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Article abstract

Renewable energy (RE) is at the forefront of Canada's strategy to achieve a net-zero electricity grid by 2035. The development of RE projects is also promoted as a means to deliver energy services in rural and remote Indigenous communities across the North. Although RE projects have the potential to contribute to sovereignty, self-sufficiency, and economic reconciliation, the social value of RE to Indigenous communities is often overlooked and poorly understood. This article advances themes for understanding and approaching RE developments to better assess their social value. It does so based on the analysis of lessons from RE research in northern Canada and Alaska. We demonstrate that RE projects can create outcomes that are value generating or value eroding and that such outcomes are often couched in the context of supporting or detracting from self-determination. Techno-human variables, from community vision and capacity to policy environments and local RE ownership, serve to enable or inhibit the realization of value-generating outcomes from RE. Finally, we identify several pathways to creation from RE, including relationships and collaborative leadership, knowledge and skills-development, Indigenous-led policies that decrease energy bureaucracy and manage benefits distribution, and regulations and structures that safeguard ecologies.

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ABSTRACT
Renewable energy (RE) is at the forefront of Canada's strategy to achieve a net-zero electricity grid by 2035. The development of RE projects is also promoted as a means to deliver energy services in rural and remote Indigenous communities across the North. Although RE projects have the potential to contribute to sovereignty, self-sufficiency, and economic reconciliation, the social value of RE to Indigenous communities is often overlooked and poorly understood. This article advances themes for understanding and approaching RE developments to better assess their social value. It does so based on the analysis of lessons from RE research in northern Canada and Alaska. We demonstrate that RE projects can create outcomes that are value generating or value eroding and that such outcomes are often couched in the context of supporting or detracting from self-determination. Techno-human variables, from community vision and capacity to policy environments and local RE ownership, serve to enable or inhibit the realization of value-generating outcomes from RE. Finally, we identify several pathways to creation from RE, including relationships and collaborative leadership, knowledge and skills-development, Indigenous-led policies that decrease energy bureaucracy and manage benefits distribution, and regulations and structures that safeguard ecologies.

Keywords: social value of energy, renewable energy, Indigenous communities, Canada, Alaska

INTRODUCTION

Energy systems are transitioning globally from fossil fuel-based systems toward renewables to mitigate climate change whilst ensuring energy security (IEA, 2023; Leonhardt et al., 2022). In Canada, the federal government has prioritized renewable energy (RE) as part of a national strategy to achieve a net-zero electricity grid by 2035 (Government of Canada, 2023a). For many of the off-grid, diesel-dependent communities across Canada's provincial and territorial North, RE is also promoted as a way to reduce the reliance on diesel fuel whilst supporting energy sovereignty, self-sufficiency, and economic reconciliation with Indigenous peoples through equity ownership of RE projects (Government of Canada, 2023b; Hoicka et al., 2021; Rakshit et al., 2019)).

The potential to generate local economic and social benefits and empower historically marginalized communities are among the noted benefits of RE projects (Berka & Creamer, 2018; Hossain et al., 2016; Walker et al., 2022). However, McMaster et al. (2023) caution that such benefits are realized only when RE initiatives align with and enhance community social values. Similarly, Mercer et al. (2020) conclude that for off-grid Indigenous communities in Canada's eastern Arctic, RE projects that do not align with local traditional values are less likely to be accepted by the community and are instead seen as capital-driven energy investments that reflect external interests. Thus, notwithstanding the growing interest in RE to power rural and remote Indigenous communities, there is need for a more critical understanding of the potential benefits of RE and the burdens or risks that these projects may pose—a balance that is absent from many narratives promoting energy transition (e.g., Rezaei & Dowlatabadi, 2016; Walker et al., 2022).

Local RE projects have the potential to deliver energy services in rural and remote communities, but the social value of energy to these communities is often overlooked (del Rio & Burguillo, 2009; McMaster et al., 2024). The social value of energy is simply "the total value derived from energy services, including both economic and non-economic value and accounting for risks, burdens, and other negative externalities" (Miller et al., 2015, p. 67). Developing RE systems for, rather than with, Indigenous communities under the guise of environmentally responsible energy production imposes an agenda that may not align with a community's values and aspirations (Menghwani et al., 2022); such projects often fail to generate social value (Holdmann et al., 2022; McMaster et al., 2023). Another major challenge is that, despite the inherent importance of social value to RE projects, there is limited research to guide community, energy planner, and policy-maker understandings of the social value of RE in the context of northern, remote, and off-grid Indigenous communities (Holdmann et al., 2022; Stefanelli et al., 2019; Walker et al., 2021). Such understanding is crucial to ensuring that local energy investments improve community wellbeing and avoid propagating energy injustices (Biswas et al., 2022; MacKay et al., 2021).

