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Government instruments for community renewable energy in northern and Indigenous communities

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ABSTRACT

Energy insecurity is part of everyday life for many remote and Indigenous communities across the North. Community energy is emerging as a solution to address enduring energy challenges in remote regions, but the success of community energy initiatives hinges, in part, on adequate and accessible government instruments. Formal policies and rules to advance energy transition play an essential role in community energy, yet there is limited understanding of government instruments to support community energy in northern and Indigenous communities. This paper provides a critical assessment of government instruments for community energy in northern, remote, and Indigenous communities in Canada. Based on interviews with 48 actors engaged in northern community energy, results show a range of available instruments. While each serves different functions, financial supports and community ownership instruments emerge as dominant needs for community energy in the North. However, many northern and remote Indigenous communities lack the capacity to access supports when they are available, are competing against each other for limited resources, or are constrained by the rules and regulations of traditional and centralized energy ownership systems. A diversity of complimentary and reinforcing instruments is essential, sensitive to community needs, capacities, and aspirations.

1. Introduction

Community renewable energy (CRE) is as a critical pathway in the transition toward a low-carbon and secure energy future. Globally, however, progress in CRE development is highly uneven, especially in those rural and remote communities that are not connected to a continental electricity grid (Holdmann et al., 2022). Much of the scholarly attention to CRE has focused on urban areas or on rural and remote regions in the global South, with considerably less attention to the Circumpolar North (Leonhardt et al., 2022). Yet, across northern Canada and Alaska alone there are 280 remote, mostly Indigenous communities, that are not connected to a main power grid or natural gas distribution network and rely on imported and costly diesel fuel for power generation (Holdmann et al., 2022; NRCanNatural Resources Canada, 2018). Transitioning rural and remote diesel-dependent communities to CRE will require not only substantial investment in local energy infrastructure and human capital, but it will also require appropriate government instruments to enable and sustain CRE systems (Andrews-Speed, 2016; Leonhardt et al., 2022).

Government instruments, referred to in this paper as formal policies, programs, or regulations, play a critical role in either enabling or constraining energy transitions (Grashof, 2021), and are paramount to transformative energy and economic growth (Belain et al., 2021; Khan et al., 2022a) and improving access to CRE (Astuti et al., 2019). Government instruments comprise the basic institutional arrangements (Williamson, 2000) of energy systems and thus impact the nature, opportunities, and extent to which energy systems can transition. Nolden (2013), for example, reports that government feed-in tariffs for renewable energy played an important role in community energy in the United Kingdom, whilst Bauwens et al. (2016) showed that state-offered financial incentives were vital to community energy success in Germany. In sharp contrast, Madriz-Vargas et al. (2018) report that grid service regulations in Panama for electrical connection, distribution, and transmission have stifled local energy in remote regions, and

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institutional obstacles are similarly reported as amongst the major barriers to local bioenergy developments in India (Irfan et al., 2022).

Notwithstanding the importance of government instruments to CRE, the focus of scholarly research on such instruments has focused largely at the national to supra-national level (Burke and Stephens, 2017; Del Rio and Kiefer, 2022; Khan et al., 2022a, 2022b; Zakari et al., 2022), and to a lesser extent on rural and remote regions (Irfan et al., 2022; Radley and Lehmann-Grube, 2022; Tseng et al., 2021). There has been limited attention in particular to government instruments for CRE in the Circumpolar North. Scholars have identified the importance of government instruments to northern CRE (MacArthur, 2017; McMurtry, 2018), and have argued that governments should provide more appropriate instruments to enable fair and equitable access to clean energy in northern communities (Hoicka et al., 2021; Mortensen et al., 2017; Rakshit et al., 2019), but there has been limited research on the instruments necessary to enable and sustain CRE in rural and remote northern communities. Based on an international review of government instruments, Leonhardt et al. (2022) stress the urgent need for research on the nature and effectiveness of instruments for CRE solutions in rural and remote northern contexts.

This paper responds to the current gaps in scholarship on government instruments for CRE in the Circumpolar North. Specifically, this paper provides a critical assessment of government instruments for CRE in northern, remote, and Indigenous communities in Canada. Emphasis is placed on the range of instruments available, the functions they serve, and the opportunities and challenges they present for community energy in the northern context. Although focused on the Canadian North, the observations and lessons emerging are of value to other northern or remote regions and jurisdictions.

2. Context and approach

Rural and remote energy systems are socio-technical systems, comprised of energy infrastructure and technologies, the communities that produce and consume energy, and the institutions in which energy transactions are embedded (Funcke and Bauknecht, 2016; Milchram et al., 2019). There is a substantial literature on the role and influence of institutions in the energy sector, from instilling energy resource dependencies to facilitating energy transitions. For example, Belain et al. (2021) note the powerful role of institutions in shaping economic growth in the energy sector, whilst Milchram et al. (2019) emphasize the importance of values in shaping institutional change processes for energy transitions. That said, in a recent global review of energy instruments, Leonhardt et al. (2022) conclude that there is only limited scholarship on the nature and role of institutions in supporting CRE in rural and remote regions.

CRE institutions are comprised of the macro-level institutional environment, which establishes the basis for economic, political, and societal interactions, and the institutional arrangements operating at the meso-level that govern transactions (Williamson, 2000). Whereas institutional environments are slow to change and can reinforce lock-in and path dependency in energy systems (Geels, 2018), but institutional arrangements are more susceptible to change or adaptation over much shorter time periods (Williamson, 2000). Based on Lowndes and Roberts (2013) and Voβ and Simons (2014), we conceptualize institutional arrangements for CRE as consisting of both rules and relationships. Rules are the formally constructed and implemented government instruments (e.g., feed-in-tariffs, energy market instruments, energy efficiency standards), whereas relationships refer to the practices concerning how different actors within an energy system interact and operate. Together, rules and relationships shape whether and how energy systems transition to meet urgent energy needs.

Energy scholars have recognized the importance of understanding the nature and role of formal institutional arrangements in energy transitions (Andrews-Speed, 2016; Leonhardt et al., 2022); however, the dominant focus of CRE scholarship has been on relationships (i.e., energy governance) versus formal instruments – notwithstanding the critical role of government instruments in supporting or constraining CRE opportunities (Astuti et al., 2019; Leonhardt et al., 2022; Seyfang et al., 2013). With thousands of remote diesel-dependent communities globally poised for energy transition, coupled with an additional 487 million people expected to gain access to electricity by 2030 via decentralized energy systems (Holdmann et al., 2022), there is a need for research that examines the opportunities and constraints of government instruments to CRE development.

2.1. Study area

The transition to CRE is particularly important in the context of northern, remote, and Indigenous communities across Canada. Approximately 66% of electricity generation in Canada is from renewable sources, with hydro accounting for 90% of renewables generation (NRCanNatural Resources Canada, 2019). The majority of Canada's population is also connected to the continental electricity grid, providing reliable and affordable access to power. Across Canada's North, however, the energy context is dramatically different. There are 170 off-grid communities in Canada's provincial and territorial North, of which most are Indigenous, that depend on the power provided by diesel generators (NRCanNatural Resources Canada, 2018). Relying on the long-distance delivery of diesel fuel and on generators operating at or near capacity, many of these communities experience high energy costs, constrained socio-economic development opportunities, and increasing energy insecurity (Hossain et al., 2016; Mortensen et al., 2017).

