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Open for bioenergy business? Perspectives from Indigenous business leaders on biomass development potential in Canada

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ABSTRACT

Canada is one of the world's top five energy producers and, within Canada's energy sector, the bioenergy economy is rapidly expanding. This research was conducted to identify perceived risks, barriers, benefits, and opportunities relating to the development of biomass energy by Indigenous business leaders and/or their communities. Eighteen Indigenous business leaders from forestry, energy, and allied natural resource sectors were interviewed to understand their perspectives on bioenergy. Results included that views on bioenergy feasibility differed between business leaders in northern versus southern Canada. There was no agreement among business leaders as to risks and benefits (neutral, positive, negative) for Indigenous businesses and communities engaging in bioenergy initiatives. Many of the benefits of bioenergy were related by participants to opportunities for increasing community self-reliance and increasing connectedness to Canadian mainstream economic and governance systems. Indigenous-led policy interventions are especially important in new industries like bioenergy in the boreal where Indigenous traditional territories, communities and businesses intersect and thus are likely to be impacted by new developments and partnerships.

1. Introduction

Over 600 Indigenous[1] communities have lands and traditional territories in Canada's Boreal Forest, which is a main source of the woody biomass being used for bioenergy development [1]. Bioenergy is renewable energy derived from any living organism or by-products (biomass) used to produce energy or fuel (biofuel). Various technologies produce energy and fuel from biomass, each combination resulting in different environmental, social, and economic impacts. Although bioenergy presents a range of advantages (e.g., greenhouse gas displacement, energy self-sufficiency, and regional economic benefits), its widespread use is a point of contention and political debate. The bioenergy industry is often perceived to compete with food production, drive up energy prices, and overstate its environmental benefits [2,3].

Canada is a top five energy producer worldwide, making it a global leader in energy resources [4]. The energy sector remains a key driver of the national economy, creating jobs, supporting important programs

and services, and meeting the daily energy needs of Canadians. The sector also attracts investment as well as international demand. Within Canada's energy sector, the bioenergy economy is rapidly expanding. In order to obtain some degree of social acceptability for energy production, domestic and international firms are seeking input from Indigenous communities and identifying Indigenous lands where benefits could exist. The energy sector is also seeking to clarify differences between local and Indigenous perceptions and goals and how they may differ from international strategic agreements [5–7]. Such is the case in the bioenergy sector, which promises to support low carbon energy options that also support economic development and Indigenous involvement [8].

Zurba and Bullock ([7] p. 1) conducted a frame analysis to "develop insights about the policy and participatory landscape in which forest bioenergy in Canada is situated." They found that identities and perspectives regarding forestry and allied energy sectors were highly nuanced and were dependent on factors such as perceived risks,

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barriers, benefits and opportunities. We extend this work by pursuing the following core objectives: (i) to determine the level of understanding of bioenergy sources and types among Indigenous business leaders; (ii) to explore the perspectives of Indigenous business leaders and how they frame benefits, opportunities, risks, and barriers in engaging with bioenergy development and partnerships; and, (iii) to relate the perspectives of Indigenous business leaders to domestic and international policy, as well as articulating divergent pressures to participate in the bioenergy economy.

This paper has four main sections. The following section provides important contextual information on Indigenous participation in the energy sector, namely the linkages between and among communities, land uses and rights, and domestic and international policy. Section three details our methods for interview data collection, ethical protocols, and elaborates how framing theory and analysis are used in the study. Results are presented in section four, which includes an analysis of Indigenous business leaders' knowledge of bioenergy, the perceived risks and barriers associated with bioenergy development, as well as associated benefits and opportunities. The final section provides a discussion of main results in the context of domestic and international policy and offers summary conclusions on new evidence for Indigenous business leaders' perspectives on bioenergy development.

2. Background

In addition to the commonly associated impacts (e.g., competition with food growing) and benefits (e.g., renewability of the resource) that come with developing bioenergy, there are several distinct considerations for Indigenous communities in Canada. The growing biomass energy sector can positively and/or negatively impact Indigenous communities in ways that are similar to other natural resources developments, such as forestry and other types of energy projects [5,9]. Bioenergy promises to support low carbon energy options that also support economic development and Indigenous involvement [10]. According to the *Canadian Energy Strategy*, provincial and territorial governments seek to be formally involved in international energy conversations, while their commitment to collaboration with their Indigenous leadership counterparts is based on observing Indigenous and treaty rights [11]. At the same time, growing global demand and international interests exert pressure on Indigenous communities and lands where outside demands and international strategic agreements may not align with local perceptions and goals. This policy context creates trilateral, multi-level, and in the case of bioenergy, multi-sector (e.g., energy and forestry) arrangements for engagement involving parties with different rights, capacities, and objectives, as well as different forums for engaging one another [7].

As energy scholars MacArthur and Matthewman ([12] p. 16) point out, energy development in settler colonial contexts requires attention be given to "questions of energy ownership and participation" to redress historic imbalances of control and benefits. Recent research connecting global companies to state driven infrastructure projects associated with natural resource extractive and transportation industries shows how such initiatives shape local environments, politics, and social conditions through, for example, the expansion of territory, service access restrictions, and cultural assimilation, at the expense of local and Indigenous peoples [13]. However, there can also be short- and/or long-term positive impacts, including job creation, revenue sharing, investments, and other forms of community enhancements such as infrastructure, which are examples of benefits to Indigenous communities from resources development projects [14,15]. Such positive impacts could be important in remote regions where economic opportunities can be scarce.

