 1].

Inuit on the southeast coast have maintained transhumance (seasonal migration) since time immemorial [52]. Harvesting began in the spring, as families moved to fishing locations on the coast to harvest seals and codfish. In the summer, cod fishing continued, with salmon runs and berry picking taking importance. The arrival of fall marked bird and seal hunting, and by the end of the fall families moved into sheltered bays to prepare for winter trapping and caribou hunts [50]. Today, families in the region maintain multiple homes, cabins, and camps to accommodate each harvest. As such, traditional way of life persists into the 21st century, as Inuit in NunatuKavut continue to travel their lands, and subsist as their ancestors did in the past [50]. Community members from Black Tickle, Norman Bay, and St. Lewis describe their deep attachment to their lands, waters, ice, and way of life in a series of booklets published by NCC [11,53,54]. Today, the southeast coast of Labrador is home to several year-round NunatuKavut communities. Cartwright being the most northern community, and others stretching down the southeast and south coast [Fig. 1]. Permanent settlement into modern day communities occurred in the 1950’s and 60’s, at the urging of the Church and the Government of Newfoundland, which wanted to end Indigenous people's seasonal movements for the stated purpose of service delivery, especially schooling [49].

Three of these modern, permanently settled Inuit communities are represented in this research: Black Tickle, Norman Bay, and St. Lewis. The three communities are remote diesel-dependent communities, with 1020 kW, 160 kW, and 1005 kW of installed capacity in Black Tickle, Norman Bay, and St. Lewis, respectively [13]. Black Tickle, Norman Bay, and St. Lewis have small year-round populations of 120, 19, and 180. Transportation to and from the communities is relatively restricted. For instance, Black Tickle is an island community and the most northern of the pilot communities in this study, accessible primarily by a freight/passenger ferry service in the summer/fall, and by dog team or snowmobile in the winter/spring. Air travel to Black Tickle is dependent upon seat availability on a medical flight, which is also extremely costly. Norman Bay is accessible by a governmental helicopter service in the summer/fall, and by snowmobile only in the winter/spring. St. Lewis is the southernmost community in this study and the only road connected community, with an access road of approximately 30kms connecting the community to the Trans Labrador Highway, which in and of itself is a remote, [mostly] gravel highway running from Blanc Sablon, Quebec to Happy Valley – Goose Bay, Labrador.

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3 This does not include the 824MW Lower Churchill Project (Muskrat Falls), currently under construction [4].

4 Referred to as only St. Lewis hereafter.

5 Additional reading about NunatuKavut Inuit identity, history of land-claim negotiations, and recognition of Indigenous rights and self-determination is available at [51].
Load restrictions occur when diesel-plants are operating at or above 75% of capacity, at which point no new electrical connections are permitted on the local grid, potentially impeding economic growth, social development, and poverty alleviation efforts. Arriga et al. suggest that British Columbia, Ontario, and Nunavut are jurisdictions where 25–50% of off-grid communities experienced load restrictions [16].

Energy security, or secure availability and/or price volatility of fuel sources, also pose economic challenges for off-grid communities. For instance, most off-grid communities purchase annual/semi-annual supplies of fuel, subjecting them to whatever the volatile price may be on the date of purchase. This can create severe challenges for community and utility budgeting: as happened when communities purchased fuel supplies in the summer of 2008 (when prices were at all-time highs), then consumed this fuel throughout 2009 (when prices had fallen by over $0.63 per litre) [17,18].

Combined, off-grid communities in Canada consume 215 million litres of diesel fuel per year for electricity generation [excluding fuel transportation and heating], representing approximately 770,000 tonnes of carbon dioxide equivalent [7,19]. On a per-capita basis, off-grid residents emit approximately 4.8 tonnes of CO2e per year for electricity-generation, or over double the 2.2 t CO2e emitted by a grid-connected resident [7,34]. Emissions also occur during fuel transport to communities via plane, truck, and barge [20,21]. In some cases, these emissions can be substantial, especially when fuel is flown in. For example, in 2015, fuel transportation to off-grid communities in Northern Ontario via plane accounted for 24.5% of total electricity-related emissions [21].

Diesel transportation, storage, and operation poses risks of fuel spills and leaks. This is a serious concern in many Indigenous communities, who remain highly dependent on and value the health of the land and environment. Arriga et al. report that there are over 2000 contaminated sites at or near Indigenous communities in Canada. The majority of these sites (approximately 70%), are contaminated by diesel-fuel [16]. Contaminants associated with diesel-spills are proven to cause cancer with prolonged exposure [22]. This represents a minimum of sites as additional spill sites may not have been reported or recorded.

Many diesel-generators are old or aging, which poses reliability challenges. For instance, in Pikangikum First Nation, in Northern Ontario [prior to being connected to the provincial grid] – the local school board lost approximately 20 percent of its educational time annually due to blackouts at the local diesel generator [16]. It took high school students upwards of an extra year to graduate due in part to these blackouts [23]. In addition, diesel-generation can be responsible for significant noise pollution, which can be loud and disruptive – especially in quiet, isolated Northern environments [56].

Some research has indicated that crown-utility controlled diesel-generation may be viewed as an imposition on self-determination in Indigenous communities. Electricity service delivery is frequently the responsibility of the federal government in off-grid Indigenous communities, or of provincial crown power utilities [3,57,58]. This in and of itself can create challenges for Indigenous decision-making with regards to electricity supply, distribution, and other operational decisions [24]. Fitzgerald & Lovekin argue that distrust of utilities is widespread across the North, driven by historical and present-day inequalities that arise from colonization [57]. The authors summarize Indigenous control of remote energy systems in Canada:

“opportunities for Indigenous inclusion are currently rooted in the colonial market-based reality of energy development in the North, power imbalances between utilities and Indigenous power proponents (where utilities currently have the authoritative advantage) and the lack of transparent information sharing” (p. 9 [57]).

Conversely, Karanasios & Parker find in their analysis of 71 off-grid renewable energy projects in Indigenous communities between 1980 and 2016, that transformation of remote community electrical systems

Fig. 1. Map of Labrador.

2. The impacts of diesel generation – missing Indigenous voices?

The existing literature demonstrates that diesel-generation poses substantial economic, environmental, and societal challenges for off-grid communities in Canada. For example, in diesel-communities with year-round road access, unsubsidized electricity costs are typically $0.45 per kilowatt hour (kWh). For communities accessible by barge or airplane, costs increase to $0.8/kWh or more. For Arctic communities, rates range from $1.5 – 2.5/kWh [7]. In comparison, grid connected communities in Canada typically pay $0.07 - $0.17/kWh for electricity [3].