This paper offers a thematic analysis and parameters for understanding the social value of RE projects in remote northern Indigenous community contexts, including potential value-generating and value-eroding outcomes. In doing so, the intent is to

support communities, energy planners, policy makers, and developers to better plan for, monitor, and evaluate RE projects based on an improved understanding of social value creation or burdens, rather than solely on techno-economic objectives. The themes and parameters offered provide a foundation for future studies aiming to develop more nuanced and community-specific frameworks for exploring the social value of energy for remote northern Indigenous communities.

TOWARDS UNDERSTANDING THE SOCIAL VALUE OF RENEWABLE ENERGY

There is growing research on RE in remote northern Indigenous communities, yet this scholarship remains limited when compared to research focused on urban environments and grid-connected communities in the south (Holdmann et al., 2022). Our approach to understanding the social value of RE is based on a scoping review of scholarship on community and RE projects and experiences from northern Canada and Alaska—regions characterized by considerable growth in RE initiatives in the North (Holdmann & Asmus, 2019), yet where the majority of off-grid communities still rely on diesel fuel for power generation.

Methods

We used the Scopus database (www.scopus.com) to identify scholarly research on the social value of energy for Indigenous communities, using keyword searches that included (Canada OR Alaska) AND (renewable AND energy) OR (community AND energy) AND (Indigenous) OR (aboriginal) OR (first AND nation) OR (Metis). Multiple search strings that included the addition of specific named Nations or bands were first tested to ensure that our final search parameters did not exclude research addressing RE in Indigenous communities that did not adopt specific terminologies. Our focus of analysis was to reveal information that is contextual, explanatory, evaluative, and generative; therefore, we focused on publications that use qualitative research methods to capture local perspectives and produce insights that are often omitted from quantitative or technical studies (Ritchie, 2003). We thus limited our search to the social science disciplines and only included studies that were based on a qualitative design, informed by data collected through community engagement (e.g., interviews, focus groups, and participatory research), and focused in some capacity on the social value of energy. These were supplemented by a limited number of studies that provided cross-sectional analyses of Indigenous RE development, including the determinants of off-grid energy transition (Holdmann et al., 2022), government instruments supporting RE in northern communities (Leonhardt et al., 2023), and Indigenous business leaders in Canada's RE sector (Bullock et al., 2020; Zurba & Bullock, 2018, 2020) (see Table 1).

The sample of papers is small yet rich in that it is only comprised of research that tackles the social value of energy through community-engaged scholarship or that is based on cross-cutting analyses that engaged Indigenous community actors. All the literature selected for analysis used co-produced methods and/or data, which are essential to investigating the social value of energy because they include local community

viewpoints: desktop studies often fail to accurately capture this data (Biswas et al., 2021; Stefanelli et al., 2019). Importantly, the sample reflects the limited empirical research available to inform RE planning and decision making in remote community contexts. That said, the research sample included in our analysis addresses RE issues and contexts across more than 20 communities.

TABLE 1
Recent Research on Remote Northern Indigenous Community Energy Included in Our Analysis

Community or regionally focused	*Communities or region*
Brewer et al. (2018)	Gwitchyaa Zhee Corporation, Fort Yukon, Alaska
Karanasios & Parker (2018)	Non-disclosed community, Nishnawbe Aski Nation, Ontario
MacKay et al. (2021)	Tuktoyaktuk, Inuvialuit Settlement Region
Mang-Benza & Baxter (2021)	M'Chigeeng First Nation, Ontario
McMaster et al. (2023)	Inuvik, Aklavik, Fort McPherson, Tsiigehtchic—Northwest Territories
Mercer et al. (2020)	NunatuKavut, Labrador
Rakshit et al. (2019)	Poplar Hill First Nation, Ontario
Rakshit et al. (2018)	Keewaytinook Okimakanak First Nation, Ontario
Rezaei & Dowlatabadi (2016)	First Nation communities, British Columbia: Tsay Keh Dene, T'Sou-ke, Hartley Bay, Douglas First Nation, Tahltan Central Council, Atlin, Xeni Gwet'in, Kwadacha, Kanaka Bar
Rodon et al. (2021)	Kuujjuaq and Inukjuak, Quebec
Schmidt et al. (2021)	Tanana, Alaska
Sikka et al. (2013)	Sealaska Corporation (Tlingit and Haida communities), Alaska
Tsuji et al. (2021)	Constance Lake First Nation, Ontario
Cross-cutting research	*Regions or actors*
Bullock et al. (2020); Zubra & Bullock (2020); Zubra & Bullock (2018)	Cross-Canada, Indigenous business leaders
Holdmann et al. (2022)	Cross-cutting, 24 Alaskan communities
Leonhardt et al. (2023)	Saskatchewan, Manitoba, Northwest Territories —Indigenous leaders, utilities, governments

