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Risk blindness in local perspectives about the Alberta oil sands hinders Canada's decarbonization

Luis D. Virla [a,f,*], Dirk-Jan van de Ven [b], Jon Sampedro [b], Oscar van Vliet [c], Alistair Smith [d], Hector Pollitt [d], Jenny Lieu [e,f]

[a] *Science Technology Policy Research Unit (SPRU), University of Sussex, Sussex House, Falmer, Brighton BN1 9RH, UK*
[b] *BC3-Basque Centre for Climate Change, University of the Basque Country, 48940 Leioa, Spain*
[c] *Climate Policy group, ETH Zürich, Department of Environmental Systems Science Building CHN, Universitätstrasse 22, CH-8092 Zürich, Switzerland*
[d] *Cambridge Econometrics, Covent Garden, Cambridge CB1 2HT, UK*
[e] *TU Delft, Multi-Actor Systems Department, Building 31, Jaffalaan 5, 2628 BX Delft, the Netherlands*
[f] *Innolab Space, Ldt. Calgary, Canada*

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ABSTRACT

Local perspectives can conflict with national and international climate targets. This study explores three stakeholder (community, provincial, and federal) perspectives on the Alberta oil sands as risks for a sustainability transition in Canada. In an ex-post analysis, we compared outputs from stakeholder consultations and energy-economy models. Our research shows that different local stakeholders groups disregarded some policy risks for the Alberta oil sands and Canadian energy transition. These stakeholders expected the sector to grow, despite increasing environmental penalties and external market pressures. The study revealed that blind-spots on risks, or "risk blindness", increased as stakeholders became less certain about policy climate goals. We argue that "risk blindness" could be amplified by dominant institutional narratives that contradict scientific research and international climate policy. Strategies that integrate local narratives, considered as marginalized, provide perspectives beyond emission reductions and are essential for meeting climate targets while supporting a just transition.

1. Introduction

Production from the Alberta oil sands contributes to ~9.3% of total Canadian greenhouse gas (GHG) emissions, this covering emissions from extraction, transportation, and processing (Ministry of Environment and Climate Change Canada 2018) only (not combustion). The oil sands are considered to be one of the most carbon intensive forms of crude oil production from a "well--to-refinery" perspective (Masnadi et al., 2018). Locally, this sector has been expected to keep growing and it is widely supported by the provincial Government and the general public, despite major environmental and economic challenges.

Numerous studies and reports, i.e. scientists, institutes, NGOs, and others, indicate that the environmental impact of the Alberta oil sands development is expanding, with impacts on local waterways, ecological integrity, and land use [(Commission for Environmental Cooperation (CEC) 2020; Cook, 2012; Hoberg and Phillips, 2011; McWhinney, 2014; Parajulee and Wania, 2014)]. Several local

* Corresponding author. E-mail address: l.d.virlaalvarado@tudelft.nl. Current affiliation: TU Delft, Multi-Actor Systems Department, Building 31, Jaffalaan 5, 2628 BX Delft, the Netherlands; and Innolab Space, Ldt. Calgary, Canada.

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communities claim the sector affects their ability to practice traditional ways of living (Baker and Westman, 2018; Joly et al., 2018; Wanvik and Caine, 2017). Various studies estimate that to meet global climate targets, more than half of fossil methane gas reserves, over 80% of coal reserves, and one-third of oil reserves, including the Alberta oil sands, should remain in the ground by 2050 to limit warming to 2 °C (Canada Energy Regulator 2020; Jaccard et al., 2018; McGlade and Ekins, 2015; Mercure et al., 2018). Even higher fossil fuel reserves - 60% of oil and fossil methane gas and 90% of coal - should be left in the ground to limit warming to 1.5 °C (Welsby et al., 2021). In addition, assets in the Alberta oil sands are at risk of becoming stranded, i.e. hydrocarbons that are never extracted, if the market shrinks due to reduced demand for carbon-intensive sources of energy, even without new climate policy (Mercure et al., 2018). Global and national climate policy aims to drive significant reductions in GHG emissions (IPCC 2014), but many actions must occur at the regional level. However, regional priorities can differ from longer term national and global climate goals. Therefore, local stakeholders[1] should have a significant say on how the transition is implemented.

As part of the Paris Accord, Canada has committed to reducing its greenhouse gas emissions to 30% below 2005 levels by 2030, as stated in its Nationally Determined Contribution (NDC) (Government of Canada 2017). To achieve this target, the Federal Government plans to reduce emissions in the energy, manufacturing, and transportation sectors (Government of Canada 2016). Although current policies are off-track (Hayes et al., 2017), the Federal Government has announced an aim 40–45% below 2005 levels by 2030 and reach net-zero emissions by 2050 (Environment and Climate Change Canada 2021). The federal carbon pricing on fuels will be increased from 30 $/tonne in 2020 to 170 $/tonne by 2030, which is expected to support meeting Canadian emission reduction goals along with other cross-sectorial policies (Environment and Climate Change Canada 2021; Environment and Climate Change Canada 2020).