Due to the high costs of diesel-generation, various levels of government are required to provide significant subsidies in order to keep rates affordable for consumers. For instance, in Nunavut – where the entire population lives in 26 diesel-dependent communities, the territorial government spends approximately 1/5th of its annual budget on the energy needs of the territory [14]. Cross-subsidization is common throughout the country, where grid-connected ratepayers pay premiums on their electricity bills, which are then re-directed towards off-grid communities. For example, in NL, grid-connected ratepayers contribute $80–90 million on an annual basis towards subsidizing off-grid operations [15]. Volume-based subsidies are typically employed in off-grid communities to discourage the use of electricity for heating, and to incentivize electricity conservation [55]. For example, in the pilot communities, residential consumers pay 12.203 c/kWh for the first block of kWh per month and 13.660 c/kWh for the second block (these blocks cover the first 1000 kWh). All kWh in excess of 1000 kWh per month are charged 18.523 c/kWh [88]. In the pilot communities, rates paid by diesel consumers cover approximately 25% of actual operating costs, with the remainder covered by cross-subsidization [39]. Load restrictions are an additional challenge facing off-grid communities.
is shifting from a “utility driven” phase (focusing on utility-owned hydroelectricity and small wind projects, 1980 – 2000) to a more “community driven” phase (focusing on local government owned small solar projects, 2000 – 2016) [59].

While all off-grid Indigenous communities in Labrador remain diesel dependent, the provincial power utility [NL Hydro] has recently launched an ‘Expression of Interest [EOI] for Renewable Energy Solutions in Isolated Diesel Communities’ in southern Labrador. Heerema & Lovekin conclude that NL Hydro’s EOI process does not appear to emphasize community-led projects and favours an industry-led approach [58]. Suggesting that the “colonial, market-based reality of energy development and utility authority in the North” (p. 9 [57]) will continue in the future.

As discussed, most evidence on the economic, environmental, and societal impacts of off-grid diesel-dependence comes in the form of quantitative reporting of a limited number of measures. Conversely, there is limited community-level evidence available which qualitatively analyzes how off-grid residents themselves perceive and experience energy sustainability. Likewise, despite the majority of off-grid communities in Canada identifying as First Nations, Inuit, and Métis, there is limited research which emphasizes the voices and lived experiences of Indigenous Peoples. Karanasios & Parker call explicitly for further research which integrates Indigenous perspectives on remote community energy systems [59].

2.1. Indigenous Peoples and renewable energy transitions in Canada

While this paper focuses on Inuit perceptions of off-grid diesel-generation in NunatuKavut, we cannot separate this research from the emerging body of literature related to Indigenous Peoples and renewable energy transitions in Canada. Researchers in this area suggest that owning to resource potential, and in-depth understandings of their local environments, Indigenous Peoples are at the forefront of renewable energy sustainability. EDST scholars propose 11 impacts which must be considered as part of renewable energy projects [25, 26]. At the core of EDST, is the notion that energy projects are mixed on a nation-by-nation basis. Some Indigenous communities pursue sustainable energy projects to achieve enhanced levels of autonomy and self-determination, while others pursue projects to reduce environmental damage, energy costs, and to generate revenue to invest in community-development initiatives. Other research suggests that while much of the environmental movement in Canada promotes renewables as an economic growth opportunity, most Indigenous communities emphasize renewable energy development as a means of exerting sovereignty [60].

Caution is also urged in this literature, as renewable energies may negatively impact Indigenous autonomy if projects are forced on communities or if consultation processes are not meaningful – potentially resulting in inequitable and unjust development processes [24, 45, 61]. Rezeai & Dowlatabadi explain several potential downsides in these scenarios, such as: further intrusion of Western models of resource governance, exposure to risks associated with novel technologies, and massive administrative burdens of projects [24].

To protect and enhance the autonomy of Indigenous communities, researchers suggest that “truly sustainable renewable energy development requires a project design that reflects community values, incorporates community control, and incentivizes Indigenous ownership” (p. 81 [61]). Likewise, Walker et al. conclude that renewable energy is only valuable in terms of lower emissions and improving socio-economic well-being of communities, when energy autonomy and local decision making power are present [45].

Our research aims to complement this literature in a unique way. NCC’s previously mentioned Community Governance and Sustainability Initiative, employs a strength-based [or asset based] community development approach [11, 53, 54]. Instead of focusing exclusively on deficits, the approach seeks to identify what is already working well in the communities, and how those strengths can be built upon. While we capture novel insights on the impacts of off-grid diesel generation in this paper, we also seek to identify strengths and local acceptance of the existing diesel system, foundational components of community autonomy and integral for future decision making.

3. Energy deployment and local sustainability theory - implementing two eyed seeing

Our research is guided by ‘energy deployment and local sustainability theory’ [EDST] [25–27]. EDST was originally proposed as a theoretical lens to help understand how renewable energy projects impact the sustainability of host communities. EDST consists of three main concepts: substantive sustainability, procedural sustainability, and endogenous development.

Substantive sustainability refers to the tangible economic, environmental, and societal impacts of energy projects in host communities [25]. Here, EDST scholars propose 11 impacts which must be considered as part of renewable energy projects [Table 1]. Similar to our discussion in Section 2., these are the most frequently considered issues in techno-economic literature; with less attention given to social aspects of sustainable energies and community-member perceptions. Given that we are assessing local sustainability implications of off-grid diesel-generation, as opposed to RE projects, we propose a set of sustainability impacts based on our own literature review [Table 2, based on Section 2]. In addition, we presented these impacts to community members from each pilot community and NCC staff at a research design summit in July 2018, prior to commencing the fieldwork period. Summit attendees agreed that these were the most pressing potential impacts to evaluate.

Procedural sustainability extends beyond tangible impacts; instead considering how local populations perceive the impacts of energy projects, how the risks and benefits of development are distributed throughout a community, and ultimately the local acceptance of the project [25, 26]. At the core of EDST, is the notion that energy projects must make positive substantive and procedural contributions in order to maintain long-term success. For example, even if a project makes positive tangible contributions [substantive sustainability], continuity is complicated in the long-term if locals maintain negative perceptions, if most of the risks fall upon marginalized groups, or if local acceptance is eroded [procedural sustainability].

Walker & Baxter make an important distinction which is not addressed in EDST literature [64]. The authors differentiate between distributive justice (the distribution of project benefits and costs – referred to as procedural sustainability in EDST literature) and procedural justice, which focuses on the participation of locals in renewable energy planning and the conditions of that participation. There is emerging
evidence to suggest that procedural justice is at least just as important as distributive justice for local acceptance of projects [64–66]. Just as EDST suggests that erosion of procedural sustainability impacts the continuity of projects, Walker & Baxter suggest that development that lacks procedural justice may spur opposition movements that can threaten the long-term sustainability of renewable energy industries [64]. EDST scholars also identify endogenous development as a critical factor in local sustainability: a bottom-up development process built on the use of local resources (physical, human, and capital). This is in contrast to top-down development processes, characterized by the settlement of firms from places beyond the host area. The authors argue that the greater the integration of energy projects into the productive structure of the local economy, the greater its socioeconomic impact on the local community [25–27].