We examined the content of this research through an iterative review and coding process following the methodological guidance of Braun & Clarke (2012). Initial coding was based on the semantic meaning of the text, identifying the range of values or outcomes of RE identified by the authors; this was followed by a second round of coding whereby codes were merged to create sub-themes based on the dimensions of social value of energy as proposed by Miller et al. (2018) and Biswas et al. (2022). NVIVO v.12 software was used to code, consolidate codes into sub-themes, and categorize

sub-themes into three emergent yet interconnected themes: i) RE outcomes, whether value creating or eroding; ii) techno-human variables; and iii) pathways to social value creation via RE (see Figure 1). The convergence of codes into sub-themes and themes was reviewed independently by the second and third authors and cross-checked against Biswas et al. (2022). The sections that follow discuss each of these components and their implications for realizing the social value of RE in remote northern Indigenous community contexts.

FIGURE 1
Social Value of Energy Core Themes

OUTCOMES: SOCIAL VALUE CREATION FROM RE

Across the selection of papers reviewed, we observed 179 references to RE outcomes, or 25% of our data codes. Of these 179 references, the majority (80%) referred to the social value created from RE projects, such as revenue generation and nurturing culture and well-being (which tend to contribute to self-determination objectives), whilst 20% of references to RE outcomes identified potential value-eroding outcomes, such as land displacement and increased local energy costs (which tend to detract from self-determination objectives).

Value Generating Outcomes—RE Aligns with Exercising Self-Determination

When envisioned, owned, and/or controlled by the community, RE projects can support self-determination as communities become more self-sufficient in meeting their energy needs, without reliance on external actors (Karanasios & Parker, 2018; Rezaei & Dowlatabadi, 2016). Many remote communities across northern Canada and Alaska rely on expensive, imported diesel fuel for power generation, straining the community's

financial resources whilst failing to meet even basic energy needs (Bullock et al., 2020; Rakshit et al., 2019; Rezaei & Dowlatabadi, 2016; Sikka et al., 2013; Zurba & Bullock, 2020). Various studies identify RE as an endogenous energy option that reduces reliance on external energy supplies and actors, thus reducing community energy costs, enhancing local energy reliability, and increasing access to essential energy services such as heating (Brewer et al., 2018; Bullock et al., 2020; Karanasios & Parker, 2018; Krupa et al., 2015; MacKay et al., 2021; Mercer et al., 2020; Rakshit et al., 2018, 2019; Rezaei & Dowlatabadi, 2016; Schmidt et al., 2021; Sikka et al., 2013). In this context, we identify four primary value-generating outcomes for communities from RE, based on the sample of scholarship reviewed.

Fostering Self-Governance. Local production and use of RE can promote self-governance via improved energy self-reliance and self-sufficiency, thus decreasing dependencies on external producers, governments, and funding for energy security. Drawing on different community contexts and perspectives, recent studies identify RE as offering communities a means to break away from colonial power structures and catalyze decolonization (Rezaei & Dowlatabadi, 2016), coupled with economic and cultural reconciliation (Mang-Benza & Baxter, 2021). Such value opportunities are reported in McMaster et al.'s (2023) analysis of RE opportunities in Gwich'in communities in the Northwest Territories, referencing a Gwich'in community leader's explanation that local control over decisions about energy means breaking "the long history of colonial policies and approaches" (p. 150) that instruct communities on how to do things.

Generating Revenue and Savings to Finance Communities' Priorities. RE allows communities to generate new revenues or realize energy cost savings (Karanasios & Parker, 2018). Resources can then be redirected to essential community infrastructure (Krupa, 2012) or to a community trust fund to support local investments and development initiatives that are not supported via other government funding programs (Bullock et al., 2020; Rakshit et al., 2019). In the Northwest Territories, for example, Gwich'in leadership explain that when a community has energy control locally, they "can make better decisions about how [to] spend that energy, what [to] do with it" (McMaster et al., 2023, p. 150). In this regard, energy cost savings can free up resources to meet basic needs and provide greater financial autonomy.