The study area of focus in this research are the northernmost regions of the provinces of Saskatchewan and Manitoba and the Northwest Territories. There are 30 off-grid communities across these three jurisdictions: one in Saskatchewan, four in Manitoba, and 25 in Northwest Territories, representing 15,467 people (NRCanNatural Resources Canada, 2018). Further, many of those communities that are grid-connected but considered 'end-of-line' communities also face energy insecurity, due to high electricity delivery costs and ageing transmission and distribution infrastructure. All three jurisdictions share a similar energy governance structure: vertical, centralized ownership with a government (i.e., Crown) energy corporation responsible for power generation, transmission, and distribution. Government policies, programs, and other initiatives to support CRE must operate inside the constraints of this centralized structure, which can challenge projects that focus on decentralized generation. The energy insecurity challenges faced in these regions is typical of northern and remote Indigenous communities across the country (Raphals, 2019).

Manitoba Hydro is the Crown corporation responsible for the generation, transmission, and distribution of electricity in Manitoba. The utility owns 16 hydroelectric and one thermal generating stations, delivering electricity over approximately 86,365 km of transmission and distribution lines (Manitoba Hydro, 2022). The utility also delivers natural gas to more than 130 communities across the southern region of the province. In northern Manitoba, the utility serves four off-grid communities via diesel generators (NRCanNatural Resources Canada, 2018). In these communities, the average monthly energy bill of $97 CDN (Manitoba Hydro, 2019) is only possible with subsidies from the provincial and federal governments. Despite limited support for community energy (Heerema and Lovekin, 2019), one of these diesel-dependent communities, Northlands Dënesųłiné First Nation, is developing biomass, geothermal district heating, and a solar park (Boke Consulting and Northlands Dënesųłiné, 2017).

Coal and natural gas are the largest generation sources in Saskatchewan; renewables represent less than 25% of generation (SaskPower, 2021). Saskatchewan Power Corporation (SaskPower) is the Crown utility with exclusive rights to supply, transmit, distribute, and sell electricity – with over 157,000 km of transmission and distribution lines (SaskPower, 2022). SaskEnergy, also a Crown corporation, is the primary distributor of natural gas, serving the central and southern regions

of the province. There is only one off-grid, diesel-dependent Indigenous community in northern Saskatchewan – Kinoosao, which recently received funding from the federal government to develop a new energy plan (NRCan, 2018). However, several grid-connected communities still face energy security challenges. The province is comprised of a southern grid and a northern grid. The northern grid is characterized by aging infrastructure and frequent outages due to storm events, wildfires, and lightning strikes (Bigland-Pritchard and Prebble, 2010; Giles, 2016). While Saskatchewan residents spend on average $170/month for household electricity (CERCanada Energy Regulator, 2018), many northern and Indigenous communities pay between $400 and $800/month. SaskPower has recently partnered with the First Nation Power Authority (FNPA) to support Indigenous independent power producers.

In Northwest Territories, the Northwest Territories Power Corporation (NTPC) controls most of the energy generation outside of the City of Yellowknife. Of the 33 communities in the territory (43,000 people, across 1.1 million square kilometers), NTPC powers three communities with hydroelectricity, one with imported liquefied natural gas, and 25 are diesel dependent (GNWT Government of Northwest Territories, 2018; GNWT Government of Northwest Territories, 2015). Heating oil is the most common energy for home and commercial heating, often supplemented with propane or cord wood, but with a growing interest in biomass heating. Electricity rates are heavily subsidized, but still the highest in Canada and more than double the national average. Households often pay $500 CDN monthly for electricity and sometimes up to $1000 CDN monthly for heating during the winter months. New renewable energy projects are being developed in diesel-dependent communities, including solar power projects in the hamlets of Aklavik and Lutsel K'e Dene First Nation.

2.2. Methods

Semi-structured interviews were conducted with 48 participants involved in CRE in Canada's North. Participants were selected from actors representing Indigenous community leadership, provincial and territorial energy utilities, governments agencies, intermediary organizations involved in CRE projects in Indigenous communities (e.g. NGOs, social enterprises), energy researchers, and private companies who develop CRE projects in partnership with Indigenous communities (Table 1). Federal government representatives and interviewees from regions outside the study area comprise the "other regions" category. The purpose of interviewing actors from different sectors and regions was to capture a variety of government instruments available for community energy in northern and Indigenous communities. Participants were recruited using snowball sampling (Lewis-beck et al., 2011), a non-probability sampling method that is effective when a few key informants are known who can then help identify other potentially interested and informed research participants (Kirchherr and Charles, 2018).

Interviews explored the government instruments supporting or constraining CRE, focusing on the challenges faced by communities in pursuing locally owned or operated energy projects, and whether the current regulations or policies support CRE projects. Interviews were recorded, transcribed, coded, and analyzed thematically based on a deductive approach (Richards and Morse, 2013; Sovacool et al., 2020) (Fig. 1). Transcripts were coded using NVivo 12 software, based on pre-defined categories of government instruments. These pre-defined categories were based on our recent analysis of international literature on CRE (Leonhardt et al., 2022), which identified 19 instruments for CRE and four categories (payment-based, grid access, community planning and capacity, and environmental protection instruments) according to their functions (Fig. 2). The categories of government instruments emphasize the diversity of tools (existing or potential) for community energy, reinforcing the value of multiple and complementary instruments. The most discussed categories of government instruments were identified based on the distribution of interview codes across instruments. The content of the most discussed categories was then analyzed qualitatively to identify lessons and recommendations.

There are limitations to our study. Our snowball sampling design started with a few key informants and, like most research adopting this sampling design, participants were unevenly distributed across participant groups (DeCarlo, 2018). That said, it was not our intent to test knowledge and compare responses by participant group. Further, we suspect that knowledge about government instruments varies considerably, based in part on what people have been exposed to in their community or professional field of practice, and thus not all participants may have been familiar with the full range of government instruments. However, our intent was not to inventory all available government instruments, but rather to understand actor's perspectives about the effectiveness of those that are familiar and to identify desirable instruments for supporting CRE.

3. Results

A total of 18 instruments to support community energy were identified (Table 2). These include tools that currently exist and those desired by participants. Financial supports, which include government-provided financial contributions, such as grants and capital funding programs, were identified the most often, by 78% of interviewees. This was followed by community ownership instruments (62%) – policies or regulations that encourage or permit community ownership of, or partnership in, CRE projects, such as Saskatchewan's power generation partners program. Grid services was the third most identified, but mentioned by less than half of participants, referring to laws and regulations that control grid access.

Results show a diversity of instruments with the potential to support CRE, each receiving different attention across jurisdictions. Community ownership, for example, was the most mentioned in Saskatchewan, with 80% referring to this tool as important for CRE in the North (Table 2). Community ownership was the second most mentioned in Northwest Territories, and third in Manitoba. The attention to community ownership instruments may be a function of current energy ownership structures in these regions, where a government energy utility is responsible for power generation, distribution, and transmission; new or revised instruments are seen as necessary for community energy.

Grid services, although identified by participants in all jurisdictions, was the most frequently raised only in Manitoba, but also mentioned by

Table 1
Participants by region and organization.