Much of the theoretical underpinning we employ in this research, such as procedural sustainability, procedural justice, and distributive justice, is synthesized in the community renewable energy (CRE) literature [67–69,92]. For example, Walker & Devine Wright’s seminal paper suggested CRE has two primary dimensions: process and outcome. The first dimension is process: which considers who a project is for, or who benefits economically and socially (ranging from distant and private to local and collective). To the authors, an ideal community project is “one which is entirely driven and carried through by a group of local people and which brings collective benefits to the local community (however that may be defined) – a project that is both by and for local people” (p. 498 [92]).

In this research, we employ the Indigenous guiding principle of Etuaptmumk or ‘Two-Eyed Seeing’ [28,29]. As noted by Walker et al., Etuaptmumk is a Mi’kmq framework, developed by Elders Murdema and Albert Marshall (Eskasoni First Nation), in collaboration with Dr. Cheryl Bartlett. However, the principle of embracing Indigenous and western knowledge systems in research is gaining traction in other jurisdictions [45]. Two-Eyed Seeing embraces both Indigenous and Western knowledge to address social and environmental challenges. As stated by Bartlett et al., two-eyed seeing “refers to using the strengths of Indigenous knowledge and ways of knowing with one eye, and the strengths of using western science and ways of knowing with the other eye, and combining both of these together, for the benefit of all” (p. 333) [30]. As such, regardless of Western scientific notions of energy sustainability, our approach to this research has been to privilege Inuit perceptions and understandings of energy sustainability, while acknowledging that expertise comes from within communities themselves. Keeping with the principles of two-eyed seeing, we note that two of four authors of this paper are NunatuKavut Inuk. Amy Hudson, from the case study community of Black Tickle, and Dr. Debbie Martin, who has immediate family and ancestral connection to St. Lewis. The other authors both identify as Settler-Canadian researchers.

3.1. Operational methods

Ethical clearance for this research was first given by NCC’s Research Advisory Committee. This approval was then forwarded to the Office of Research Ethics at the University of Waterloo, and the Research Ethics Board at Dalhousie University, who also completed their own ethics reviews. In this paper, we assess the local sustainability of off-grid energy systems through three primary research instruments: mixed-methods community-member interviews; key informant interviews, and a supporting document review. Our procedures were collaboratively developed in grant-writing with NCC staff, and approved by community members from the pilot communities at an NCC hosted Research Summit in early July 2018. During an approximately eight-week fieldwork period (July 8 – September 1, 2018), we spent two weeks in the community of Black Tickle, three weeks in the community of St. Lewis, one week in the community of Norman Bay, as well as additional trips to other Inuit communities in NunatuKavut in order to enhance the context and cultural understanding of our work.

With the aid of three grant-paid local Research Assistants, we distributed a recruitment letter to all households in the case study communities. We aimed to speak to all permanent residents (6+ months per year) who were of voting age in the province (18+). Bernard argues that the number of interviews needed for a qualitative study to reach data saturation is not quantifiable, but researchers should speak to as many people as possible given resource constraints [70]. As such, we aimed to speak to any community member that met our inclusion criteria and was available during the fieldwork period.

In total, we conducted 75 mixed-method community-member interviews: including 33 in Black Tickle, 36 in St. Lewis, and 6 in Norman Bay – representing approximately 31%, 30%, and 32% of the target population, respectively [Table 3]. We note that 11% of our sample self-identified as non-Indigenous. We include this subset in our analysis as we wanted to be as inclusive as possible of all community-members. Furthermore, community-members and NCC staff informed us during research design that individuals who do not possess active NCC membership, may not self-identify as Indigenous, but belong to their community and have valuable insight to contribute.

The community-member portion of the study aimed to assess how locals understand and experience energy sustainability. We sought to determine quantitatively what community-members perceived as the most pressing energy-related challenges in their community [based on our previously established sustainability impacts, Table 2]. We accomplished this by asking respondents to rate the variables on a scale of one to five (where 1 = not concerned, and 5 = extremely concerned). Qualitative follow-ups permitted participants to elaborate on these themes. Additionally, we quantitatively assessed local acceptance of the existing energy system, by asking respondents to rate diesel-generation on a scale of one to five (where 1 = strongly opposed, 2 = somewhat opposed, 3 = neutral, 4 = somewhat support, and 5 = strongly support). We then asked respondents to qualitatively elaborate on their preferences.

Table 1 Socio-economic impacts of renewable energy development [25,26].

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Table 2 Sustainability impacts of off-grid energy systems.

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7 Fusch & Lawrence describe data saturation in qualitative research: “data saturation is reached when there is enough new information to replicate the study, when the ability to obtain additional information has been attained, and when further coding is no longer feasible” (p. 1408 [71]).
One of the primary limitations of our study is our limited representation of off-grid Indigenous communities in Newfoundland and Labrador [and Canada]. In this study, we include three Inuit communities in NunatuKavut: and do not include other off-grid Indigenous communities in the province represented by Nunatsiavut Government or Innu Nation [1]. Cultural differences, socio-economic realities, and community priorities may result in very different results on a nation-by-nation basis. We note this was a purposeful decision, as CBPR requires research be completed ‘with and for communities’ as opposed to ‘on’ communities [76]. Our research relationships exist in NunatuKavut, and this research served to address their self-identified priorities. An additional limitation is the risk of bias in qualitative methods, especially the tendency for social desirability in responses [77]. Off-grid diesel dependence is frequently framed as a challenge in Indigenous communities, and the provincial crown power corporation has moved to transition off-grid communities away from diesel. In addition, the lead author for this study has been publicly involved in renewable energy research throughout the region. As such, community-members may be predisposed to opposing diesel and magnifying local challenges for the purpose of satisfying the public and the researchers. We sought to address this bias in our informed consent process, by stressing our rationale for energy autonomy and local decision-making, and ensuring participants that their perceptions would contribute to community energy planning – no matter which preferences they held.

4. Results: diesel-generation local acceptance and community concerns

We find that the pilot communities are not necessarily opposed to diesel-generation. Interview results from all three communities gave diesel-generation a mean-acceptance rating of 3.2 out of 5 [Fig. 2], suggesting that they are largely neutral [slightly more supportive than opposed] to the generation-source as a whole. Of the 75 respondents, 35% strongly or somewhat supported diesel-generation, 35% reported being neutral, 24% reported being strongly or somewhat opposed, and 1% responded that they ‘Do Not Know’.

Fig. 3 presents energy related concerns across all pilot communities. However, we note that differences emerged at the community-by-community scale [Figs. 4–6]. For example, the continuance of energy subsidies emerged as the greatest energy-related concern across all pilot communities [mean concern rating of 4.3/5], however supplies of fuel and the cost of home heat emerged as the greatest energy-concerns in Black Tickle [mean concern rating of 4.5/5 and 4.4/5, respectively].