Negative impacts can also be short- or long-term, including degradation to the environment, as well as impacts on the social and economic wellbeing of communities, such as impacts on Indigenous rights and civil liberties [16,17]. Work by Peterson St-Laurent et al. [9]

also note the Indigenous and non-Indigenous stakeholders identify strong potential for bioenergy development but research participants expressed a desire to identify the ecological values of forest residuals in concert with economic benefits for bioenergy from forest resources. Within the environmental impact assessment literature, Bruhn-Tysk and Eklund [18] identify gaps in assessing socioeconomic impacts from biofuel plants in Sweden. They conclude that biofuel projects often fail to assess local impacts in particular, neglecting key environmental concerns. In another study, Weldu and Assefa [19] identify trade-offs between sustainability objectives, including economic diversification, technological innovation, and resources conservation. Although bioenergy can mitigate greenhouse gas (GHG) emissions, it can shift negative impacts to human health and the ecosystem. More broadly, in looking at impacts from forest clearing, multiple authors identify numerous adverse effects, including the contamination of lands and waters, and the disconnection from traditional territory and practices, such as hunting, fishing, and trapping [20–22]. Connected to these impacts and the disassociation from traditional ways of life are emotional pain and numerous social effects on individuals and communities [23]. The trans-generational effects associated with colonization and ongoing development on traditional territories, as well as their impacts on individual and community wellbeing and governance, is only beginning to be understood and represented in the emerging literature from community leaders and academics [24].

Indigenous communities face barriers to developing meaningful participation and obtaining benefits from renewable energy sources, such as biofuels [6]. Moreover, research shows that local benefits do not accrue 'naturally' to local communities unless they are designed and negotiated to do so [25]. Within Canada, there is a lengthy policy context for understanding the implications of resource development and partnerships between First Nations, project proponents, and provincial and federal governments. Consultations with First Nation governments and Indigenous people have been conducted mainly because of legal obligations, with limited regard for culture or other issues thought critical to enhancing participation and equitable outcomes for communities [26]. As Wyatt [27] points out, Crown fiduciary responsibilities cause governments to uphold the "duty to consult" in order to respect constitutionally protected rights, although consultative measures typically do not include decision making. But he adds, optimistically, that information sharing and consulting can help develop understanding among governments, First Nations and industry.

In order to influence governments and (development and conservation) project proponents, the international community, and advisory bodies such as the International Union for Conservation of Nature (IUCN) and the United Nations have brought together multi-institutional perspectives (i.e., community representatives, NGOs, national and regional governments) to build guidelines for new policy affecting Indigenous peoples [28,29]. The United Nations' *Declaration on the Rights of Indigenous Peoples* (UNDRIP) is a leading example of such policy. This declaration signals a major shift in international values, norms, and politics regarding Indigenous peoples, their roles in governance and their rights to sovereignty and other forms of decision-making power. Canada joined UNDRIP as one of the last signatory nations in November 2010 [30]. Fifteen of the forty-six declarations relate to the rights of Indigenous peoples to participate in decision-making processes that affect their livelihoods [31]. Despite impacts associated with the dispossession and degradation of land and limited participation in governance, Indigenous peoples remain connected to their traditional territories and they assert traditional custodial rights and responsibilities. Coinciding with these actions, and due to court decisions (e.g., recognition of Aboriginal Title for the Tsilhqot'in Nation in British Columbia in 2014) as well as collaborative actions (e.g., Miitigoog Partnership Inc. in northwestern Ontario, established in 2010), governments and resource development companies have shifted incrementally towards greater Indigenous participation. Co-management arrangements have elevated Indigenous decision-making

authority with regard to their traditional territories [32,33]. Over the past decade in northern Canada, several formal and informal arrangements have been utilized to better share control, benefits and capacity building from energy, forestry and mining. These include, for example, land use/regional planning processes, impact and benefit agreements, memorandums of understanding, Indigenous businesses, joint ventures, environmental assessments, revenue sharing agreements, advisory committees, and regional economic councils [34]. Furthermore, acting as proponent of new renewable energy projects and securing ownership of energy companies and infrastructure can maximize local benefits and control, and put Indigenous communities in the driver's seat of participative processes [5].

Concurrently, a wealth of research offers important insights into governance systems that are inclusive of Indigenous participation (e.g., [35–38]). This literature is linked loosely to the bioenergy sector, but sets an important context for closer examination of bioenergy development in Canada.