Sectors represented	Manitoba	Saskatchewan	Northwest Territories	Other regions[a]	TOTAL
Indigenous leadership	0	3	12	0	15
Energy utilities	2	2	2	0	6
Government	3	1	0	1	5
Intermediary organizations	2	3	4	1	10
Researchers	3	1	3	2	9
Private companies	1	0	0	2	3
TOTAL	11	10	21	6	48

[a] Representatives from federal government and other provinces with insight to government instruments in the study regions.

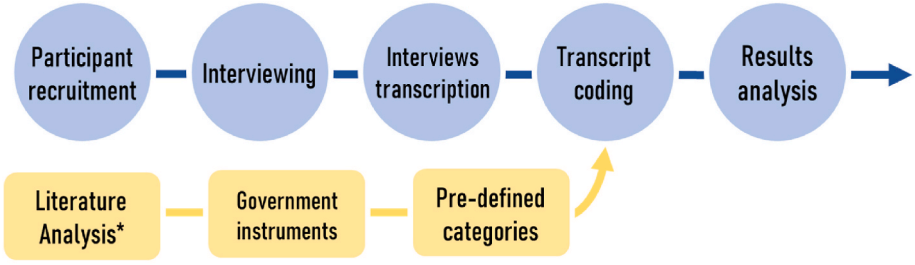

Fig. 1. Research design drawing on primary interview data, with analyses informed by government instruments and categories defined in the literature.
* Literature analysis results presented in Leonhardt et al. (2022).

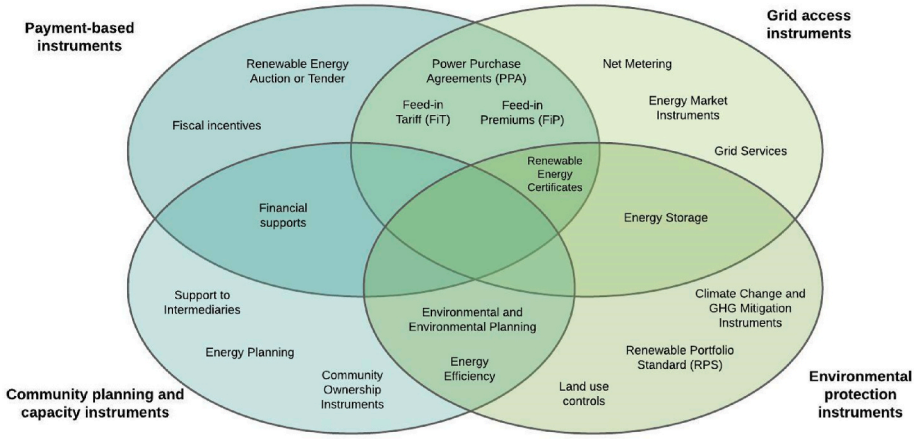

Fig. 2. – Government instruments and four global categories, based on Table 1 from Leonhardt et al. (2022).

participants from the federal government and other jurisdictions (Table 2). Participants identifying this instrument noted the lack of grid services to support community energy. The Manitoba Hydro Act, for example, prohibits ownership of transmission and distribution lines. Climate change and mitigation instruments, in contrast, were identified by more than half of participants only in Saskatchewan. This may be attributed to the large percentage of hydroelectricity in the energy mix of Northwest Territories (70%) and Manitoba (99.6%) for grid-connected communities, while in Saskatchewan renewables represent les than 25% of the energy mix.

Variability is further emphasized by power purchase agreements (PPA), energy market instruments, and land use controls. For example, 50% of Saskatchewan and Manitoba participants identified PPAs, while only 13% of Northwest Territories participants mentioned this instrument. Energy market instruments were the fourth most identified in Manitoba (63%), while it was discussed by only 10% of Northwest Territories participants (Table 2). In some instances, instruments received no attention. Renewable energy certificates were discussed only in Saskatchewan, whereas land use controls and energy storage were only raised in the Northwest Territories and Manitoba. Feed-in premiums was the only instrument not identified by participants in any region, yet it was identified by Leonhardt et al. (2022) as an important CRE instrument based on international scholarship.

It was not the intent to compare results by participant group, mainly because participants, especially Indigenous leadership, were unevenly distributed across jurisdictions, but some similarities and variabilities emerge. For example, Indigenous leadership in Northwest Territories most often identified financial support instruments (83%) for CRE, with similar responses from Indigenous leadership in Saskatchewan. The emphasis was on small grants or loans to support CRE planning and project start-ups. Variability was observed between intermediary organizations. The importance of climate change instruments was noted by all intermediary organizations in Saskatchewan but by none in Manitoba. In Manitoba, the most discussed instruments by intermediaries were financial incentives and grid services; in Northwest Territories it was energy efficiency instruments, namely those emphasizing home retrofitting, such as insulation and windows, to improve home heating efficiency.

Following Leonhardt et al. (2022), the 18 instruments identified were grouped into four categories based on the functions they serve: payment-based instruments, grid-access instruments, environmental protection instruments, and planning and capacity instruments. The payment-based category was the most identified (84%), and environmental protection the least identified (62%). Among payment-based instruments, financial supports dominated (78%), with fiscal incentives (7%) and renewable energy auctions or tenders (7%) receiving the least attention. The most discussed environmental protection instruments were climate change and GHG mitigation (33%), and environmental planning (33%). These instruments represent, respectively, policies and regulations that establish GHG reduction targets, and control the environmental impacts of CRE projects. Renewable portfolio standards received the least attention (4%) in this category.

Grid access, and planning and capacity instruments were identified by 73% and 80% of participants (Table 2). Among the grid access category, 49% identified grid services, followed by net metering (38%), and power purchase agreements (31%) as important for community energy. Net metering are the credits received in exchange for excess electricity generated, and power purchase agreements refers to the electricity purchase agreements between the consumer and energy generator. Energy storage (11%) was the least mentioned in this category. Among planning and capacity instruments, community ownership dominated, identified by 62% of participants, followed by energy planning (36%), and support to intermediaries (22%). Energy planning instruments guide the development of a community or regional energy

Table 2
Distribution of interview codes by instrument and by region.