In Section 4.1, Section 4.2, and Section 4.3., we explore community support for diesel-generation, establishing what community members perceive as the socio-economic contributions and risks of diesel-generation. In Section 4.3, we contrast the local socio-economic benefits of diesel-generation with ongoing hydroelectric development in the region where most benefits have been exported. Section 4.4 focuses on ‘procedural justice’ issues in relation to the existing energy system, primarily the lack of consultation on energy related decisions. Finally, in Section 4.6, we argue that heat insecurity [i.e. access to clean, affordable, and reliable heat] is amongst the greatest energy related challenges in NunatuKavut communities.

4.1. Diesel socioeconomic contributions

Diesel is generally supported as a generation-source because respondents are comfortable and familiar with the technology. As explained by one key informant:

“the diesel plant has been here since the early 70’s. I think everybody is like, it’s always been here, it’s pretty reliable, and everyone is used to it… if you are used to something, and don’t have any problems with it, people do not want to change”.

Many respondents echoed this sentiment. One respondent stated “I don’t mind diesel so much, because diesel has… been around ever since

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In total, 19 community members and one key informant opted not be audio-recorded.

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Table 3
Demographic information of community respondents.

<table>
<thead>
<tr>
<th></th>
<th>Black Tickle (# of respondents)</th>
<th>St. Lewis (# of respondents)</th>
<th>Norman Bay (# of respondents)</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>33</td>
<td>36</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
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<td></td>
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<tr>
<td>Female</td>
<td>19</td>
<td>21</td>
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<td>57%</td>
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<tr>
<td>Male</td>
<td>14</td>
<td>15</td>
<td>3</td>
<td>43%</td>
</tr>
<tr>
<td>Current Profession</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Public Sector</td>
<td>12</td>
<td>8</td>
<td>3</td>
<td>31%</td>
</tr>
<tr>
<td>Private Sector</td>
<td>8</td>
<td>9</td>
<td>3</td>
<td>57%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>9</td>
<td>5</td>
<td>0</td>
<td>19%</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>14</td>
<td>0</td>
<td>24%</td>
</tr>
<tr>
<td>Income (vs $29,000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Much Less/Less</td>
<td>18</td>
<td>6</td>
<td>0</td>
<td>32%</td>
</tr>
<tr>
<td>Same</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>15%</td>
</tr>
<tr>
<td>Much More/More</td>
<td>9</td>
<td>15</td>
<td>2</td>
<td>35%</td>
</tr>
<tr>
<td>No Response</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>19%</td>
</tr>
<tr>
<td>Identify as Inuit, First Nations, or Métis?</td>
<td>30</td>
<td>31</td>
<td>6</td>
<td>89%</td>
</tr>
<tr>
<td>Yes</td>
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</tr>
<tr>
<td>No</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>11%</td>
</tr>
</tbody>
</table>

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the first power to come here”. Another respondent stated “[Diesel] is just what we grew up with, it’s the only thing that I know from living here”.

Diesel is perceived as highly reliable in harsh Northern climates. A key informant, speaking about the community of Norman Bay, indicated that there had been no power outages locally for the previous 6–7 months. Another key informant, speaking about St. Lewis, stated “we have a fairly new [diesel] plant, it’s only about 11 or 12 years old, so we have very few power outages… this plant, even the old one, we had one of the best [performance] records on the coast [of Labrador]”. Respondents echoed these sentiments. As stated by one respondent “I think our energy system is fine… I never want to see it disappear… we had… 159 km of wind last winter, in a storm, and we didn’t lose power”. Another respondent echoed “We very rarely have a power outage. So I mean, why mess with it?”.

Given high unemployment rates and dependence on seasonal work in the pilot communities, the employment opportunities associated with diesel generation are regarded as highly valuable. For instance, while the unemployment rate across NL was 15.5% in 2018, the rate reported in the pilot communities was in excess of 19% [Table 3]. This was reported during the peak of seasonal employment, and does not include respondents whom described being severely underemployed. Census data from 2016 provides unemployment rates of 27.3% and 36.4% in St. Lewis and Black Tickle, respectively [90,91]. Currently, there are three full-time diesel-operation jobs in Black Tickle, two in St. Lewis, one in Norman Bay, as well as supplemental relief and maintenance positions in each community.

Jobs associated with diesel-generation are perceived as valuable as they are high-paying, full-time positions, in communities where little full-time employment is available. As explained by one respondent “…[Diesel jobs] are steady: a week on, and week off. Around this community, you get steady income, you got to hang on to it. If we get rid of the [diesel] plant, that is three incomes gone, and more really, because you got the boys shovelling [around the diesel plant] in the winter time… you are losing all of this”.

The livelihoods afforded to diesel-workers allows them to contribute to their communities in meaningful ways, oftentimes carrying out additional duties integral to community resilience. The flexibility associated with the jobs and the relatively high incomes allows diesel-workers to own and operate grocery stores, to harvest firewood, fish, and wild game for community Elders and seniors, to assist neighbours with household maintenance, to serve as volunteers for community initiatives, and to act as community leaders. These indirect benefits of diesel employment further enhance the community’s support for the generation source.
4.2. Diesel-generation and community risk

While diesel-generation is supported in terms of its local socio-economic contributions, it does not come without risks for the communities. For example, climate change was given a mean concern rating of 3.4/5 across all pilot communities [Fig. 2]. In 2016, the pilot communities consumed approximately 849,000 litres of diesel fuel for electricity-generation (451,000 litres in St. Lewis, 324,000 in Black Tickle, and 74,000 in Norman Bay) [13]. This results in approximately 2260 tonnes of annual carbon dioxide emissions for electricity generation in the pilot communities [33]. While this is a small total amount of emissions, per-capita emissions for electricity-generation in the pilot communities (~7.1t CO2e) are over three times larger than the national average (2.2t CO2e) [34].

When probed about the impacts of climate change, community members most frequently referred to environmental degradation caused by diesel consumption in general. As stated by one respondent “when it comes to diesel… there is harmful effects going into the environment… we have used it for years, and I’m guessing we will continue in the future, but it comes at a cost”. Similarly, one respondent stated “[diesel is] horrible. Not fit to be using. All the more emissions come from the more diesel you use”.

Continued fossil fuel dependence made respondents weary, suggesting they desire more sustainable generation sources in the long-term. One respondent explained, “I have this thought that [diesel] is going to run out and there is going to be widespread panic”. Similarly, another respondent stated “we need to wean ourselves off of fossil fuels”. Expressing desire for more sustainable alternatives, one respondent stated “I would like to see us eventually advance into better types of power possibilities that are better for the environment”.