3. Methods

3.1. Participants and data collection

The Canadian Council for Aboriginal Business (CCAB) was an active and equal partner in all stages of this research and facilitated our connection to Indigenous business leaders. The CCAB is a national non-profit, non-partisan association, offering knowledge, resources, and programs to both Indigenous and non-Indigenous owned companies that foster economic opportunities for Indigenous peoples and businesses across Canada. The study involved in-depth interviews with close-ended as well as open-ended questions to identify framings of risks, barriers, benefits, and opportunities relating to the development of biomass energy by Indigenous business leaders.[2] This approach enables comparisons between points of agreement and disagreement among leaders. Interviews were undertaken with a purposive sample of specialized informants from forestry, energy and allied natural resources sector representatives. This sampling technique is appropriate for qualitative research, which aims to obtain detailed knowledge within a particular field of study [39]. The CCAB comprehensive directory of Indigenous businesses and leaders (referred to as "business leaders" from here on) across Canada provided the sample frame for the study. As a partner in the current study, CCAB's directory offers the largest available list of businesses and business organizations classified by sector, and included complete contact information for those who would likely become involved in newly initiated or existing bioenergy developments. Accordingly, we follow this scope and use this sampling technique quite intentionally to examine, as Sovacool et al. ([40] p. 20) recently highlighted in the context of social science energy research, "new data from exceptional groups or populations." There is a proven lack of research and information focused on understanding and accommodating Indigenous views of bioenergy development in Canada [7]. Sovacool et al. ([40] p. 20–21) also explain how "small populations" such as early adopters of low-carbon technologies (or Indigenous business leaders in our case), may not be readily accessible because of "small or non-existent sample frames, yet their viewpoints can provide an important, often missing contribution to a given literature." Further, Sovacool et al. [40] point out that working to understand the

perspectives and experiences of "sensitive or vulnerable populations", such as Indigenous peoples, is crucial yet requires very different approaches to gaining access and realizing ethical standards, which contrasts with conventional research with energy experts and elites. Thus, our scoping and sampling approach is appropriate given the participant pool as well as the exploratory and novel nature of the research.

After securing university research ethics approval, all business leaders in the sample frame were contacted and asked to participate in the study, and eighteen participants in total agreed to be interviewed. Interviews were conducted over the phone and lasted from ten to twenty-five minutes, depending on how much the participant wanted to say in their response to each of the questions. Interview questions were categorized into the following sections: (i) knowledge of bioenergy; (ii) risks and barriers associated with Indigenous involvement in bioenergy development; and, (iii) benefits and opportunities associated with Indigenous involvement in bioenergy development. If business leaders stated that they were unfamiliar with bioenergy (e.g., did not know what types of materials could be used to produce bioenergy, and did not know what types of energy could be produced) they were given a brief overview of bioenergy sources and outputs so that they could proceed with the questions that followed from a more informed standpoint.

Ethical protocols and informed consent were conducted verbally over the phone and each participant was also emailed a copy of the consent form. Participants were informed that they could abstain from responding to any questions they chose not to answer. With prior permission, interviews were audio recorded and detailed written notes were taken paying attention to the tone of the response (e.g., negative, neutral of positive). Participant demographics were recorded, except for one participant who opted out of having their demographic data taken. Occasionally, participants also opted out of answering particular questions, and were not asked to give reason for opting out. Business leaders were also asked at the conclusion of the interview if they would like to receive more information on bioenergy and copies of transcripts and reporting materials.

3.2. Frame analysis

This research uses social framing theory to examine the views of Indigenous business leaders. It builds on previous studies that used social framing [7,41] and similar approaches to critical discourse analysis [42] to understand the perspectives of natural resource industry leaders, government policy makers, and the media in Canada, Finland and Sweden. Social framing theory is used regularly in policy and organizational development research to understand how people relate to important issues, events, and interactions. It offers a systematic approach for making sense of debates, shifting perspectives and co-constructed meanings related to distributions of benefits, opportunities, risks and barriers linked to governance processes, mechanisms and outcomes [43–45]. Frame analysis can enable new understandings of Indigenous perceptions of the biomass energy sector, including preferences and expectations surrounding biomass energy innovation and growth.

Our approach employs different types of frames to make sense of main issues, perspectives, roles and responsibilities relating to bioenergy governance systems. *Identity frames* can help us understand how people position themselves (i.e., whether they are for, against or neutral) within governance systems and their effects [46,47]. *Characterization frames* distinguish how different individuals and groups describe "the others" according to particular issues and future scenarios and outcomes. The perceived roles of other people, groups, or entities are typically connected to these sorts of frames, and may include attributions of blame or credit for benefits, opportunities, risks and barriers. For example, one party may view another party's influence on bioenergy as creating negative environmental effects. *Diagnostic* and *prognostic frames* are also common within our interview data, and are used respectively to define the issues and personal reasoning for issues, as

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[2] Not all participants were necessarily private entrepreneurs but could be those generally responsible for leading local economic enterprises, whether private businesses or economic development corporations. We also acknowledge that there are others with local, professional and traditional knowledge that can provide broader insights on future bioenergy research. The point of the current paper, however, is to focus on would-be partners and leaders in bioenergy development to gain "insider" understandings to explore feasibility and entry point issues that can be further investigated.

well as the roles and responsibilities involved in implementing solutions [47].

For our study we used "benefits," "opportunities," "risks," and "barriers" as commonly understood terminology emerging from bioenergy literature. These categories guided analysis of the different parties and perspectives involved, as well as the issues relating to bioenergy development. An interview questionnaire was structured according to these categories, which made it possible to discern Indigenous business leader perspectives regarding the bioeconomy. Interview data was analysed in stages. To begin, interviewers listened to recorded interviews using the interview log technique, which involved taking notes on the responses to each of the questions within each of the sections of the interview questionnaire (see [48]). A researcher then listened to interviews and made additional notes and recorded prominent or explanatory quotes verbatim. Coding included content analysis involving theme coding, pattern matching and ranking to construct profiles of the different perspectives that were shared [49].