Government instruments[a]	Interviewees addressing each government instrument, by region[b]								Total	
	NWT		SK		MB		Other regions			
	#	%	#	%	#	%	#	%	#	%
Financial supports: Financial contributions to support community energy, including funding programs, grants, and loans.	17	81	7	70	8	100	3	50	35	78
Community ownership: Regulations, legislations, and policies supporting full or shared community energy ownership.	10	48	8	80	6	75	4	67	28	62
Grid services: Instruments controlling access to a grid, including laws and regulations for connection, transmission, and distribution.	6	29	3	30	8	100	5	83	22	49
Net metering: Program providing consumers who generate energy with credits on their electricity bill for excess electricity generated.	5	24	5	50	4	50	3	50	17	38
Energy planning: Legislation, regulations, and policies that guide the development of a region's energy system.	7	33	3	30	3	38	3	50	16	36
Climate change and GHG mitigation: Laws, regulations, or policies for GHG reduction or emissions control.	6	29	6	60	2	25	1	17	15	33
Energy efficiency: Laws, regulations, and policies to reduce energy use and promote energy conservation.	5	24	3	30	4	50	3	50	15	33
Power purchase agreements (PPA): Contracts between those who generate and those who will purchase the generated electricity.	3	14	5	50	4	50	2	33	14	31
Energy market instruments: Control the ability to sell generated power in the energy market, such as market regulations.	2	10	2	20	5	63	4	67	13	29
Land use controls: Land and spatial planning legislation, regulation and policies that control or designate land use in a specific area.	6	29	2	20	1	13	4	67	13	29
Support to intermediaries: Supports for organizations that assist with the planning and implementation of local energy projects.	5	24	1	10	2	25	2	33	10	22
Environmental and environmental planning: Laws, regulations, policies, and strategies to protect the environment and identify and manage possible the impacts of renewable energy projects.	4	19	0	0	1	13	0	0	5	11
Energy storage: Laws and regulations for the storage of energy produced and the types of energy storage available.	4	19	0	0	1	13	0	0	5	11
Tax incentives: Benefits offered in the form of tax deductions, exceptions, or exclusions for energy development.	2	10	0	0	0	0	1	17	3	7
Renewable energy auction or tender: An instrument of sourcing and acquiring renewable energy through competitive bids, whereby the interested parties who offer the lowest price are selected.	0	0	2	20	0	0	1	17	3	7
Renewable portfolio standard (RPS): Establishes a minimum of total energy production that must come from renewable sources.	0	0	0	0	0	0	2	33	2	4
Feed-in tariff (FiT): Agreements that offer fixed payments for renewable energy generation over an established period.	0	0	0	0	0	0	1	17	1	2
Renewable energy certificates (REC): Attest the generation of a minimum amount of renewables-based electricity, offered to renewable energy generators who trade on the energy market.	0	0	1	10	0	0	0	0	1	2
Feed-in premiums (FiP): Payments for renewable energy generation based on the wholesale electricity price.	0	0	0	0	0	0	0	0	0	0
Total number of interviews	**21**		**10**		**8**		**6**		**45**	

[a] Definitions of government instruments based on Leonhardt et al. (2022).
[b] Table shows the number of interviews that addressed the government instrument by region (#) and the relative percentage considering the total number of interviews by region (%).

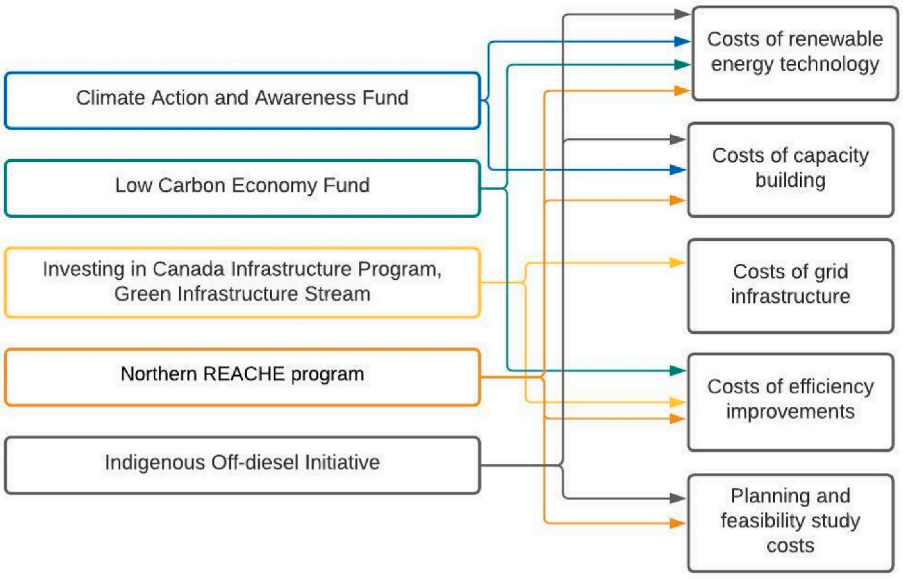

Fig. 3. – Key federal funding programs and objectives as identified by interview participants.

system. Support to intermediaries are the tools available for those organizations to work with communities.

In the sections below, the instruments identified by approximately 50% or more of participants in all three regions, and by participants from other regions, are explored. Emphasis is placed on the relative strengths and constraints of those instruments, as identified by interviewees, for supporting CRE in the North.

Financial supports

Discussions on financial supports focused on the organizations that provide funding; the areas to which financial incentives should be applied, such as renewable energy technology and infrastructure, offsetting the costs of local human capacity, and energy efficiency; and the ability of communities to take advantage of financial programs.

3.0.1. Source and availability

Participants across all regions identified national government funding as important for developing CRE in northern and Indigenous communities, with each program supporting multiple objectives (Fig. 3). A Saskatchewan intermediary organization reported that "the federal government … has put a lot of money into grants, not just for communities but for individual households and buildings," which has facilitated a growth in community energy. Federal funding was also identified as essential to support CRE infrastructure, such as grid upgrades, and human resource capacity development through training programs. The Northern REACHE program, for example, which supports communities in the territories, is developing a funding model for the hamlet of Tuktoyaktuk, Northwest Territories, to build a 51-kW solar project. The project is intended to increase local generation up to the current 20% intermittent renewables generation cap, as set by the Crown energy utility for the local grid. In Saskatchewan, participants identified the federal government's Indigenous Off-Diesel initiative, which is supporting Kinoosao, the only off-grid diesel-based community in northern Saskatchewan, to develop a community solar initiative.

However, results also indicate that financial supports for CRE are not evenly accessible, regionally. While communities in British Columbia (BC), for example, have access to funding programs focused on remote communities through the CleanBC Remote Community Energy Strategy, participants noted limited opportunities available for Saskatchewan communities. A provincial government representative confirmed that the primary sources of financing for CRE are the federal government and private sector. Participants also reported that northern and Indigenous communities in Saskatchewan are not the priority areas to receive financial incentives for renewable energy, noting that the priority areas seem to be non-Indigenous oil and gas-producing communities in south. Northwest Territories participants did identify funding opportunities available through the territorial government; however, the Gwich'in Tribal Council noted an example where government funding to support solar panel installation in one Gwich'in community was lost last minute, and the portion of the grid reserved by the Crown energy utility for renewable energy projects was met by non-Indigenous people or by individuals who had previous access to financial resources.

In Manitoba, energy-related programs to support remote communities are offered only by provincial crown corporations – either Manitoba Hydro or Efficiency Manitoba, specifically a regulatory requirement that 5% of Efficiency Manitoba's budget supports "low-income First Nations, Indigenous communities" and "hard-to-reach customers."

A representative of Northwest Territories Power Corporation, however, suggested that financial supports for community energy should *not* be provided by the Crown energy utility; rather, the utility should focus on technical and economic assessments for CRE because financial incentives can increase customer rates. The participant explained that some individuals or communities, even with limited financial support, may be able to get off the utility's diesel-based system and become energy self-sufficient, which can lead to rate increases for those who remain powered by the utility. The problem, explained the interviewee, is that "the poorest customers have the least number of options" and even with large incentives "they're not financially able to purchase their own generation system … or install solar panels to offset their rates; the wealthier customers benefit, and the poorer customers suffer."