Creating Local Economic Opportunities. Likewise, RE can create new local economic opportunities such as employment and income for local suppliers, operators, and maintenance personnel: this enables self-reliance and offers new opportunities to train and retain technical skillsets in the community (Brewer et al., 2018; MacKay et al., 2021; Schmidt et al., 2021; Zurba & Bullock, 2020). Coupled with more affordable energy and financial autonomy, this nurturing of new skillsets can enable entrepreneurial opportunities, which creates more local economic opportunities and gains. For instance, in Fort Yukon, Alaska, the Indigenous-owned Gwichyaa Zhee Corporation provides good paying local jobs by employing community members to harvest biomass, maintain boilers, and operate biomass power plants, while keeping revenues from biomass energy sales within the community, rather than spending on diesel fuel imported from outside the community (Brewer et al., 2018).

Nurturing Culture and Well-Being. RE can provide the means for communities to access energy services that are essential to live comfortably and affordably, while reducing local pollution from diesel fuels. Research from rural Alaska (Schmidt et al., 2021) and communities in Canada's boreal region, for example, show that harvesting local resources for bioenergy production helps sustain cultural practices, whilst other studies indicate that RE allows household resources normally spent on electricity for home heating to be invested instead in fuels and equipment to support hunting, fishing, trapping, and gathering (Rodon et al., 2021; Schmidt et al., 2021; Tsuji et al., 2021). In the Mackenzie Delta, McMaster et al. (2023) report that the prospects of secure and affordable RE can translate to improved resourcing of social services, such as schools, recreational centers, and community buildings.

Value-Eroding Outcomes—RE Creates Barriers to Self-Determination

Notwithstanding the considerable value-generating outcomes, RE can also create value-eroding outcomes to self-determination. Based on our analysis, four cautionary value-eroding outcomes emerge from recent scholarship:

Land and Job Displacement. Whilst in Canada the concerns over displacement from traditional lands are most often documented in relation to hydropower development (Krupa, 2012; Tsuji et al., 2021), in other jurisdictions, including northern Sweden and Norway, such displacement is an increasing concern regarding wind power development and its disruption of traditional livelihoods (Szpak, 2019). Further, Indigenous communities in northern Ontario and Labrador have raised concerns that RE can also lead to job displacement, especially when RE projects replace locally operated diesel plants and lead to the loss of the diesel-related institutions that provide energy services to communities (e.g., fuel service and maintenance) (Karanasios & Parker, 2018; Mercer et al., 2020; Rodon et al., 2021).

Extractive and Adverse Impacts. Although considered clean energy, RE does have adverse impacts associated with it (Krupa, 2012), including impacts related to the demand for critical and rare earth mineral extraction in the North to support the manufacturing of RE technologies (Tortell et al., 2023). Such emerging concerns—coupled with more enduring concerns related to methyl mercury contamination and flooding from hydropower reservoirs (Tsuji et al., 2021), impacts of biomass harvesting on habitat and soil health (Bullock et al., 2020), or wind turbine disturbance to land and wildlife (MacKay et al., 2021)—can threaten subsistence activities and quality of life. Mercer et al. (2020), for example, report concerns from NunatuKavut communities regarding certain energy technologies, including small hydro and energy storage technologies, citing fears over disturbance to traditional food sources such as fish and soil contamination due to lithium battery disposal.

Adverse Effects on Physical and Social Health. Related to the above are concerns about the adverse impacts of RE projects to well-being, including those related to the noise and visual impacts of wind turbines (Mang-Benza and Baxter, 2021; Mercer et al., 2020) and emerging concerns from some communities about the health risks of

small modular nuclear reactor projects (Mercer et al., 2020)—a target technology for energy transitions in remote Canada (NRCan, 2022). Further, research in Canada's North notes that low-cost RE can free up household income but cautions that it can also lead to further social disruption in communities where underlying social health challenges and coping mechanisms need to be addressed (Bullock et al., 2020; Zurba & Bullock, 2020).

Increased Energy Cost and Financial Losses. Replacement of existing energy services with RE can lead to increased energy costs or it may not generate sufficient profit for the local organizations providing RE services (Holdmann et al., 2022). Geographical remoteness, human resource capacity, and energy production ownership and distribution restrictions are all identified in the Canadian and Alaskan context as conditions that could lead to higher costs of producing and purchasing RE compared to current diesel-based generation (Bullock et al., 2020; Sikka et al., 2013). The capital cost of certain technologies, such as battery storage and replacement for solar, can also be prohibitive for many communities in absence of government subsidies (Mercer et al., 2020), increasing power rates and exacerbating energy poverty (MacKay et al., 2021).