4. Results and discussion

In the following sub-sections, we provide details about the demographics of Indigenous business leaders who participated in this study and their familiarity with bioenergy (4.1), and present the results relating to their perspectives on the potential benefits and opportunities (4.2), and risks and barriers of being involved with engaging in bioenergy initiatives (4.3).

4.1. Indigenous business leaders' demographics and familiarity with bioenergy

Table 1 provides the participants' demographic information. Thirteen of the participants were male, and three were female (two chose not to respond). Eight of the participants identified as First Nation, two as Métis, three as Inuit, one as "settler" (i.e., Canadian immigrant), two as "other", and two chose not to respond. Five of the business leaders had a university graduate degree, two had an undergraduate degree, three had a college diploma, three had some college, three had done an apprenticeship, two had a high school diploma or general education diploma (GED), one had some high school, and two chose not to respond.[3]

Table 2 provides professional details regarding the business location, sector, and the position held by the participant. Of the eighteen business leaders who participated in the study from across Canada, seven were from British Columbia, five were from Ontario, two were from Newfoundland and Labrador, two were from Nunavut, one was from Manitoba, and one chose not to respond. Participants had different roles within their respective companies. Eight of the participants were owners, five were managers, two were directors, one was president, and one was a shareholder. Eight of the businesses were situated on-reserve, seven off-reserve, and two were situated partially on- and partially off-reserve. The types of companies included five forestry, four energy, one energy and forestry, and seven natural resources (construction, general environmental, retail, aquaculture, science and technology, and mining).

Three business leaders were completely unfamiliar with bioenergy, twelve were somewhat familiar, and five were very familiar and could cite sources and types of energy produced. Those familiar with bioenergy had attended workshops or presentations. Most of the business

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[3] In Canada, universities and community colleges are distinct. In general, the former offer bachelor and graduate degrees based on conventional disciplines (e.g., sociology, biology) and advanced professional schools (e.g., medical, dental), while the latter typically offer shorter intensive diploma and certificate programs focussed on skill development for specific jobs. College programs tend to focus on particular trades, apprenticeships, and industry training needs.

Table 1
Research participant demographic information.

Gender	N
Male	13
Female	3
No response	2
Age range	
31–40	2
41–50	6
51–60	5
60 +	3
No response	2
Identity	
First Nations	8
Métis	2
Inuit	3
Settler	1
Other	2
No response	2
Highest level of education	
High school or graduate equivalency	2
Some high school	1
Trade school	3
College / Some university	3
Undergraduate degree	2
Graduate degree	5
No response	2

Note. N = 18.

Table 2
Research participant company information.

Province residing	N
British Columbia	7
Manitoba	1
Ontario	5
Newfoundland	2
Nunavut	2
No response	1
Business location	
On-reserve	8
Off-reserve	7
Both on- and off-reserve	2
No response	1
Sector	
Energy	4
Forestry	5
Energy and forestry	1
Natural resources	7
No response	1
Position in the company	
Owner	8
President / Director	3
Shareholder	1
Manager	5
No response	1

Note. N = 18.

leaders, whether familiar with bioenergy or not, wanted to learn more about bioenergy technology, business, policy and the types of training and partnership opportunities that could be possible with established bioenergy producers. Only two business leaders stated that they did not want further information on bioenergy, and related it to their community not being in a position where bioenergy would be a viable option. For example, one business leader felt their community had limited capacity and was not ready to enter the bioeconomy, and that they didn't require information at that time. The other business leader who declined information felt that bioenergy would not work for their region in the high north (e.g., Nunavut) because it is an area where "nothing grows" and where they thought diesel dependency would be a long-term reality.

4.2. Benefits and opportunities

Business leaders talked about the benefits and opportunities of engaging in the bioeconomy and bioenergy partnerships. Views on bioenergy feasibility differed between business leaders in the north (as noted above) and those located in the south (e.g., Ontario). Southern business leaders often expressed that a transition from diesel could be possible and might be a good opportunity for diversifying energy in their communities. For example, one business leader stated that bioenergy development would be a logical choice for a new source of power:

> We use diesel to power our Nation's village. Say we decided to start up a new industry, I think we would look to use bioenergy. There's a lot of woody biomass left on the ground. - IBL08

Several other business leaders echoed a similar perspective and thought that the woody biomass that was left following forest harvesting was an untapped and viable resource that could be beneficial to communities. Two business leaders felt that wood that was left over after logging could also be used as a resource that could provide economic benefits for their communities instead of engaging in "wasteful" practices such as burning remaining wood as a way of disposing of it:

> None of us like that we burn the piles of wood left after logging. - IBL04
>
> [Using residual biomass for bioenergy] is better than letting it go to waste! - IBL18

However, not all participants felt that bioenergy production was the best use for the excess woody biomass from forestry. Some business leaders imagined other uses such as building products. Overall, participants were open to new opportunities that could reduce waste especially if it helped improve local self-reliance and enterprise.

Environmental benefits highlighted by business leaders were primarily associated with the renewability potential of bioenergy, its ability to play a role in reducing carbon emissions and climate change, as well as environmental issues relating directly to the composition of the forest. The main benefit to forest composition cited by business leaders was that the removal of biomass following harvesting "could prevent forest fires" (ABL12 and ABL18).