Current funding programs, whether federal, provincial, or territorial do not cover all expenses associated with planning, developing, and operating CRE projects. An interviewee with Indigenous Services Canada, a federal agency, explained that communities often need to secure funding from multiple programs or sources to develop a CRE project. In Northwest Territories, for example, most CRE projects have been supported by financing from both the federal and territorial government, often paired with money from energy intermediaries and private companies. The challenge with this approach, explained an interviewee from Northwest Territories, is the competition that exists for limited money and ensuring a fair distribution of funding: "there's only so much funding and one community gets it, and the other community has to wait until next year …" As a result, a community declining funding or that does not receive sufficient funding, not only remains energy insecure, but it may also have to forfeit the money it received from one source in absence of matching funding to make the project viable; or pursue a less optimal energy initiative that may not meet community needs. Programs such as the Green Municipal Fund, administered by the Federation of Canadian Municipalities, combines funding from federal, provincial, and territorial governments and public and private sector partners to support community *sustainability* projects; similar joint programs were said to be essential for supporting community energy in the North.

3.0.2. Function and benefit

Results indicate different views on the focus or intent of financial supports for CRE, and who benefits. Some participants suggested that funding should be focused on energy efficiency versus renewable technologies and local generation. Interestingly, this was raised only by individuals from intermediary organizations. For example, one interviewee argued that the immediate focus for northern and remote communities should be on energy efficiency measures and the cost savings used to invest in future energy projects: "At the end of the day, if you're gonna to be saving money with energy efficiency, you can finance it." In Manitoba, most current programs are related to efficiency improvements, versus community energy per se, including loans and grants provided by Efficiency Manitoba for home energy improvements.

A more nuanced view of the function of financial supports was provided by another intermediary, questioning who benefits most from the money available for installing renewable energy technologies in northern and remote Indigenous communities. The interviewee explained that there's been a shift in federal funding programs from energy efficiency to renewables technology and, while important, it doesn't always benefit the community. Rather, such programs drive external energy entrepreneurs to *sell* energy solutions to communities, installing equipment that may or may not work in harsh climates, with limited maintenance support, with a "promise you the world and hope for the best" approach. The participant explained that communities in the North are becoming the "experiment ground for new tech" for projects that do not support community values and may not "help them at all in terms of achieving energy security and reducing energy poverty."

3.0.3. Capacity to access

Most participants identified the limited capacity of northern and remote Indigenous communities to pursue community energy. As one participant explained, "more Indigenous-owned renewable energy companies would be a huge thing" for communities in the North, but accessing programs is not easy. According to Gwich'in Tribal Council in the Northwest Territories, funding opportunities are announced on a government website with limited direct outreach to communities. Instead, what is needed is for government to "come and sit down, and

say 'look, we have this pot of money and these are the things you can do with it' … they should provide someone in each of the communities" to help communities achieve their energy goals.

In sharp contrast, participants noted an Indigenous community in the south of Saskatchewan with a dedicated staff for securing community energy funding. An Indigenous leader from the province described funding for community energy as "flowing like crazy from the federal government right now" but went on to note that "I don't know if First Nations have the capacity to make stuff happen when that money's available to them." A participant from Manitoba's Crown energy corporation echoed this challenge, indicating that communities are not making full use of the resource available to support CRE simply due to their limited capacity.

The importance of financial support for communities to participate in training programs for community energy planning, installations, and management was thus identified by several interviewees, emphasizing government programs such as the Catalysts program, ECO Canada and Climate Action and Awareness Fund, training support from Indigenous Service Canada, and apprenticeship programs available through Crown energy utilities. That said, access to these programs was described as limited; in Manitoba, for example, the provincial government and Manitoba Hydro used to fund social enterprises that trained people in Indigenous communities, but those programs are no longer available. The concerns raised by Gwich'in Tribal Council in Northwest Territories revealed a much deeper capacity constraint, explaining that the Council is attempting to secure a coordinator to support CRE but that even if an individual can be identified "we really don't have housing, we don't have office space" to support such a role in the communities.

3.1. Community ownership instruments

More than 60% of participants identified the importance of ownership instruments to advance CRE, with several expressing that remote and Indigenous communities are increasingly interested in having greater control over the means of generation. According to an Indigenous community leader from northern Saskatchewan, having more control and ownership of energy generation allows for local job creation, new financial opportunities, and a better understanding of local capacity development needs to ensure that energy projects are inclusive of Indigenous culture. The interviewee explained that when projects are "built by the community, for the community … then you're incorporating culture, you're incorporating language, and all of those teachings that … community can identify with … and the interpretation of what the project actually means and the impact of it".

3.1.1. Ownership restrictions

Notwithstanding the importance of local ownership, two-thirds of participants noted either the lack of energy ownership instruments or ownership restrictions – largely attributed to the dominant role of Crown energy utilities. Current legislations, which only allow the Crown utilities to generate, transmit, and distribute electricity, was identified as a major constraint to community energy. According to an intermediary organization in Saskatchewan, even though there are policies to support renewable energy, Crown energy utilities serve as "the source, and the seller, and the customer", which "has a lot of benefits but … unknowingly hinders, at least, distributed renewable energy generation because there isn't this freedom of access to the grid." Another participant, an Indigenous leader in Saskatchewan, raised similar constraints but went on to question: "Why can't we [Indigenous communities] have our own grid, and they [Crown utilities] can sell to our grid?" adding: "we're a sovereign nation, why don't we have our own?".

In Manitoba, regulations such as the Manitoba Hydro Act, which at the time of writing offers exclusivity over the generation and sale of electricity to Manitoba Hydro, was identified as an obstacle to community ownership. An intermediary argued that Manitoba Hydro's exclusive rights to sell electricity "may make sense in southern Manitoba, it absolutely does not make sense up there [northern Manitoba]." Currently, for a northern community, if that community installs a solar array, "they have to sell that electricity to Manitoba Hydro [who] runs it through their wires for half a kilometer, and then sells it back to the community." The interviewee described this as "an absurd situation" adding that energy security in the North means that "it has to be possible for the community to make their own power, both electricity and heat" - they can currently do that for heat, because heating fuel is sold by a private company, but not for electricity.

Similar ownership regulations were identified as barriers in Northwest Territories, with an Indigenous leader commenting that the regulations are "developed for large systems that don't prioritize the needs or flexibility in small communities." A similar point was raised by the Arctic Energy Alliance, an intermediary organization in Northwest Territories, noting that the current regulations support centralized ownership, limiting the participation of communities as independent power producers (IPPs), and posing a barrier to local power generation. The participant described the current system as one where "the [territorial] utility provides power, and if the community wants to produce power, they have to sell it to the utility."

3.1.2. Accommodating alternatives

Provincial government participants and utilities in Manitoba and Saskatchewan identified alternative ways to support community ownership, which do not necessarily require changes in the nature and function of Crown utilities. These participants identified power purchase agreements (PPAs) and competitive procurement programs as ways for communities to access the local grid. For example, a representative of Saskatchewan's Crown energy utility explained that "there's no shared ownership of our power grid [but] we do have programs that have come and gone … where people can generate power and feed it back into the system," such as the current Power Generation Partners Program to which businesses or individuals can apply to have renewable systems that they fund and build and connect into the provincial grid. Such power purchase and generation partnerships were described as instruments that facilitate First Nations' ownership of projects through eligibility criteria that not only consider the price of the offer, but also the participation of Indigenous communities. A representative from First Nations Power Authority reinforced that the Crown energy utility has been active in facilitating other forms of ownership in the province's generation monopoly by integrating IPPs into the energy market through competitive procurement. An intermediary organization in Manitoba, however, cautioned that changes in ownership regulations are not enough to guarantee successful community ownership and energy security; government needs to help build the local capacity to support energy security.