TECHNO-HUMAN VARIABLES INHIBITING OR ENABLING SOCIAL VALUE FROM RE

The techno-human variables of energy systems either enable social value creation from RE projects or pose barriers to social value realization. Techno-human variables were widely discussed across the sample of papers reviewed, referred to more than 400 times by the collection of authors and representing 56% of our data codes. The techno-human variables identified include community awareness and vision (192 references; 47%), ownership and control (76 references; 19%), policy infrastructure and coordination (39 references; 9%), and capacity (100 references; 25%).

Community Awareness and Vision

The potential of RE projects to generate positive social value hinges on whether such projects are envisioned with or by community members and leaders, rather than based on the visions of outside interests (McMaster et al., 2023). Deep community involvement in RE planning, development, and even operations and maintenance are critical to establishing community support for RE initiatives (McMaster et al., 2024). Grassroots RE is more likely to align with community values that reinforce connections to land, water, and wildlife (Brewer et al., 2018), ensure the well-being of future generations (Mang-Benza & Baxter, 2021), and promote the sharing of benefits among community members (Schmidt et al., 2021). In Tsiigehtchic, Northwest Territories, for example, McMaster et al. (2023) show that the vision for RE must be embedded in the community's way of life and not "imposed…from outside the community" (p. 7). Community visions for RE may be drastically different from those of energy developers, nonprofits, or external governments (Mercer et al., 2020). Limited attention is often paid to what northern and Indigenous communities want from RE, resulting in RE projects that are potentially threatening to local values such as subsistence activities,

traditions, and food security (MacKay et al., 2021; Tsuji et al., 2021). In Canada's eastern Arctic, Mercer et al. (2020) report that past experiences with external energy actors have left negative sentiments among community members—this is especially so when RE is politicized, its benefits overemphasized, or when the community has limited understanding about how a specific RE technology works (Brewer et al., 2018; MacKay et al., 2021; Mang-Benza & Baxter, 2021).

Ownership and Control

Local ownership and control of RE projects have been shown to support community acceptance and social value creation (Krupa et al., 2015; MacKay et al., 2021; Menghwani et al., 2022). For example, in the case of M'Chigeeng First Nation's wind power project, the community's sole ownership reduced members' negative sentiments about wind energy and even created a sense of pride and empowerment (Mang-Benza & Baxter, 2021). Similarly, Krupa et al. (2015) report that Pic River Nation, Ontario, managed to uplift the community through decades of RE development, which gained momentum because of local leadership's learning from outside partners during a pilot run-of-river project and that eventually led to the community's full ownership and control of RE projects. The importance of local control is further illustrated by Rondon et al. (2021), reporting on case studies from northern Quebec and the relative success of the Innavik hydro project (an essentially local initiative to explore alternative energy solutions) versus the externally driven and unsuccessful diesel-powered solutions introduced by the Crown energy utility, Hydro Quebec, for Kuujjuak. Local ownership and control of RE allows a community to reinvest the savings accrued from lower-cost energy (Brewer et al., 2018; MacKay et al., 2021). As summarized by Gwich'in leadership in the Northwest Territories, when communities control energy locally, they can "make better decisions about how you spend that energy, and what you do with it" (McMaster et al., 2023, p.8).

Policy Infrastructure and Coordination

Energy governance varies jurisdictionally, but it typically involves multiple layers of regulatory bodies with varying responsibilities and priorities. It is common for government-owned utilities to monopolize energy infrastructure and supply and to dominate energy governance (Leonhardt et al., 2023). Experiences across northern Canada show that monopoly control can reinforce colonial structures, disregard the cultural and social value of RE, and inhibit energy sovereignty (Rezaei and Dowlatabadi, 2016; Rodon et al., 2021; Tsuji et al., 2021). In the Inuvialuit Settlement Region, for example, MacKay et al. (2021) report that quota regulations for distributed energy projects limit an individual's ability to be energy secure. Similarly, in Aklavik, Northwest Territories, the community owns an integrated 55-kilowatt solar system, but to ensure energy cost balancing across the service region, the Crown energy corporation Northwest Territories Power Corporation allows for only a maximum 20% of electricity generation to come from local intermittent sources (Leonhardt et al., 2023; McMaster et al., 2023). And for RE sources such as biomass and hydro, land tenure restrictions

and water licenses limit community access to RE resources (Bullock et al., 2020; Krupa, 2012).