Business leaders' perspectives on the socioeconomic benefits centered on opportunities for individual community members, as well as whole communities. One business leader related stable employment through bioenergy development to Indigenous people being able to work closer to home:

> Stable employment is a benefit. It would allow people to continue to live in their communities. - IBL09

At the level of the whole community, business leaders expressed that socioeconomic benefits could include greater autonomy in the form of "revenue for bands, independent of government funds" (IBL12) and "enhanced management ability" (IBL02), "improved First Nations economies" (IBL17), "fuller participation in the Canadian economy" (IBL03), as well as other positive outcomes such as "work force and learning, a better quality of life, and healthier environment" (IBL02). Energy independence was discussed by several of the business leaders who thought that biofuel could be a great source for heating homes in Indigenous communities, and that this was of particular benefit for communities that were marginalized and/or underserviced by power companies or authorities in their region:

> On a local scale for power security it would be great! Some bands are at the ends of power lines, which means they are the last to get fixed by hydro [power], and then there's high transmission costs. - IBL06

There was perceived potential for economic gains to be made through the exporting of biomass for bioenergy from Indigenous lands.

One business leader framed this in terms of the production of all goods and how they thought there were benefits to selling to the broader community:

> Export is always good. You will never make money if you just keep it on the reserve. Reserve to reserve will never work for any product. It's not big enough, right. You have to export it. You have to sell it. It doesn't matter if you make moccasins or if you make electricity. - IBL06

Education was emphasised as being essential for developing successful community-based bioenergy enterprises. The following business leader associated education as one of the benefits that could come through partnering with an outside bioenergy firm.

> People need to be shown the ropes. You don't wake up a biofuel expert. You need to be shown how to make efficient and high-quality bioenergy. - IBL10

Several business leaders specified that partnerships with industry held the most immediate potential for opportunities to entering the bioeconomy. In addition to the industry knowledge and the ability to "guide businesses into organization and implementation" (IBL14), business leaders felt that partners would bring additional capacity (e.g., financing) and "could alleviate some of the risk in starting bioenergy" (IBL10). One business leader explained how such a partnership need not be equally weighted, and that the industry partner could have more control:

> Find a partner that is already involved and let them take the lead. Partners do not need to be 51/49. Nothing wrong with non-Indigenous partner majority. - IBL02

Business leaders talked about how trust building would be an important first stage of any partnership, and how meaningful partnerships could be built through partners who wanted to invest and spend time in their communities.

> There's something to be said for professionals with knowledge traveling to Nations so people can lean over a map in a boardroom table and say "Hey, this is what we've got" and the person with the knowledge can say "Hey, we have something that can fit." - IBL08

Business leaders also shared ideas about potential solutions and opportunities within their own communities. Several business leaders talked about the importance of leadership and planning within their communities. The following business leader framed this in terms of needing to be realistic when going into a new business venture:

> We all have different ideas about how we want to participate. You need to have a clear investment plan. A lot of the time we don't. We don't have the right people sitting at the table with us to talk about what it's going to cost us up front. We've got to realize that we have to pay debt off. We have to realize that you don't just actually get into the business and have dividends start flowing. You actually have bills to pay for a first 5 or 6 years before you can start seeing a good return on your investment. - IBL02

Another business leader spoke about the potential benefits that could come through communities to collaborating and sharing costs, as well as the potential for building financial support through the co-ordination of a trust:

> There should be trust operations that would be willing and openly encouraging their own investment in the Native community and Natives period and help them get projects off the ground. I know there's All Nations Trust in Kamloops that does that. - IBL07

4.3. Risks and barriers

There was no agreement among business leaders as to whether benefits outweighed risks, risks outweighed benefits, or if risks and benefits were neutral for Indigenous businesses and communities engaging in bioenergy initiatives. Perspectives on environmental risks were connected to harvesting the forest, as well as outputs from bioenergy production. Some business leaders felt that bioenergy development could result in negative environmental impacts, such as over-harvesting of forest biomass, for example:

> We can't chop down the forest to feed the power plant! It must be done responsibly with responsible operators. - IBL06

However, other business leaders explained that the biomass would be "waste wood" harvested from the forest floor, and that there could be several risks involved in clearing this wood from the forest. Perceived risks included damage to plants, pollution to waterways, impacts to wildlife, and overall disturbance to the forest floor. Several business leaders were also concerned about the loss of nutrients associated with removing the additional biomass from the forest.

> A risk would be not leaving enough biomass on the forest floor. - IBL12

Linking this finding to other published research, we find a number of areas of overlapping concerns by research participants. In a study by Weldu and Assefa [19] on biofuel options in Alberta, Canada, they identified human health and ecosystem impacts from development of the bioeconomy. Ecosystem impacts are associated with increased logging activity, deforestation and the collection of residual and unmerchantable wood from the forest landscape. Similarly, in the work of Peterson St-Laurent et al. ([9] p. 12), a bioenergy strategy within the Province of British Columbia "scored relatively low against the biophysical objectives, mainly because of concerns that removing an excessive amount of coarse woody debris…could lead to soil disturbance and negatively affect ecosystem services and ecological habitats." These perspectives in the literature are consistent with results from the study presented here.