The risks of fuel spills and leaks was given a mean concern rating of 3.3/5 across all pilot communities. Hunting, trapping, fishing, and gathering remain important components of livelihoods and culture in the communities. As such, any amount of fuel spilled on the land, sea, or water could have detrimental impacts for livelihoods and public health. As explained by one respondent “Fuel will just ruin anything that grows. If animals get into it, then they are going to get sick. If we eat the animals, then we are going to get sick”. Similarly, another
respondent explained…

“We get our salmon, our char, our codfish, any of our sea mammals… our waterfowl, everything is on the doorstep. So a fuel spill here, would have a big impact on a lot of wildlife, and on a lot of people’s actual sustainable [country] foods”.

4.3. Exogenous aspects of local energy systems: dependence on outsiders

While community-members supported diesel-generation in terms of its local socio-economic contributions, there is significant concern across the pilot communities in relation to exogenous aspects of existing energy systems. For example, the ‘continuance of energy subsidies’ was rated as the greatest energy-related concern across all pilot communities (mean concern rating of 4.3/5) [Fig. 3]. As previously discussed (Section 2), off-grid ratepayers are greatly subsidized by financial transfers from grid-connected consumers, only paying 26% of the ‘actual cost’ of electricity generation [43]. Community-members fear that this subsidy could disappear at anytime, making the cost of electricity untenable for most households and forcing settlement away from off-grid areas.

Across all pilot communities, the community’s relationship with the primary utility [NL Hydro] was given a mean concern rating of 3.3/5 [Fig. 2]. NL Hydro has exclusive responsibility for electricity provision (fuel imports, electricity generation, storage, and distribution) in 14 of 15 off-grid Indigenous communities in Labrador [39]. Community-members fear being exclusively dependent on a crown power utility, and what it may mean for the survival of their communities if the utility ever ceased operation. As explained by one respondent in Norman Bay, “If [NL Hydro] decides to take the power, then we have nothing… we are going to be forced to leave. With only 19 people [residents] here in the winter, I see that happening in the next few years”. Similarly, one respondent stated “there is a possibility [NL] Hydro might fold after awhile and move on… the people reliant on diesel will be left in the cold”. Another respondent explained “this community is [always] on the edge, are they [NL Hydro] going to boot us out or not?... It is just a constant worry”.

Across all partner communities, power outages were given a mean concern rating of 3.3/5 [Fig. 3]. Community members feel frustrated that they have to depend on outsiders to fix/maintain local power lines. While local workers are responsible for diesel-operation, they are not permitted to maintain or repair power lines. As explained by one respondent “if everybody knew how to fix the problem [with power lines], you would not have to rely on getting somebody in here, which is really hard at times”. This is especially challenging during harsh weather conditions, when power line-related outages cannot be repaired until outside-crews can make it into the communities. As stated by one respondent “In the winter time, if you lose power and it is gone for a couple days… with weather bad, you cannot get a crew in”. Another respondent explained

“There has been other times too, when the weather has been clear, but you are still waiting hours for them to finally get their butts in here to deal with power outages... it could be during a time when it is really cold, so you cannot afford to be without power”.

Community-members expressed frustration that they receive little spin-off benefits when outside crews visit. While it is standard practice for utility employees to rent local accommodations or dine at restaurants, these services do not exist in the pilot communities. As explained by one respondent “[For] every other community in Labrador, Hydro [employees] is [sic] supposed to stay in hotels, but we do not have a hotel. They would be spending money if we had a hotel, and again it all comes right back to [negative impacts on community] sustainability”. A key informant explained “Not so much [local benefit] now because there is no hotel here. They used to come here and stay, they stay now in [the adjacent communities of] Mary’s Harbour or Port Hope [Simpson]”.

4.4. Hydroelectric development in NunatuKavut

While the local socio-economic benefits of diesel-generation drive community support of the generation source, the same cannot be said for ongoing hydroelectric development in the region. Nalcor Energy [NL’s crown energy corporation] is currently building Muskrat Falls, an 824MW hydroelectric facility, on the Churchill River approximately 30kms upstream from Goose Bay, Labrador [Fig. 1]. Across all pilot communities, respondents gave ‘Relationship with Nalcor’ a mean concern rating of 3.6/5 [Fig. 2]. However, this emerged as one of the greatest energy-related concerns in St. Lewis (mean concern rating of 4.1/5) [Fig. 5]. Cooke & Ryan state “NunatuKavut Inuit have an
ongoing relationship with the lands and waters of the Churchill River and Lake Melville, including those downstream from the Muskrat Falls Project” (p. 1 [79]). As such, Nalcor’s activities surrounding Muskrat Falls are a significant concern of community members. Community members feel a great sense of loss in relation to the Muskrat Falls project: as one respondent explained “[Nalcor] is not giving us power, that is in our land”. Similarly, another respondent explained “They [Nalcor] are stealing from the hydro dams”.

A pervasive sense of unfair treatment and inequitable development exists throughout the pilot communities in relation to the Muskrat Falls hydroelectric facility, which provides no power to isolated diesel communities. Community members felt their resources were being taken advantage of for the benefit of outsiders. This is reinforced by the Muskrat Falls transmission assets running directly through [or adjacent to] NunatuKavut Inuit communities, but all the power is exported to urban centres elsewhere in Newfoundland, Nova Scotia, and beyond. As explained by one respondent “this major project, that is right on our doorstep, is soon going to be complete… and it is bypassing us”. Similarly, another respondent stated “It boggles me how there is power from Muskrat Falls going to St. John’s, and we are using diesel. It makes no sense”. Another respondent explained “they [Nalcor] are going to take all this electricity out of Labrador, [and] we are not going to get enough to turn on a flashlight bulb”.

Community members perceive that they are paying for Muskrat Falls via increases in their electricity bills and provincial taxes but are seeing no corresponding benefit from the development. As argued by a key informant “I feel that if we are not getting any electricity from Muskrat Falls, our light bills should not be going up. We are not getting any benefit from it”. Another respondent explained “If our community is on diesel power.... And we have absolutely nothing to do with electricity coming from Muskrat Falls, we should not have to dish out a cent for it”.

4.5. Procedural justice: utility lack of transparency, consultation, and local decision-making

Respondents in our research felt as though they had little control over energy related decisions within their communities or region. Transparency in decision-making was of central concern. As stated by energy related decisions within their communities or region.

Transparency in decision-making was of central concern. As stated by one respondent “it is not much of a relationship [with the existing utilities]. They tend to do things their own way, it is not transparent”. A key informant explained...

“I would prefer that they [existing utilities] got into contact with the towns and say… ‘these are the plans for this year’, ‘do you have any issues with this?’, ‘is there anything we can do to help your community’, but they do not”.

Community members stated that lack of consultation was most problematic during the sanctioning of Muskrat Falls. One respondent captured this feeling of powerlessness as they stated “I do not like dams, never did… no good for me to say. The government wants to do it; they are going to do it anyway”. Similarly, another respondent explained:

“[Existing utilities] were bulldozing through [Muskrat Falls sanctioning], not listening to anybody, not listening to the environmentalists, not listening to the scientists. I lost a whole lot of respect for the organization… they were not listening to the people; it was all about profit”.