Indigenous leadership in Northwest Territories described a contrasting relationship in the adjacent state of Alaska, USA, where many remote communities "work on a co-op-based system, so the community is a part of the electric utility in the sense that they're a part of that co-op [and] they can do a lot of things that are, in the Canadian territories, very challenging to do." That said, community power generation as IPPs is happening in Northwest Territories, to a limited extent, including a solar project in the hamlet of Aklavik. A representative of the Crown energy utility described emerging Indigenous IPPs a "real game changer for the north". However, notwithstanding community ownership, under the Crown energy utility's current policy only a maximum of 20% of electricity generation can come from intermittent renewables generation.

3.1.3. Costs of ownership

Although participants focused primarily on regulatory constraints and opportunities, several raised concerns about the costs associated with community-owned projects. A representative of Northern Energy Innovation, a university research program, suggested that when comparing community-owned generation and utility generation, the

costs of community-owned projects are often higher than utility generation. Efficiency Manitoba similarly suggested that generating energy independently can sometimes mean high energy storage costs; and in case that the province decides to support locally owned projects, those costs would have to be spread among other energy consumers. A contrasting perspective was offered by a representative of the Saskatchewan government, arguing that if northern communities have ownership over the energy system, they have "the opportunity to generate power [let's] say from wind, or solar, or biomass, at a *cheaper* rate than what they are currently receiving from the state-owned utility." An intermediary organization in Manitoba also argued that it is not sustainable to *not* provide community ownership for northern and remote communities, because under the current model, "where a utility from the south owns your energy system and manages your energy system … the costs are horrendous; if something goes wrong … just to get somebody up there if it's entirely owned and operated by a southern utility" is far greater than community owned energy projects, with the local capacity to operate and maintain those systems.

4. Discussion

Advancing CRE hinges in part on supportive government instruments (Rogge and Reichardt, 2016; Rosenow et al., 2017). Results of this research reinforce the diversity of government instruments in scholarly literature, identifying several instruments available or desired to support CRE in northern and Indigenous communities in Canada. Of many instruments identified in the literature (Leonhardt et al., 2022), only feed-in premiums were not discussed by study participants - an absence likely due to no similar programs existing in the jurisdictions in this study. Financial supports and community ownership instruments dominated the conversations, but results indicate variability of available and preferred instruments across regions and by participant group. Financial supports dominated in conversations with Indigenous leaders from Saskatchewan and Northwest Territories, while intermediary organizations from Saskatchewan emphasized climate change and climate instruments; energy efficiency instruments were common among intermediaries in Northwest Territories.

Results highlight the importance of financial supports for establishing CRE projects, the need for sustainable programs over time, and the negative impacts that changes in funding programs can have on the long-term viability of CRE initiatives. However, results also indicate different perspective on the desired purpose of financial instruments for community energy – from energy efficiency to supporting new renewable energy technologies to building local human resources capacity. This suggests the need to reconcile interests (i.e., governments, Indigenous communities, intermediaries) in order to ensure targeted instruments that support community needs (Hicks and Ison, 2018). Interestingly, although international literature frequently identifies the importance of loans for community energy projects (Bauwens et al., 2016; Nolden, 2013), loans were rarely identified by interviewees as viable instruments for northern and remote communities.

Results also show that capacity is critical. Communities must often pursue multiple financial programs or instruments to meet the needs of a single community energy initiative, often requiring matching funds from the private sector or intermediaries; yet, many northern and Indigenous communities lack the capacity to do so. Thus, notwithstanding the diversity of financial instruments, not all instruments may be appropriate to northern and remote contexts or ensure equitable opportunities. Capacity to pursue funding for local energy is limited in many Indigenous communities (Mortensen et al., 2017; Poelzer et al., 2016); in absence of local capacity, community energy initiatives are sometimes implanted by external business interests. Such externally driven projects are less likely to succeed in the long-term (Ikejemba et al., 2017) and can even result in communities becoming more vulnerable to energy insecurity (Tenenbaum et al., 2014). Community development corporations (i.e. community-focused non-profit organizations managed by two or more communities) is an alternative to share costs and increase capacity resources while maintaining decision making authority. Further research and lessons from international cases are required to explore how the design and accessibility of financial incentives for community energy in northern and remote communities can be improved to ensure more equitable consideration of the local capacities of communities to access those programs and incentives.

Community ownership also emerged as a dominant instrument to support community energy in the North, but ownership has not received the same level of attention in the literature compared to other instruments (Leonhardt et al., 2022). Research on community energy in the context of northern and remote communities in Canada often speaks to the importance of energy ownership (Schelly et al., 2020), owing in part to the importance of Indigenous rights and a growing recognition of Indigenous sovereignty (Blackburn, 2009; Mercer et al., 2020). That said, results indicate major limitations to community-owned energy within the current, vertically integrated energy systems of Saskatchewan, Manitoba, and Northwest Territories, characterized by government-owned energy utilities with a monopoly over generation, transmission, and distribution. Grid inaccessibility and restrictive generation rules were commonly identified as constraints to community energy in remote regions. Questions thus emerge as to whether the alternatives to centralized energy systems available in other jurisdictions (such as BC) with historically embedded rules and regulations, are available and sufficiently flexible to support community generation and renewables transition in the North. Supporting community energy directly implies the need for alternatives to traditional, centralized structures.

Finally, the different focus of government instruments and the variety of needs of each community emphasizes the need for place-based tools to enable energy transition (Bazilian et al., 2021), especially for northern and Indigenous communities. Further research is necessary to integrate and develop government instruments that are able to support a just transition, where communities with different needs have the opportunity to benefit from community energy. However, this must be complemented by a deeper understanding of the more informal instruments and the different actors involved in the shaping of community energy transitions, including the mechanisms used to promote intergovernmental relationships, especially relationships between Indigenous communities and utilities, and federal and provincial governments.

5. Conclusion and policy implications

Community energy can provide multiple benefits to local communities and governments embracing renewable energy targets (Hicks and Ison, 2018), and help alleviate energy insecurity in northern and Indigenous communities. The success of community energy in achieving these goals hinges, in part, on adequate and accessible government instruments. This research identified multiple instruments to support community energy in the North and reinforced the importance of financial supports and community ownership. However, we also caution that many northern and remote Indigenous communities either do not have the capacity to access such supports when they are available, are competing against each other for limited resources, or are constrained by the rules and regulations of traditional and centralized energy ownership regimes. There is no single instrument that is capable of providing the necessary support for community energy in all northern and Indigenous communities. Instead, a diversity of complimentary and reinforcing instruments is essential. Understanding community needs, capacities, and the options available to support community energy goals is an important first step in the development of tools to support transition. This research captures only a segment of the current scenario in northern Canada. Further research is required to explore cross-country and international lessons to improve government instrument to support energy transitions in these unique northern and remote community contexts.