Other perspectives on environmental risks included those relating to climate change and goals for carbon neutrality. Some business leaders explained that they felt that bioenergy could be 'green washing' and that it might not be a carbon neutral form of energy, especially when considering the whole development cycle.

> Bioenergy for mitigating climate change could be green washing, but every little thing counts, so some of it could be important…With the burning and the creation of carbon [from the development of infrastructure], I'm not sure if it would balance. - IBL08

Looking at broader environmental risks and benefits, beyond local impacts discussed above, there is also some consensus with published literature. On one hand, research from Weldu and Assefa [19] indicates a clear potential for biofuels to mitigate climate change. In this sense, a key motivation for promoting bioenergy is to meet global GHG reduction targets. Similarly, Peterson St-Laurent et al. [9] indicate that bioenergy development can be motivated by climate change mitigation opportunities. They noted that forests are carbon sinks, whereby biofuels could be utilized as a replacement for fossil fuels and could reduce carbon emissions by utilizing sources of carbon that would otherwise be lost to the atmosphere through forest decay or fire. In the study presented here, participants were keen to see opportunity for bioenergy that could replace other forms of energy such as nuclear or diesel fuel. These energy alternatives are particularly germane to northern and remote communities where alternatives to fossil fuels are scarce, and in some locales, bioenergy may prove viable.

Business leaders also talked about how bioenergy development could impact the use and development of other resources for energy, including different types of renewable energy. They spoke about this in terms of trading local environmental benefits for broader environmental benefits, such as reducing dependence on nuclear power and energy from fossil fuels, which were cited several times as providing important environmental outcomes from bioenergy development. However, some business leaders stated that they saw bioenergy as drawing attention away from developing other "cleaner" forms of renewable energy. Wind and solar power were given as examples by the business leaders who discussed this aspect of environmental risk. Some business leaders also explained that communities are wary of 'green technologies' that could be part of 'green washing,' and that there is often a lack of trust of technology that is marketed as sustainable.

> People hear 'bio' and they think it's 'green,' and people are afraid of green stuff. There is absolutely not enough knowledge out there [about what bioenergy is]. - IBL14

Some business leaders also had concern over the potential for air pollution resulting from bioenergy operations.

> Biofuel burns cleaner, but it's not perfect. It's still burning. It's still producing fumes when it burns. - IBL10

One business leader related the concerns over pollution to the lack of knowledge around bioenergy technology in the community, and how this could enhance the risk of air pollution from bioenergy production:

> You'd need to keep stoves clean and healthy so there wasn't smoke. There could be more pollution if it's [bioenergy production] not done properly. - IBL04

This concern was connected to some business leaders' perspectives concerning the need to enhance capacity within their communities before they could develop bioenergy. Business leaders also shared several perspectives regarding the potential socioeconomic risks and benefits of being involved in the development of bioenergy. Some worried about the start-up costs that could be involved with bioenergy projects, and how large investments could be especially risky for smaller Indigenous communities with limited resources. One business leader who talked about this also mentioned the need for greater market research to determine if bioenergy was a good investment for communities:

> As a small Nation there is only so much time that we can invest looking into opportunities. We would need market research to know if it's a good opportunity. - IBL08

In the context of developing a partnership with an outside firm, one business leader also stated that they understood there would be risks as well as opportunities (e.g., access to biomass) for companies that entered into a business partnership with an Indigenous business leader or community, and stated that the government should play a role in securing their investments:

> A private company couldn't put it [the business] on First Nations land, nor would you expect them to, so you have to find a way for that to be guaranteed by the government. - IBL06

Business leaders mentioned on several occasions how government policy and programs could create opportunities for Indigenous communities that wished to enter into the bioenergy industry. Business leaders specified the types of support that government could be involved in, including grants that would "make it easier for individuals to get involved" (IBL01), "information on what the industry is all about" (IBL02), "programs to give First Nations access to biomass on Crown land" (IBL12), and "power purchase agreement such that could help Indigenous groups." One business leader mentioned "university partners for research would be beneficial" (IBL07). One individual talked about how it is important to understand business structurally and become informed through different channels. They related a lack of business acumen and self-sufficiency to the potential for business failure:

If you don't inform yourself or have someone informing you about what the business is about, or what the structures are, then we'll always fail. Consultants will make a lot of money off our failures. - IBL02

The decision-making and financial capacity of communities was also referred to several times by business leaders. On one hand, smaller Indigenous communities were referred to as having "only so much time and money" (IBL08), while on the other hand some communities were said to have too many people with different ideas about how to do development.

Too many Chiefs at the table is always a problem. - IBL02

Several of the business leaders also spoke about self-sufficiency and the risks associated with competing with other large energy providers, especially the fossil fuel industry. Business leaders viewed fossil fuel companies as having a great amount of infrastructure and overall power over how energy systems are governed in Canada.

You've got this fossil fuel industry and supply lines and all this other stuff all designed for cars to fill up and keep going. You've got nothing [infrastructure] even close to that for biofuel. - IBL10

The banking system in Canada was also highlighted as a major barrier to developing any kind of business on Indigenous lands. Business leaders talked about how it was not possible for them to acquire business loans because of the reserve tenure system, which would not permit for banks to seize assets.