While noise pollution was given the lowest mean concern rating of any particular variable we assessed (2.3/5), community-members expressed frustration that their particular complaints related to the diesel system have gone unaddressed in project planning. For instance, when a new diesel-plant was being built in the community of St. Lewis, community-members advocated for the plant to be built in a new location, in order to mitigate noise pollution impacts. As explained by one respondent “I cannot stand where [the diesel plant] is located. When the plant was rebuilt just a few years ago, they had an opportunity to move it outside the community, and they chose the dollar over safety or noise pollution”. Similarly, another respondent explained:

“I brought it [noise pollution concerns] up to [NL] Hydro when they were building the new plant. They come in with some kind of machine [that measures sound] … and said there’s nothing wrong with it…. there is nothing wrong with it for them, because they are not living here”.

4.6. Heat insecurity: access to clean, affordable, and reliable heat

Our findings suggest that heat insecurity is amongst the greatest energy-related challenges in NunatuKavut.10 As previously discussed, in Black Tickle, supplies of fuel and the cost of home heat emerged as the highest rated concern within NunatuKavut communities (mean concern ratings of 4.5/5, and 4.4/5, respectively). In total, 24% of respondents from Black Tickle reported living in an ‘inadequately heated home’, compared to 14% and 0% in St. Lewis and Norman Bay, respectively. Respondents’ descriptions of ‘inadequately heated homes’ ranged from 4 to 17 °Celsius throughout the winter. A systematic review by Public Health England concluded homes should not fall below 18 °Celsius in order to avoid health impacts, such as: cardio-vascular disease, respiratory illness, increased levels of minor illnesses (colds, flu, exacerbation of existing conditions such as arthritis and rheumatism), and degradation of mental health [36].

4.6.1. Cultural importance and accessibility challenges of firewood

Black Tickle is located on the Island of Ponds, a tundra island, as a result, there is no locally available wood source in the community [Fig. 1]. Despite this, approximately 42% of respondents remained reliant on wood heat, a much smaller proportion than in the other case study communities [Table 4]. Respondents across all three pilot communities reported that firewood harvesting is an important cultural tradition, albeit sometimes an expensive and time-consuming process due to the need to travel inland.

As for the cultural importance of firewood harvesting, one respondent explained “…we don’t have no issues with going to get wood, it’s a whole thing. My kids, and my dad, and my mom, we all go”. Similarly, another respondent explained:

“[firewood harvesting] is a tradition, because we are Southern Inuit, so we’ve done it our whole life… I can remember getting ready and going in the woods with my father, two and three years old… you go in and you have a boil up, get the firewood”.

Firewood permits are inexpensive in the communities, typically $25 for adults, and $16.50 for seniors, allowing the permit holder to cut upwards of 10 cords of firewood. The more significant costs are associated with burning gasoline, maintenance for snowmobiles and komatiks (snowmobile trailers), and the operation of chainsaws.

In Black Tickle, respondents reported travelling between 70 and 105kms (round trip) to access firewood. A much longer distance than respondents in St. Lewis (40 – 60kms) or Norman Bay (10 – 44kms). Across all three communities, respondents generally reported consuming 8–11 cords of firewood per year for space heating, with some outliers [who typically supplement with furnace-oil] consuming only 4–6 cord per year. A komatik load typically carries half a cord, suggesting 20 trips are required to haul a permits’ worth of firewood. Most respondents in Black Tickle reported burning ~19 litres of gasoline per trip, suggesting that household gasoline costs for firewood harvesting are $600–700 per year in the community.

This does not include the labour of firewood harvesters (typically

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10 Nunatuavut Government defines heat security broadly as access to clean, reliable, and affordable heat [35]
4–7 full days to cut 10 cords of wood) or the maintenance, lube, and wear-and-tear costs for snowmobiles, komatiks, and chainsaws. As explained by one respondent “you go through [the costs]: chainsaw, your snowmobile, the truck… you have to look at all the ways it is going to cost”. Another respondent stated “[in the case of breakdown] skidoo parts is not cheap either”.

There are significant greenhouse gas emissions associated with firewood harvesting. Our sample suggests that approximately 13 homes in Black Tickle are dependant on firewood, each completing ~20 snowmobile trips to harvest firewood per year. This equates to approximately 5910 litres of gasoline consumed and 13.5 tonnes of CO2e emissions from burning gasoline alone, not accounting for chainsaw operation, or the burning of the firewood itself [33].

4.6.2. Fuel security: local shortages and long distance hauling

Due to local unavailability of wood resources, a larger proportion of Black Tickle respondents are reliant on oil-furnaces compared to the other pilot communities [Table 4]. Access to furnace oil became significantly restricted in the community in 2016, when the only local supplier announced that they would be discontinuing fuel storage and sales in the community [37]. As a result of this, the volunteer local governance committee [Local Service District] took on responsibility for furnace oil/gasoline imports, with the assistance of $50,000 of funding from the provincial government. The Chair of the Local Service District explained that they operate strictly on a cost-recovery basis, charging residents only the direct fuel and transportation costs of importing drums. This has led to several fuel-access challenges in the community.

The LSD is only able to import a limited supply of fuel/gasoline (~100 drums at a time) via freight ship in the ice-free season [June – December]. The LSD works to ration available fuel supplies to community-members [households are limited to purchasing one drum at a time when fuel is available]; however, respondents reported many instances of unavailability and unequal access. Referring to unavailability, one respondent explained “sometimes it [fuel] just doesn’t come in at all”. Another respondent explained “by the time you are out of the [rationed] drum, if you need to go get another one, it might not even be there”. Unequal access to fuel disproportionately affects low-income earners. As explained by one respondent:

“It is pretty much first come, first serve. So if you got the money to buy 100 drums, you can have 100. The next feller, if he only got enough money…. to buy one drum, and there is neither one left, tough [luck]”.

Even when fuel is available in the community, the requirement to purchase ‘by the 46-gallon drum’ can be a significant financial challenge for community members. A significant portion of Black Tickle respondents (＞30%) are dependent on employment insurance [E.I.] in the winter months (approximately $400 bi-weekly) [Table 3]. A drum of furnace oil/gasoline cost $302 or $328, respectively in 2018. This suggests community members may spend greater than 80% of their bi-weekly income on fuel needs. As explained by one respondent “you either buy a drum of fuel, or you eat for two weeks. You do not have the option of having both”. A key informant explained “most the time you are almost taking your full pay cheque, just to buy a drum of gas”.

The fuel access burden was less severe prior to the departure of the local fuel supplier, as community members had the option to purchase small amounts of fuel on an as-needed basis. Community members could purchase a 20 litre can of fuel, at a cost of approximately $30, which would typically last them a day or two. Small purchases eased the financial-burden and allowed community-members to maintain access to furnace oil.