CRediT authorship contribution statement

Renata Leonhardt: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Bram Noble:** Conceptualization, Writing – review & editing, Supervision, Funding acquisition. **Greg Poelzer:** Conceptualization, Writing – review & editing, Supervision, Funding acquisition. **Ken Belcher:** Writing – review & editing, Funding acquisition. **Patricia Fitzpatrick:** Writing – review & editing, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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References

Andrews-Speed, P., 2016. Applying institutional theory to the low-carbon energy transition. Energy Res. Social Sci. 13, 216–225. https://doi.org/10.1016/j.erss.2015.12.011.

Astuti, S.P., Day, R., Emery, S.B., 2019. A successful fuel transition? Regulatory instruments, markets, and social acceptance in the adoption of modern LGP cooking devices in Indonesia. Energy Res. Social Sci. 58, 101248 https://doi.org/10.1016/j.erss.2019.101248.

Bauwens, T., Gotchev, B., Holstenkamp, L., 2016. What drives the development of community energy in Europe? The case of wind power cooperatives. Energy Res. Social Sci. 13, 136–147. https://doi.org/10.1016/j.erss.2015.12.016.

Bazilian, M.D., Carley, S., Konisky, D., Zerriffi, H., Pai, S., 2021. Expanding the scope of just transitions: towards localized solutions and community-level dynamics. Energy Res. Social Sci. 80, 102245 https://doi.org/10.1016/j.erss.2021.102245.

Belain, F., Dagher, L., Filis, G., 2021. Revisiting the resource curse in the MENA region. Resour. Pol. 73, 102225 https://doi.org/10.1016/j.resourpol.2021.102225.

Bigland-Pritchard, B., Prebble, P., 2010. Transforming Saskatchewan's Electrical Future. CPCA: Regina, Canada.

Blackburn, C., 2009. Differentiating indigenous citizenship: seeking multiplicity in rights, identity, and sovereignty in Canada. Am. Ethnol. 36, 66–78.

Burke, M.J., Stephens, J.C., 2017. Energy democracy: goals and policy instruments for sociotechnical transitions. Energy Res. Social Sci. 33, 35–48. https://doi.org/10.1016/j.erss.2017.09.024.

CER, Canada Energy Regulator, 2018. Saskatchewan - electricity generation and consumption. https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/report/canadian-residential-electricity-bill/saskatchewan.html. (Accessed 30 August 2021).

Consulting, Boke, Dënesųłiné, Northlands, 2017. Northlands-denesuline renewable energy-and remediation. Available at: https://bokeconsulting.com/northlands-denesuline-renewable-energy-remediation/.

DeCarlo, M., 2018. Scientific Inquiry in Social Work. Press Books, Creative Commons. https://pressbooks.pub/scientificinquiryinsocialwork/front-matter/acknowledgements-and-contributors/. (Accessed 13 March 2023).

del Rio, P., Kiefer, C.P., 2022. Which policy instruments promote innovation in renewable electricity technologies? A critical review of the literature with a focus on auctions. Energy Res. Social Sci. 89, 102501 https://doi.org/10.1016/j.erss.2022.102501.

Funcke, S., Bauknecht, D., 2016. Typology of centralised and decentralised visions for electricity infrastructure. Util. Pol. 40, 67–74. https://doi.org/10.1016/j.jup.2016.03.005.

Geels, F., 2018. Disruption and low-carbon system transformation: progress and new challenges in socio-technical transitions research and the Multi-Level Perspective. Energy Res. Social Sci. 37, 224–231. https://doi.org/10.1016/j.erss.2017.10.010.

Giles, D., 2016. Aging Infrastructure Causes One-Third of Power Outages: SaskPower. Glob. News. https://globalnews.ca/news/3036400/aging-infrastructure-causes-one-third-of-power-outages-saskpower/. (Accessed 29 October 2021).

GNWT, Government of Northwest Territories, 2015. Electrical generation in the NWT. https://www.inf.gov.nt.ca/sites/inf/files/resources/electrical_generation_in_the_nwt_4_converted.pdf.

GNWT, Government of Northwest Territories, 2018. Energy initiatives report 2018 – 19. https://www.inf.gov.nt.ca/sites/inf/files/resources/7467_inf_report_web.pdf.

Grashof, L., 2021. Who put the happer in the toolbox? Explaining the emergence of renewable energy auctions as a globally dominated policy instrument. Energy Res. Social Sci. 73, 101917 https://doi.org/10.1016/j.erss.2021.101917.

Heerema, D., Lovekin, D., 2019. Power Shift in Remote Indigenous Communities A Cross-Canada Scan of Diesel Reduction and Clean Energy Policies. Calgary, Canada, 2019. www.pembina.org.

Hicks, J., Ison, N., 2018. An exploration of the boundaries of 'community' in community renewable energy projects: navigating between motivations and context. Energy Pol. 113, 523–534. https://doi.org/10.1016/j.enpol.2017.10.031.

Hoicka, C., Savic, K., Campney, A., 2021. Reconciliation through renewable energy? A survey of Indigenous communities, involvement, and peoples in Canada. Energy Res. Social Sci. 74, 101897 https://doi.org/10.1016/j.erss.2020.101897.

Holdmann, G., Pride, D., Poelzer, G., Noble, B., Walker, C., 2022. Critical pathways to renewable energy transitions in remote Alaska communities: a comparative analysis. Energy Res. Social Sci. 91, 102712 https://doi.org/10.1016/j.erss.2022.102712.

Hossain, Y., Loring, P.A., Marsik, T., 2016. Defining energy security in the rural North — historical and contemporary perspectives from Alaska. Energy Res. Social Sci. 16, 89–97. https://doi.org/10.1016/j.erss.2016.03.014.

Manitoba Hydro, 2019. Manitoba hydro 2019/20 electric rate application. In: http://www.pubmanitoba.ca/v1/proceedings-decisions/appl-current/pubs/2019-mh-gra/amc-ex/amc-mh-i-1-18.pdf. (Accessed 2 February 2022).

Manitoba Hydro, 2022. Facilities and operations. https://www.hydro.mb.ca/corporate/facilities/. (Accessed 12 January 2022).

Ikejemba, E.C.X., Mpuan, P.B., Schuur, P.C., Van Hillegersberg, J., 2017. The empirical reality & sustainable management failures of renewable energy projects in Sub-Saharan Africa. Renew. Energy 102, 234–240. https://doi.org/10.1016/j.renene.2016.10.037.

Irfan, M., Elavarasan, R.M., Ahmad, M., Mohsin, M., Dagar, V., Hao, Y., 2022. Prioritizing and overcoming biomass energy barriers: application of AHP and G-TOPSIS approaches. Technol. Forecast. Soc. Change 177, 121524. https://doi.org/10.1016/j.techfore.2022.121524.

Khan, I., Zakari, A., Zhang, J., Dagar, V., Singh, S., 2022a. World energy trilemma and transformative energy developments as determinants of economic growth amid environmental sustainability. Energy Econ. 108, 105884 https://doi.org/10.1016/j.eneco.2022.105884.

Khan, I., Zakari, A., Zhang, J., Dagar, V., Singh, S., 2022b. A study of trilemma energy balance, clean energy transitions, and economic expansion in the midst of environmental sustainability: new insights from three trilemma leadership. Energy 248, 123619. https://doi.org/10.1016/j.energy.2022.123619.