The biggest barrier is that you can't finance anything on First Nations land. The bank will not give a mortgage to someone on First Nations land. You can't build a health center and get it financed by a bank on First Nations land. Why, because you can never take it away. Can't seize the asset. You have to build it outside of band lines. You could never build it on reserve. I don't think that's ever going to fly. - IBL06

One business leader expressed particular frustration with regards to how the banking system posed a major barrier to business development on Indigenous land, and how it was unwarranted based on his experiences:

They [banks] give out unsecured high-risk venture business loans every day, but they won't do it on reserve… It's a big barrier to somebody like me… I could go anywhere in Canada not in a First Nation and the banks would be tripping over each other to lend me money. But because I'm on a reserve they won't do it. They have to change the way they do business… I've got a business plan, I've got projections, I've got real numbers on how well my business had done. I've got everything they'd ask of anyone else, so somebody's got to put pressure on them to change their rules a bit and start being a little more cooperative. - IBL10

Financial risks associated with the on-going operation and transportation of bioenergy were also mentioned several times, and were of great concern to several of the business leaders.

It's costs of running it, cost of trucking and machines. It could go backwards economically. - IBL04

Such risks of bioenergy production were especially pronounced for business leaders hailing from remote northern communities. Business leaders in the north had concerns over the viability of bioenergy because of the lack of biomass available in these regions, the need to transport biomass, the remoteness and high cost of shipping, and the difficulties with implementing technology not developed for harsh northern environments.

It's very trial and error in the Arctic… Usually things have to go wrong first and then be adapted to the environment and the

circumstances. Feels like often technologies are developed in the South, and it just doesn't work well in the north. Things are also much more expensive to run in the north… If you have an ailing machine or something that needs servicing it's not possible that far north because there are only flights every couple of days. - IBL15

One business leader stated that "Inuit are often left out of resource development planning" (IBL11), and that this was the reason for the lack of suitable solutions to bringing new energy sources to the north. Other barriers relating to geography were primarily associated with land tenure and access to areas for harvesting of woody biomass. For example, one participant on Vancouver Island talked about how there was not enough access to product because of how the land was subdivided and "some areas are mostly private land, so there is little access to crown land for product" (IBL12).

Business leaders also discussed the socioeconomic risks associated with bioenergy development. Social downfall was of a concern to some of the business leaders who said they had observed new and sustained social problems in their communities following new influxes of income for community members.

Risks would include enabling the population to keep bad habits going, such as drinking and driving and drug abuse. - IBL02

Despite the diverse perspectives around the risks and barriers to participating in the bioeconomy business leaders also shared their perspectives about the potential benefits and opportunities existing around bioenergy development by Indigenous communities, as well as bioenergy partnership.

5. Conclusion and policy implications

This paper provides an entry point for better understanding framings held by the Indigenous business community by examining leaders' views on the existing or potential benefits, risks, opportunities and challenges in engaging with bioenergy development and partnerships. As recent energy studies demonstrate [42], positive and negative framings of Indigenous renewable energy development are much more nuanced than often portrayed and must be viewed alongside colonial histories responsible for structural issues affecting communities. Our results illustrate levels of familiarity with bioenergy and an appetite for learning about and providing leadership for new initiatives in this burgeoning sector. Most business leaders we interviewed wanted to learn more about bioenergy and receive available information to become more informed. It is noteworthy that the few who did not wish to learn more had based their decision on the perceived irrelevance or unviability of bioenergy systems in their area due to biophysical (i.e., no trees) and human capacity (i.e., no specialized ability) barriers, rather than lack of interest in opportunities. In this way, low capacity can be seen as more than a limiter of opportunity because the capacity needed to mobilize simply does not exist; rather, lack of capacity also can be seen as a limiter of imagination needed for innovation and entrepreneurialism. Transcending capacity barriers created by the long history of exclusion from sectors such as forestry and energy remains an important context for the development of bioenergy in Canada [50].

Start-up industries like bioenergy need talent and resources to propel novel governance structures and technologies past the piloting stage. While very real physical limitations exist in some locations, such as northern barren land communities where diesel or biomass needs to be transported in, exploring renewable energy options may still be a viable alternative that could boost regional linkages. Still, to some participants developing woody biomass energy in certain parts of the north seems counter intuitive—it does not fit with some northern contexts, experiences, or how people identify with the land. These issues of identity, risk and opportunity are always historically contingent, and have to be viewed in the context of on-going conditions of colonization and exclusion from resource-based industries [42,51].

With further regard to capacity, there are challenges associated with professional education and the need to ensure that people have access to information and training needed to understand the industries and regulations they are pressed to operate within [37]. Opportunity costs associated with new ventures, especially ones surrounded by uncertainty and lack of trust, may not be a good use of time and money for communities that are capacity constrained. But communities that come to strategic agreement on future development can make intentional decisions to either lead development or else 'go along for the ride'. Attaining cooperation and collaboration therefore can also help focus communities and businesses so that those leaders involved in community business decision making and governance are committed to similar priorities. In the absence of these governance arrangements, disagreements can further fragment limited resources that become all the more important when large outside partners arrive seeking new project opportunities. Overall, these pressures may stress the need for a coherent Indigenous energy strategy to guide new bioenergy deals. In some jurisdictions, a new focus on regional political and economic organization (e.g., [52,53]) illustrates that Indigenous leaders are building and finding strategic advantages in such horizontal connections.