Central governments and utilities typically support renewables, but multi-level, multi-layered policy and regulatory processes pose barriers to local RE projects (Rakshit et al., 2019). The experiences of northern communities are echoed in Leonhardt et al.'s (2023) cross-jurisdictional analysis of Canada's energy systems, which are characterized by monopoly ownership, grid inaccessibility, and generation restrictions and which stifle RE in many remote and Indigenous communities. Examples such as Aklavik (McMaster et al., 2023) and Pic River First Nation (Krupa et al., 2015) demonstrate that it is possible for RE to emerge and benefit communities under centralized utility structures, but these examples simultaneously illustrate social value constraints and emphasize the importance of complementarity between government instruments for RE deployment: this ensures the development of community and place-based tools for value-added RE projects (Leonhardt et al., 2023; Rakshit et al., 2019).

Capacity to Plan, Build, Operate, and Maintain RE Projects

Communities must have the capacity to plan, build, operate, and maintain RE projects, including access to financial resources, expertise, technologies, and supporting energy infrastructure. Numerous studies on Indigenous community RE emphasize the importance of financial resources to the materialization of RE projects (MacKay et al., 2021; Mang-Benza and Baxter, 2021; Mercer et al., 2020). However, securing financing for local RE is complex, often stifling or delaying project development (Bullock et al., 2020; Rodon et al., 2021). Leonhardt et al. (2023) report that Indigenous communities must often pursue multiple financial programs to support a single RE project, often requiring matching funds from the private sector. Other reported barriers include debt ceilings (Rodon et al., 2021), as banks are not able to seize infrastructure built on First Nations' land in Canada in the event of a debt default. The borrower must instead secure a loan guarantee beforehand, which obstructs RE development (Bullock et al., 2020). Difficulty in capital financing of projects, coupled with the high start-up and maintenance costs of RE relative to the cost of energy from established fossil fuel companies, which are sometimes subsidized, remain inhibiting factors for RE in the North (Karanasios & Parker, 2018; Schmidt et al., 2021; Sikka et al., 2013).

Local human resource capacity plays an equally important role in enabling or constraining the social value of RE. Across Gwich'in communities in the Mackenzie Valley, for example, McMaster et al. (2023) identify two definitive capacity challenges: energy literacy and opportunities for RE skills development, including technical, financial, and managerial skillsets. Unfamiliarity with energy businesses and technologies and the installation, operations, and maintenance of RE can limit a community's ability to fully realize the benefits of RE (Bullock et al., 2020; Krupa, 2012) or even cause reluctance to pursue RE options (Mercer et al., 2020). For instance, McMaster et al. (2023) report that community members of Aklavik are aware that a portion of their electricity is generated by solar, but there is limited technical understanding of how the

solar energy system functions or awareness of generation policies set by the territorial utility that limit solar capacity.

Several scholars note that the historical exclusion of many Indigenous communities in the energy industry has contributed to the lack of energy-related skills and has fostered a dependency on external governments and corporations for energy services (Mang-Benza and Baxter, 2021; Rezaei and Dowlatabadi, 2016). That said, others report a rich embedded and transferable skillset; for example, across Gwich'in communities, McMaster et al. (2023) identify skills from the mining and oil and gas sector that are "easily transferable" (p. 152) to the RE sector. There is sometimes a perception that because RE is a new technology that remote Indigenous communities lack the skills to engage with it (Krupa, 2012; Rakshit et al., 2019); this perception is not always the reality.

PATHWAYS TO SOCIAL VALUE CREATION FROM RENEWABLE ENERGY

Based on the social value outcomes of RE and the enabling techno-human variables identified across communities' RE experiences, several potential pathways to social value creation were identified. Benefit pathways were referred to the least in the sample of scholarship, comprising 141 (19%) data codes: they included relationship building (29 references; 21%), knowledge and skills (50 references; 35%), decreasing bureaucracy (48 references; 34%), and safeguarding ecologies (14 references; 10%). These pathways are not meant to be prescriptive or comprehensive of all possible opportunities for realizing the social value of RE. Rather, the pathways draw on the common lessons and opportunities emerging from recent scholarship and experiences with RE deployment and interests across the North.

Building Relationships and Establishing Local Leadership

Several case studies in the literature emphasize the importance of local leadership or community energy champions to facilitate actor engagement, knowledge mobilization, and internalizing RE as a community-directed initiative (Krupa et al., 2015; Rakshit et al., 2018). Local leadership for RE is collaborative, not hierarchical, and focused on building the social capital to enable and sustain RE projects (Goedkoop et al., 2022). In other words, realizing the social value of RE opportunities requires leadership that engages community members, fosters a collaborative approach to shaping a community's energy vision, and ensures integration of community values into RE project planning, implementation, and benefits distribution (Krupa, 2012; MacKay et al., 2021; Rakshit et al., 2019). This requires gender-inclusive and multi-generational engagement to ensure social value distribution from both current and future RE projects (Rakshit et al., 2018; McMaster et al., 2023).