At the provincial level, the Government of Alberta in 2019 implemented the "Technology Innovation and Emissions Reduction engagement (TIER)" program (Government of Alberta 2020). This revoked the 2015 "Climate Leadership Plan" that was included in Canada's 2017 NDC targets (Government of Canada 2016; Leach et al., 2015). Non-compliance within the TIER program, i.e. emissions exceeding a baseline set at the emission intensity of the best available technology, will result in a $30 per tonne cost for carbon. Although very similar in price to the preceding NDP's Climate Leadership Plan, the TIER program does not impose any emission cap and expects self-benchmarking. Therefore, critics argue that the TIER program is insufficient and will result in the continued growth of carbon emissions in the sector (Calgary Chamber 2019; French, 2019).

The current provincial view of developing the oil sands sector whilst (hopefully) decreasing its environmental impact is confronted with many challenges. Today, Alberta has the second highest emissions per capita of the thirteen provinces and territories of Canada. Total emissions increased by 7% between 2017 and 2018; this is only considering oil and gas production emissions and would be larger if indirect and combustion emissions were included. After months of debate, in December 2019 the Provincial and Federal Governments reached an agreement for a non-compliance fee of $30/tonne of carbon for the TIER program in 2020, $40/tonne in 2021, and $50/tonne in 2022 to meet the Federal requirements (Department of Finance Canada 2020). Consequently, Alberta sued the federal Government at the supreme court to remove the economy-wide carbon price, claiming that the policy was outside federal jurisdiction and was harmful to the local economy (Stefanovich, 2020). In March 2021, the Supreme Court of Canada ruled the Federal Carbon Price was constitutional and all provinces should implement a price on pollution aligned with the national standards (Supreme Court of Canada 2021; Tasker, 2021). Conflicts between federal and provincial policies add to the challenges in achieving a successful low carbon energy transition in Canada.

Understanding risks for energy transitions is essential to develop effective policies covering the economy, environment, and society. The definition of risks varies across disciplines and there is no consensus among experts (Fischhoff et al., 1984). Hanger-Kopp et al. (Hanger-Kopp et al., 2019) described risks as "the probability, chance, or potential for a negative outcome, impact, or consequence" to occur. However, the identification of risk, and respective mitigation strategies, requires thorough evaluation across contexts and disciplines (Lieu et al., 2020). An inadequate assessment can lead to policies and actions with "blind-spots", or significant underestimation of risks (Elshurafa et al., 2019; Leggett, 2014). In management literature, Hillson (Hillson, 2014) described "risk blindness" as a condition of being unaware of the existence of risks, voluntarily or involuntarily. Also, Silver (Silver, 2017) found that certain risks are "invisible" to investors, since most risk analysis are based on historical risks or benchmarks incapable of accounting for developing risks. Along with inadequate practices, regulations, and incentives to address risks, stakeholders are more likely to ignore certain risks that seem external but could greatly impact their livelihood. The understanding of risk blindness requires researchers to develop comprehensive methods to understand both individual and contextual factors, as well as the social roles in systems and structures that can impact the perception of risks amongst stakeholders.

Considering the growing evidence of climate change risks for extractive industries - such as wildfires, floods, tornados, etc. - we questioned if local jurisdictions could rely on reducing their carbon emissions while maintaining growth, as expressed by local stakeholders. Rajak (Rajak, 2020) discussed this paradox for the oil and gas sector and suggested that the engagement of extractive industries with climate change is based on "willful blindness" on their capacity to act. The author argued that extractive industries largely believed that climate responsibility lies with "higher powers", such as shareholders and technology, and that there is a techno-optimistic solution to the environmental issues resulting from the industrial activity that will redeem their wrong-doing. Bovensipien and Pelkmans (Bovensiepen and Pelkmans, 2020) described willful blindness in criminal law as "The deliberate avoidance of knowledge of the facts", which may manifest in any circumstance where there is a conflict between intention and recognition. Also, willful blindness can be reflected in phrases such as "deliberate or willful ignorance", "conscious avoidance", "deliberate

[1] In this study, stakeholders are defined are right holders (of traditional lands), person, and/or institutions who have and interest or concern about the Alberta Oil Sands sector.

indifference", "strategic ignorance" and others, as individuals are able to detach themselves from the reality of others (Bovensiepen, 2020; Heffernan, 2011).

Considering these understandings of risk blindness, we explore this concept within our case study. In Canada, each province has constitutional rights to manage their own natural resources (Government of, 1982). Therefore, understanding how local perspectives are (mis)aligned with federal perspectives is key to both developing unified climate agendas and understanding risks for climate policies. This study is an ex-post analysis that used stakeholder consultations and outputs from energy-economy models (EEMs) to investigate stakeholder perspectives in the Alberta oil sands as risks for a sustainability transition in Canada. Risks are defined as the barriers to a sustainability transition in Canada (implementation risk, IR) or as a consequence of its implementation (consequential risk, CR). Within the study, we consider the evaluation of risks in different perspectives presented by a range of stakeholder groups. We also included research outcomes from academic and gray literature to represent national and international perspectives on climate change action and mitigation.