On average, respondents reported consuming 12 drums of furnace oil per winter, which would cost approximately $3700. Given that 55% of respondents in Black Tickle reported earning much less or less than $29,000 per year, we suggest that a large proportion of the community is living in energy poverty – what has been described as spending in excess of 10% of yearly income on energy needs [38].

The fuel supply imported by the LSD is exhausted by mid-February of each year, leaving the community with no local access to furnace oil or gasoline. As stated by one respondent “[Fuel] gets in on a boat in the fall time, that lasts until February, and then it is gone”. When the supply is exhausted, community-members are forced to travel to Cartwright via snowmobile to purchase fuel and haul it back to their community [a roundtrip of approximately 200kms]. Hauling fuel is an expensive and time-consuming endeavour. Respondents reported making between 5 and 9 trips to Cartwright per winter to haul fuel, and burning between 20 and 80 litres of gasoline per trip. This suggests community members are burning $180 - $1300 per winter in gasoline, just so they can access furnace oil. This does not account for maintenance or wear-and-tear costs associated with snowmobiles or komatiks. As explained by one respondent “You got to spend the money to go down, spend the money to come back, in gas… we got to have materials for the cart, if you break your cart. Springs or shocks, or anything that happens with your [snow] machine”.

4.6.3. Electric heat: utility restrictions, inadequate infrastructure, lack of local capacity

Three primary barriers exist to accessing electric heat in the case study communities: utility policy financially restricts the ability to use electric heat, electrical upgrades required for households are prohibitively expensive, and there is a lack of local capacity for electricians. As discussed in Section 2, electricity rates in most of NL’s off-grid communities are structured in order to discourage the conversion to electric heat. Any consumption in excess of subsidized blocks of electricity [upwards of 1000 kWh monthly] is charged at a rate of 18.252 c/kWh [39,88]. Electric heating in the winter requires several thousand kilowatt hours. As such, respondents who relied exclusively on electric heat reported paying electricity bills ranging from $400 – 900 monthly, a cost which is untenable for most households in the community.

Many of the homes in Black Tickle were built in the 1970’s and do not have the proper infrastructure to support electric heat. For example, a panel box greater than 200 amps is typically required to support electric heat, and most households currently have 100 or 120-amp service. One respondent, with in-depth knowledge on the topic, spoke to the results of a community survey where only 5 of 22 households studied in Black Tickle possessed panel boxes adequate for electric heat. In addition, the wiring of homes would likely have to be upgraded which is a significant cost. As explained by one respondent “My house was built in 1979. So [for] wiring, I’d have to remove everything: walls, partitions… it would be literally cheaper to rebuild than to renovate”. Another respondent explained “[for electric heat] we would have to rewire everything, that would cost you in the thousands”.

Electrical upgrades are significantly more expensive in off-grid communities due to remoteness and lack of local electricians; as such, residents have to pay the transportation and accommodation costs of contractors. As explained by one respondent “there is no electrician in the community to do it [upgrades], and it is very expensive to have an electrician come here”. The Chair of the Local Service District explained “you have to pay their way in the summer on the boat [ferry service] and back, and a place for them to stay, and food to eat… can’t afford it”. Many respondents have received panel-box upgrade quotes from

| Table 4 | Primary heating source by community. |
|---|---|---|---|---|---|
| Primary heat source | Black Tickle | St. Lewis | Norman Bay | Percentage of total |
| Oil | 11 | 2 | 0 | 17% |
| Wood | 11 | 30 | 6 | 63% |
| Electric | 8 | 1 | 0 | 12% |
| Wood/Oil Mix | 3 | 3 | 0 | 8% |

electricians, ranging from $2500 to $5000 (plus travel, accommodations, etc.). These conversions are significantly cheaper in grid-connected areas. As explained by a key informant, ‘[If electricians] supply it [electrical equipment in urban areas] ... get it for probably $2000 or less... Whereas here you are supplying your own gear and still looking at $5000 to get it done’.

5. Discussion

Referring to the community energy literature [Section 3], off-grid diesel systems offer a unique case study. Walker & Devine Wright define an ideal community renewable energy [CRE] project as one which is both ‘by and for local people’ [92]. Our findings suggest that off-grid diesel systems in NunatuKavut could be considered ‘for local people, but by outsiders’. In this case, the outcome dimension of diesel-systems drives local support and acceptance. However, the process dimension erodes community support.

The outcome dimension of diesel-systems is ‘local and collective’ [92]. Due to the isolated nature of the partner communities, their exclusive reliance on diesel-generation, and the general lack of other economic development opportunities, the socio-economic contributions of diesel are felt directly by locals and enhance community acceptance of the generation source. Community familiarity with the diesel-system, diesel’s reliability in harsh climates, the valuable employment opportunities created, and broader contributions to community resilience – are valuable components of the existing energy system, and as a result, a considerable portion of community members “never want to see [diesel] disappear”.

Community support is not unanimous however, and our use of Etuaptmumk stresses two key themes which erode support for diesel systems: environmental degradation, and risks of fuel spills and leaks. These findings supplement existing techno-economic literature, which often asserts the challenges of diesel-systems (i.e. emissions, risk of fuel spills), but fails to explain what these impacts mean, or how they are experienced by community members (i.e. access to country foods). While in totality, the outcome dimension of diesel-systems can be considered local and collective, community members are frustrated when maintenance crews utilize non-local accommodations and services.

We contrast the local socio-economic contributions of diesel-generation with a regional hydroelectric project (i.e. Muskrat Falls), where community members feel an inequitable sense of development and dispossession of resources. In NunatuKavut diesel-powered communities, the process dimension of Muskrat Falls can be classified as ‘closed and institutional’, while the outcome dimension is felt ‘distantly and privately’ [92]. As previously discussed (Section 2.1.), the motivations of Indigenous communities for participating in energy transitions are mixed [42]. While some communities pursue projects in pursuit of energy autonomy and greater self-sufficiency, others pursue projects primarily for local socio-economic and environmental benefits. Our findings place greater emphasis on local socio-economic benefits of projects. We find that community members are more accepting of known diesel-based energy systems which benefit locals, than massive hydroelectric projects where the vast majority of benefits are exported.

Conversely, the process dimension of diesel-systems, aligns closely with the ‘closed and institutional’ model of community involvement [92]. Walker & Baxter identified ‘the ability to affect outcomes’ as a key procedural justice issue affecting acceptance of generation sources, and to a lesser degree: information sharing, opportunities to participate, and general resident-developer relationships [64]. The ability to affect outcomes emerged as a significant concern related to diesel-systems and regional hydroelectric development. Community members expressed frustration that the existing utility [NL Hydro] would not take seriously or address their concerns related to noise pollution. Likewise, community members felt as though they were not being adequately involved in the Muskrat Falls development, and that they were powerless in influencing decisions - captured by one respondent “if the government wants to do it, they are going to do it anyway”. The resident-developer relationship in general is fraught: where community members worry NL Hydro is in a position of power and could influence the very survival of their communities by shutting off the electricity. Information sharing emerged as a lesser, but still evident procedural justice issue. Communities felt that the existing utilities are not transparent in their planning or activities. This supports the findings of Mercer, Sabau, and Klinke, whom suggested a general lack of information sharing with regards to NL’s utilities and their interests in renewable energy development [80].