Due to the multi-sectoral and multi-layer governance structure of energy in remote northern Indigenous communities, working fluidly with multiple actors is necessary to develop RE initiatives (Krupa et al., 2015; Zurba and Bullock, 2020). This means that local energy leaders must be equipped with both the mandate and the resources to engage

both community members and external actors and to pursue new RE technologies and funding opportunities. Reporting on experiences from Tsiigehtchic, Aklavik, and Fort McPherson, for example, McMaster et al. (2023) note that not having locally designated or sufficiently resourced energy champions means missed opportunities to pursue RE projects; the challenges to local RE leadership are largely capacity related.

Building Knowledge, Skills, and Local Capacity

Three key opportunities to facilitate energy literacy and build the knowledge and skills to engage in RE initiatives emerge from community scholarship on RE across the North. First, there is empirical evidence that communities benefit and learn from partnering with industries or other actors to build local capacity for RE (Brewer et al., 2018; Krupa et al., 2015). Such partnerships can be in the form of demonstration projects, as in the case of Pic River Nation's learning from a run-of-river pilot initiative. The importance of local context-specific skills development and training for community engagement in RE is reinforced by McMaster et al. (2023), who emphasize the importance of local, hands-on training and mentorship after looking at the challenges of formal training programs that require a prerequisite knowledge base and thus are largely inaccessible to community members. There are also examples of initiatives that ensure local capacity building is community appropriate, such the Northwest Territories Power Corporation initiatives to provide apprentice-type training and applied mentorship for community members out of high school (McMaster et al., 2023).

The next key opportunity is strengthening community energy literacy. Energy literacy has been a key catalyst to RE success in rural Alaska (Holdmann et al. 2019), with community understanding of energy technologies being foundational to their acceptance. Mercer et al. (2020), for example, report community resistance to certain energy technologies on the southern coast of Labrador, owing in large part to misunderstandings about the technology itself. As McMaster et al. (2023) note, a major challenge to current energy literacy programs in remote northern Indigenous communities is the focus on energy efficiency rather than on improving community knowledge about how energy systems work (production, distribution, and end use).

Finally, community-to-community energy networks provide an important opportunity for communities to learn from each other regarding the implementation of RE projects: for example, technological options, financing, governance, and operations and maintenance (Brewer et al., 2018; Krupa et al., 2015). While values may differ from one community to the next, community-to-community relationships can help build local capacity through knowledge sharing, technology transfer, or even resource sharing. At a minimum, sister community relationships provide an opportunity to learn about success stories and how mistakes can be avoided (McMaster et al., 2023). Socially networked communities have been instrumental to the emergence and success of regional grids across rural Alaska, providing support for energy project planning and maintenance across remote locations (Holdmann et al., 2019).

Decreasing Bureaucracy in Centralized Utility Structures

In many jurisdictions, legislation permits only Crown energy utilities to generate, transmit, and distribute electricity (Leonhardt et al., 2023), limiting the ability of Indigenous communities to be independent power producers. New opportunities are slowly emerging through power purchase agreements, but scholars argue that current policies and regulations, created by non-Indigenous governments mainly for centralized utility-based markets, create burdens and barriers for remote and Indigenous communities to engage in RE and could reinforce fossil fuel dependencies (Brewer et al., 2018; Leonhardt et al., 2023). Realizing the social value of RE requires not only engaging Indigenous governments and communities in energy sector governance (MacKay et al., 2021; Rakshit et al., 2019) but also supporting Indigenous-led policies that strengthen Indigenous communities' capacity for self-sufficiency (Bullock et al., 2020; Krupa et al., 2015). For instance, the success of Pic River Nation in becoming an RE developer involved advocating for policies that require Indigenous participation in provincial procurement processes and for RE siting allocation that would contribute to First Nation development (Krupa et al., 2015). There are also lessons to be learned from remote Alaska, namely the Alaskan Village Electric Cooperative (AVEC), for restructuring an energy sector to enable energy self-sufficiency. AVEC, although powered largely by diesel generation, emerged in the late 1960s as a non-profit electric cooperative and now provides power to 58 off-grid communities across Alaska (Holdmann et al., 2022). The cooperative is wholly owned by the communities it serves. No such organizational structure currently exists in Canada's North.