Kirchherr, J., Charles, K., 2018. Enhancing the sample diversity of snowball samples: recommendations from a research project on anti-dam movements in Southeast Asia. PLoS One 13 (8), e0201710. https://10.1371/journal.pone.0201710.

Leonhardt, R., Noble, B., Poelzer, G., Fitzpatrick, P., Belcher, K., Holdmann, G., 2022. Advancing local energy transitions: a global review of government instruments supporting community energy. Energy Res. Social Sci. 83, 102350 https://doi.org/10.1016/j.erss.2021.102350.

Lewis-Beck, M.S., Bryman, A., Liao, T.F., 2011. Snowball Sampling. in: SAGE Encycl. Soc. Sci. Res. Methods. SAGE, Thousand Oaks, CA. https://doi.org/10.4135/9781412950589.

Lowndes, V., Roberts, M., 2013. Why Institutions Matter: the New Institutionalism in Political Science. Palgrave Macmillan, New York, NY.

MacArthur, J.L., 2017. Trade, tarsands and treaties: the political economy context of community energy in Canada. Sustainability 9, 1–20. https://doi.org/10.3390/su9030464.

Madriz-Vargas, R., Bruce, A., Watt, M., 2018. The future of Community Renewable Energy for electricity access in rural Central America. Energy Res. Social Sci. 35, 118–131. https://doi.org/10.1016/j.erss.2017.10.015.

McMurtry, J., 2018. Canadian community energy: policy, practice, and problems. In: Handb. Energiewende Und Partizipation. Springer VS, Wiesbaden, pp. 975–996. https://doi.org/10.1007/978-3-658-09416-4_57.

Mercer, N., Parker, P., Hudson, A., Martin, D., 2020. Off-grid energy sustainability in Nunatukavut, Labrador: centering Inuit voices on heat insecurity in diesel-powered communities. Energy Res. Social Sci. 62, 101382 https://doi.org/10.1016/j.erss.2019.101382.

Milchram, C., Marker, C., Schlor, H., Kunneke, R., van de Kaa, G., 2019. Understanding the role of values in institutional change: the case of the energy transition. Energ Sustain. Soc. 9, 46. https://doi.org/10.1186/s13705-019-0235-y.

Mortensen, L., Hansen, A.M., Shestakov, A., 2017. How three key factors are driving and challenging implementation of renewable energy systems in remote Arctic communities. Polar Geogr. 40, 163–185. https://doi.org/10.1080/1088937X.2017.1329758.

Nolden, C., 2013. Governing community energy-feed-in tariffs and the development of community wind energy schemes in the United Kingdom and Germany. Energy Pol. 63, 543–552. https://doi.org/10.1016/j.enpol.2013.08.050.

NRCan, Natural Resources Canada, 2018. The atlas of Canada - remote communities energy database. https://atlas.gc.ca/rced-bdece/en/index.html. (Accessed 9 July 2021).

NRCan, Natural Resources Canada, 2019. Energy fact book 2019-2020. https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/Energy Fact Book_2019_2020_web-resolution.pdf.

Poelzer, G., Gjorv, G., Holdman, G., Johnson, N., Magnusson, B., Sokka, L., Tsyiachinouk, M., Yu, S., 2016. Developing Renewable Energy in Arctic and Sub-arctic Regions and Communities. Working recommendations of the Fulbright Arctic Initiative Energy Group, Ottawa ON: Fulbright Canada.

Radley, B., Lehmann-Grube, P., 2022. Off-grid solar expansion and economic development in the global South: a critical review and research agenda. Energy Res. Social Sci. 89, 102673 https://doi.org/10.1016/j.erss.2022.102673.

Rakshit, R., Shahi, C., Smith, M.A., Cornwell, A., 2019. Energy transition complexities in rural and remote Indigenous communities: a case study of Poplar Hill First Nation in northern Ontario. Local Environ. 24, 809–824. https://doi.org/10.1080/13549839.2019.1648400.

Raphals, P., 2019. Energy poverty on first nation reserves in Manitoba. In: http://www.pubmanitoba.ca/v1/proceedings-decisions/appl-current/pubs/2019-mh-gra/amc-ex/amc-3-raphals-evidence-final.pdf.

Richards, L., Morse, J.M., 2013. Readme First for a User's Guide to Qualitative Methods, third ed. Sage Publications, Thousand Oaks (CA).

Rogge, K.S., Reichardt, K., 2016. Policy mixes for sustainability transitions: an extended concept and framework for analysis. Res. Pol. 45, 1620–1635. https://doi.org/10.1016/j.respol.2016.04.004.

Rosenow, J., Kern, F., Rogge, K., 2017. The need for comprehensive and well targeted instrument mixes to stimulate energy transitions: the case of energy efficiency policy. Energy Res. Social Sci. 33, 95–104. https://doi.org/10.1016/j.erss.2017.09.013.

SaskPower, 2021. Renewable power update: fall 2021. https://www.saskpower.com/about-us/Our-Company/Blog/2021/Renewable-Power-Update-Fall-2021. (Accessed 2 February 2022).

SaskPower, 2022. Our power future. https://www.saskpower.com/. (Accessed 12 January 2022).

Schelly, C., Bessette, D., Brosemer, K., Gagnon, V., Arola, K.L., Fiss, A., Pearce, J.M., Halvorsen, K.E., 2020. Energy policy for energy sovereignty : can policy tools enhance energy sovereignty? Sol. Energy 205, 109–112. https://doi.org/10.1016/j.solener.2020.05.056.

Seyfang, G., Jin, J., Smith, A., Park, J., Smith, A., 2013. A thousand flowers blooming? An examination of community energy in the UK. Energy Pol. 61, 977–989. https://doi.org/10.1016/j.enpol.2013.06.030.

Sovacool, B.K., Axsen, J., Sorrell, S., 2020. Promoting novelty, rigor, and style in energy social science: towards codes of practice for appropriate methods and research design. Energy Res. Social Sci. 45, 12–42. https://doi.org/10.1016/j.erss.2018.07.007.

Tenenbaum, E., Greacen, C., Siyambalapitiya, T., Knuckle, J., 2014. From the bottom up: how small power producers and mini-grids can deliver electrification and renewable energy in africa. Washington, DC. https://doi.org/10.1177/1070496508326432.

Tseng, M.-L., Ardaniah, V., Sujanto, R.Y., Fujii, M., Lim, M., 2021. Multicriteria assessment of renewable energy sources under uncertainty: barriers to adoption. Technol. Forecast. Soc. Change 171, 120937. https://doi.org/10.1016/j.techfore.2021.120937.

Voß, J.-P., Simons, A., 2014. Instrument constituencies and the supply side of policy innovation: the social life of emissions trading. Environ. Polit. 23 (5), 735–754. https://doi.org/10.1080/09644016.2014.923625.

Williamson, O.E., 2000. The new institutional economics: taking stock, looking ahead. J. Econ. Lit. 38 (3), 595–613. https://doi.org/10.1257/jel.38.3.595.

Zakari, A., Khan, I., Tan, D., Alvarado, R., Dagar, V., 2022. Energy efficiency and sustainable development goals (SDG). Energy 239, 122365. https://doi.org/10.1016/j.energy.2021.122365. Part E.