EDST urges understanding not only of procedural sustainability (i.e. local perceptions) but also substantive sustainability (i.e. tangible economic, environmental, and social impacts). While a great deal of our analysis focused on perceptions of community energy systems, we also make the case that heat insecurity has reached crisis proportions in Black Tickle. The community currently has no secure heat source; even when available, fuel supplies are unaffordable to many community members; and in many instances this can be directly tied to utility policy (i.e. subsidy levels which discourage electric heat).

The emerging literature on Indigenous Peoples and sustainable energy transitions in Canada urges that renewable energies are only acceptable when grounded in energy autonomy and local decision-making. Our research concludes that off-grid communities in southeast Labrador are not necessarily opposed to diesel-generation, and that community members value socio-economic aspects of the energy system such as familiarity, reliability, and employment. Diesel-generation is not without its challenges, but it is currently necessary and builds community resilience in the absence of reliable and affordable alternatives. Respecting the autonomy of communities, any proposed energy transition should recognize and seek to maintain community-identified strengths, and avoid imposing a western ‘sustainability’ agenda on communities [24]. This is a dramatic shift compared to much popular discourse which refers to ‘dirty diesel’ in off-grid communities [81-86].

Similar to community members in the study, we as authors recognize the need for urgent decarbonization in the face of global climate change [87]. As stated by one respondent “we need to wean ourselves off fossil fuels”. With that said, our research points to the need for ‘decolonized decarbonization’ in off-grid communities. We define decolonized decarbonization as sustainable energy transitions which are grounded in community autonomy and local decision-making, which recognize and protect community strengths associated with existing energy systems (i.e. familiarity, reliability, employment), and which seek to support communities in addressing self-identified priorities (i.e. environmental degradation, access to country foods, exogenous development, procedural justice).

6. Concluding remarks

While Canada is generally perceived as a global leader with regards to low-carbon electricity deployment, the same cannot be said for off-grid communities throughout the country. Of the 259 off-grid communities in Canada, 190 remain almost exclusively reliant on diesel-generation for their electricity needs. A growing body of literature purports that diesel-generation poses substantial economic, environmental, and societal challenges for off-grid communities; however, to our knowledge, there is no qualitative analysis of how community members perceive and experience the local impacts of off-grid energy systems. Likewise, despite the majority of off-grid communities in Canada identifying as First Nations, Inuit, or Métis, there is even less research which seeks to meaningfully integrate Indigenous perspectives on the topic. By partnering with the NunatuKavut Community Council, and the Inuit diesel-dependent communities of Black Tickle, St. Lewis,
and Norman Bay, our research sought to address this gap in existing knowledge. This is a timely area of research, as Canada continues to work towards decarbonization via sustainable energy development, and Indigenous communities remain at the forefront of this transition [42,62,63].

Our CBPR approach, which has involved deeply engaging with community residents, spending a great deal of time in the community, and reviewing the results of our research with the community, demonstrates the importance of engaging Indigenous communities directly in energy sustainability studies to develop a more comprehensive understanding of Indigenous People's perspectives. For instance, while a growing body of research criticizes diesel-generation, our research suggests off-grid communities are not necessarily opposed to existing energy systems. among the 75 respondents participating in this study, only 24% were opposed to diesel while 35% supported existing diesel systems and another 35% were neutral. Building off Devine Wright & Walker's seminal contribution on community energy: we find that the outcome dimension of diesel systems is 'local and collective', while the process dimension is 'closed and institutional'. Given that 'ideal' community energy systems are both 'by and for local people', we suggest that diesel-systems can be valued to the extent that they are 'for local people, but by outsiders' [92]. This can be contrasted with large-scale hydroelectric development in the region, which can be classified as 'for outsiders, by outsiders' [92].

Our findings serve to better respect the autonomy of communities. We do this by identifying what is already working well at the community level as a result of diesel-generation (i.e. local jobs, reliability, familiarity), and protect the community from being unduly imposed upon by projects which are not compatible with their desires. Any proposed sustainable energy transition should protect these benefits, while seeking to address what community-members themselves perceive as their greatest energy-related challenges (i.e. environmental degradation, risk of fuel spills and leaks, as well as issues related to exogenous development and procedural justice). This paper serves as the first example of research to fully investigate what living in a diesel-dependent community is like from the local perspective. Doing so allowed us to identify heat insecurity as a key challenge in off-grid communities, an issue which has been given inadequate attention in the existing literature. This is demonstrated most vividly in Black Tickle, where upwards of 24% of community members report living in inadequately heated homes, fuel supplies are restricted across all potential heating sources, and the high costs of fuel/retrieving fuel result in a significant portion of community members living in energy poverty.

By privileging Inuit voice and community expertise in conducting research with these three pilot communities in NunatuKavut, we not only filled an existing gap in the literature as it relates to off-grid energy sustainability, we also captured people's active interests and investment in the preservation and survival of their communities. Community participation and knowledge sharing in this research is indicative of NunatuKavut Inuit self-determination, demonstrating the success of our collaborative community led research that seeks to acknowledge and support community knowledge and autonomy in decision making and planning.

We cannot assume that results from partner NunatuKavut Inuit communities apply to the 167 other sovereign, autonomous, and diverse Indigenous off-grid communities throughout Canada. As such, we encourage researchers to seek permission and meaningful partnerships with other First Nation, Inuit, and Métis communities, and we call for future research which is grounded in energy autonomy, local decision making, and integrates Indigenous perspectives. Such research, if desired, may broaden our understanding of community acceptance, sustainable energy transitions, and the impacts of off-grid energy systems.

Declaration of Interest: none

Role of the funding source

This research was funded by the Social Science and Humanities Research Council of Canada (grant number: SSHRC892-2017-2101). The funding agency had no involvement in research design, data collection, analysis, or the interpretation of results.

Declaration of Competing Interest

None.

Acknowledgments

First and foremost, thank you to the 75 community-members and seven key informants who let us into their homes for a cup of tea and donated their valuable time and expertise in the process of interviewing. For your knowledge, we are forever grateful. Nakummek. Thank you to the Social Sciences and Humanities Research Council of Canada for funding this research. Thank you to the Waterloo Institute of Sustainable Energy and the Energy Council of Canada for supporting the doctoral student. Thank you to Barry Wheeler and team at the Atlantic Forestry Institute for help with figures. Thank you to our research assistants and supportive friends: Siobhan Slade, Emily Beacock, Abigail Poole, Stacy Keefe, Kaylila Little, and Jade Zavarella. Thank you to three anonymous peer reviews for your thoughtful comments, advice, and critique.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.erss.2019.101382.

References


13