Beyond ownership and grid access, the success of community RE hinges on appropriate financial policies and regulations. Leonhardt et al. (2022) emphasize the inequities created by instruments such as power purchase agreements when smaller remote communities lack the capacity to negotiate rates. A substantial scholarship thus points toward the importance of context-specific policies for financing RE, such as government-backed loan guarantees or grants for start-ups and small enterprises (Bullock et al., 2020; Krupa et al., 2015). Evidence indicates that policies providing such financial incentives for Indigenous RE contribute significantly to the initial planning or deployment of RE projects. For instance, Ontario's Green Energy and Green Economy Act of 2009 provided a feed-in-tariff known as the Aboriginal Price Adder for RE developed by First Nations, which sparked the interest of Constance Lake First Nation and Northland Power Inc. to plan the development of hydropower projects on the Kabinakagami River, as well as the completion of a 2 MW wind project owned by the M'Chigeeng First Nation (Mang-Benza and Baxter, 2021; Tsuji et al., 2021).

Of course, such incentives for RE project development must be coupled with policies that support market expansion, including incentivizing power purchases from local RE vendors (Brewer et al., 2018) and creating an export market (Bullock et al., 2020). In addition, policy or regulations would need to support the local distribution of benefits accrued from RE projects. In the bioenergy sector, for example, Bullock et al. (2020) and Zubra and Bullock (2020) discuss how Indigenous business leaders recognize the need for mechanisms that uphold the Indigenous value of sharing and ensure the

distribution of benefits, with Rodon et al. (2021) reporting similar priorities emerging from Inukjuak regarding the distribution of project revenues to meet community needs.

Safeguarding Ecologies

Finally, the social value of RE projects encompass environmental impacts that need to be assessed and mitigated. Studies on bioenergy development, for example, show that Indigenous leaders see the overharvesting of wood and pollution from burning biomass as a potential threat to traditional lands and resources, thus requiring permitting and regulating processes to ensure sustainable biomass harvesting practices (Bullock et al., 2020; Sikka et al., 2013). Similarly, in the case of Nunavik, Rodon et al. (2021) report that Inukjuak community members supported local development plans for Innavik hydroelectric but requested specific ecological setbacks, thus minimizing the potential for adverse environmental impacts.

Assessment and permitting processes are needed for RE projects, but these processes may look different from those established under regulatory impact assessment for major mining or fossil fuel energy projects (Hanna et al., 2019). The challenge is to ensure sufficient regulatory controls for RE projects to mitigate potential adverse environmental impacts without introducing costly impact assessment processes that delay RE project approvals (McMaster et al., 2021). Macintosh et al. (2018), for example, note that complicated impact assessment and approval processes can delay RE projects, reduce the social and economic returns from investment, and, in the worst case, derail clean energy projects. Canada may require something similar to Europe's TEN-E Regulations for 'common interest projects,' introduced to ensure that priority energy infrastructure is developed that meets energy and climate needs (McMaster et al., 2021): Canada would benefit from similar expedited and novel procedures that prioritize Indigenous-led RE projects on Indigenous lands and ensure an efficient and Indigenous-led assessment and approval process whilst safeguarding local ecologies. Minimizing the transaction costs of RE project approvals and incorporating Indigenous-led review and approvals processes are important to realizing timely and appropriate benefits to communities.

CONCLUSION

The development of RE projects does not automatically lead to Indigenous communities' energy sovereignty, self-sufficiency, or economic reconciliation; hence, understanding the social value of RE for remote northern Indigenous communities is crucial to achieving these aspirations amidst the ongoing energy transition. This article presented a thematic analysis for the social value of RE in remote northern Indigenous communities, emphasizing the pathways that lead to social value creation and the techno-human variables that either enable or constrain social value from RE, while recognizing that outcomes of RE can be value generating or value eroding. To ensure alignment of RE with local values and economic reconciliation efforts, the actors involved in planning, developing, and implementing RE policies, programs, and initiatives need to recognize these pathways, variables, and value-generating or value-eroding outcomes. The themes

identified in this research are based on the Canadian and Alaskan Northern context: we acknowledge that further lessons and experiences with RE from research with northern and Indigenous communities across other Arctic regions such as Norway, Sweden, and Russia may challenge or reinforce the foundational principles presented in this paper. We thus recommend further research to explore these themes across different RE and community contexts and to translate the lessons learned into actionable guidance for community energy planning and evaluation of RE opportunities.

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