Evidence presented here suggests that there is an openness to business partnerships as capacity can be linked with access to enable new projects and risk reduction for all partners involved (e.g., firms, communities, governments). For Indigenous communities and businesses, there is a risk of loss associated with business failure, but there is also a more long-term risk of lasting ecosystem degradation within traditional territories. For non-Indigenous businesses, failed relationships could mean heightened risk of being blocked from territories that hold opportunity. The varying goals and desires of communities and businesses may require flexibility in business partnerships. Our findings confirm what other studies have found regarding benefit distribution [54], that leaders are mindful of the need for mechanisms for managing the distribution of benefits that are needed to ensure new development initiatives follow Indigenous ways of sharing. Further, as previous researchers have found [51], Indigenous community and corporate risks and impacts can be reduced through paying more attention to Indigenous rights and taking efforts to develop trusting personal and professional relationships. Such actions support more positive identity and characterization frames of corporate and community roles as mutual attention shifts to shared risks and impacts of development.

Our study highlights that on-reserve entrepreneurs and business leaders are at a disadvantage because the banking system is not designed to support Indigenous business realities. Systemic challenges in the banking and related systems such as energy distribution systems and research and development pose barriers to Indigenous involvement in economic development, governance, and research/knowledge production, which are needed in natural resource sectors and land management to realize self-governance [50]. A government-backed loan guarantee opportunity could be instituted by the federal government to help support Indigenous innovation in the bioenergy sector. Governments have offered similar guarantees to large companies during economic downturns in recent years [55]. These are the sorts of policies and infrastructures that will need to be developed to support growth industries, as well as truth and reconciliation actions, aimed at Indigenous involvement. Indigenous-led policy interventions are especially important in new industries like bioenergy in the boreal where Indigenous traditional territories, communities and businesses intersect and thus are likely to be impacted by new developments and partnerships. These financial and governance barriers along with the reserve systems created by colonization must be addressed [51] in part because the majority of known energy development potential is on Treaty land and traditional Indigenous territory.

Participants consistently expressed concern about the environmental risks connected to harvesting the forest. Where risks were identified, similar to the published literature, these risks were associated with the local environment and the potential to place additional pressures on already taxed forest and arable lands. However, some perceived benefits were also noteworthy. For example, recent heightened concerns for community fires and wildfire fire management made bioenergy development more attractive as a potential key part of forest fire management and, in turn, community energy strategies. Focussing on removing woody debris that fuels fires was certainly appealing given recent forest fires around Northern America, but especially in northern Canada. However, it may be that the forest thinning work required to help reduce fire risks in and around communities may not fully satisfy woody biomass demands of new facilities and markets so that supply issues could simply mirror the wood supply challenges faced in other parts of the forest sector. Quotas and bioenergy production may have to be regulated to ensure ecosystem resilience is maintained (e.g., set by ecosystem limits rather than by companies and markets) to avoid possible over exploitation of the resource.

In addition to the perceived potential to reduce fire risk, achieving self-sufficiency in energy supply was viewed as something that could add stability and local control, especially for remote and northern communities. Participants saw value in local energy production as it was viewed as another potential path towards improved self-governance and reduced reliance on other modes of government, sources of funding, and outside producers. Certainly, many of the benefits of bioenergy were related by participants to opportunities for increasing community self-reliance and increasing connectedness to Canadian economic and governance systems. These framings of bioenergy potential are consistent with other energy studies involving Indigenous peoples in Canada [56,57]. Bioenergy may be another way to help bolster local control and resilience [58] as well as meet regional and national objectives for Indigenous inclusion in the development of the forest and bioenergy sectors [59]. Furthermore, bioenergy development aimed at supporting self-sufficiency can be viewed as a decolonizing process working to change political and business framings and practices that remain incongruent with Indigenous framings of their own community energy goals [57].

While local involvement remained a focus of this study, participants warned of perhaps idealistic or restricted views of exclusive band to band dealings or local markets for bioenergy. Indigenous bioenergy would need to be connected to outside markets, transportation infrastructure, and users in order to grow and to be relevant and lucrative. These concerns suggest that leaders see potential for and a need to grow bioenergy production beyond local need and markets. This also raises the question of developing infrastructure and business relationships to carry energy and energy products (e.g., wood pellets) to other markets, in order to increase the integration of Indigenous businesses and communities in the sector.

Our findings suggest that more information on ecological implications of bioenergy, including carbon emissions and potential climate impacts, forest health, and forest flora and fauna, is needed. Our findings also underscore that bioenergy, like other emerging and climate change relevant industries, will have to contend with and accommodate additional expectations linked to greenhouse gas emission reduction goals. Unlike previous forest and energy industries that advanced during times of scant regulation and public participation, new bioenergy industries have the challenge of proving themselves as carbon neutral as a public relations and policy standard or ethic of "good" environmental performance. Nonetheless, a focus on switching away from conventional energy such as oil and nuclear suggests that there is perhaps an appetite for transition options, especially those that favor renewable forms of energy. So-called "clean" energy preferences might be what shifts leaders' interests to support financial and political investment. However, unproven energy sources that present higher uncertainty may be met with pragmatic scepticism, rather than enthusiasm. This scepticism is further exacerbated by histories of marginalization and instability coupled with ongoing efforts to restore wellness and stability.

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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.

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Supplementary materials

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