Our first research questions explored: "*How do local perspectives in the Alberta oil sands impact a sustainability transition for Canada*?" and "*To what extent are the views of local stakeholders barriers to transitioning towards a more sustainable future*? Answering these questions led us to an ex-post analysis of stakeholders' blind-spots in the risks they identified, which we described as risk blindness and explore in this study. For instance, some stakeholders failed to see (or did not acknowledge) risks pointed out by other stakeholders. The researchers only noticed blind spots when risks from all stakeholders were gathered and compared to each other. Thus, in this study we are not only proposing to focus on risks assessment in energy transitions, but also take note of risk-blindness as perceived by different stakeholder groups.

This study is unique as we present the perspectives from *diverse* local stakeholder groups, not just the dominant perspectives represented by the industry and supporting provincial government. Instead, we present important alternative perspectives that are often absent in energy policy making. Including the diverse views of stakeholders helps to identify risks that cannot be quantified in models but can compromise the achievement of climate targets.

2. Methods

2.1. Stakeholder dialogue

Several methods of stakeholder engagement were used to capture local perspectives on risks associated with the Alberta oil sands. Face-to-face meetings, bilateral calls, surveys, semi-structured interviews, and stakeholder engagement workshops were conducted to establish a dialog with stakeholders. 17 semi-structured interviews were performed between November 2016 and April 2018, including academics (4 interviews), Indigenous community members (6 interviews), industry players (5 interviews), a non-profit organization (1 interview) and a policy maker (1 interview). The interview questions used with stakeholders in bilateral meetings and calls are listed in the Section 1 of the Supplementary Information.

To further assess stakeholder perspectives, we conducted a risk elicitation survey (van Vliet et al., 2020) and three stakeholder engagement workshops (workshop 1 and 2 in March 2018, and Workshop 3 in December 2018) with a combined attendance of 150 participants. This qualitative analysis was strengthened by drawing information from local policy reports, statistical data, and media outputs, as well as using available academic literature and documents from the UNFCCC to inform the global perspective. We continued bilateral calls and meetings with stakeholders throughout 2019 to review and verified our interpretation of their perspectives. More details about the method used for stakeholder dialog is presented in Virla et al., 2019 (Virla et al., 2019) and in Section 1 of the Supplementary Information.

2.2. Quantitative analysis

We quantitively assessed risks for an energy transition in Canada, based on policies for the Alberta oil sands, using two different energy-economy models (EEMs): The Global Change Analysis Model (GCAM) (Kyle et al., 2017) and the Econometric Energy-Environment-Economy Model (E3ME) (Cambridge Econometrics 2019). GCAM was used to study the impact of local perspectives on environmental and oil production indicators, for both the oil sands sector in Alberta and total GHG emissions for Canada. It focused only on production emissions. In addition, GCAM was used to model scenarios studying the impact of other countries keeping within their NDC (or not) on the aforementioned indicators. Oil sands production, natural gas inputs and emission outputs were calibrated for Canada to 2015 levels, and to a regional and technological detail informed by data from the Alberta Energy Regulator (AER) and the National Inventory Report 1990–2016 (Ministry of Environment and Climate Change Canada 2018). E3ME was used to assess the socioeconomic impacts of global and national climate policy on GDP and employment. Scenarios were developed from previous research by Mercure et al. (Mercure et al., 2018). Detailed information about GCAM and E3ME can be found in Section 2 of the Supplementary Information.

These models were pre-selected based on a wider research project rather than on this specific case study needs[2]. As a result, we faced limitations with model selection as we were required to choose from an existing set of models with wider national and global implications, rather than using models that were more specific to the local context. These models helped to provide data and

[2] TRANSrisk (T***ransitions Pathways and Risk Analysis for Climate Change Mitigation and Adaptation Strategies,)*** *an* H2020 European Commission under grant agreement No. 642260. See model applied: http://transrisk-project.eu/virtual-library/transrisk-models

information on the national and global context, while our qualitative research provided more local context and data (see Section 2.3 for further details).

2.3. Integration of stakeholder consultation and modeling assessments

The integration of qualitative data (stakeholder engagement) and modeling data (quantitative data) provided a more complete vision of the local perspectives and its potential impacts. In policy development, the human dimension is not always quantifiable and is typically neglected when quantitative modeling data becomes available. Commonly, the human dimension is mostly considered through socioeconomic indicators such as employment. Also, EEMs have been criticized for their limitations in capturing complex interdependencies between technology and society (Keen, 2020; Ackerman et al., 2014; Asefi-Najafabady et al., 2020). Therefore, it is essential to combine EEMs estimations with stakeholder dialogues to provide a more realistic view of the complex contexts in low-carbon transitions.

In this work, the integration of stakeholder consultation and modeling assessments was performed by relating the stakeholder inputs with modeling outputs during the project execution, following elements considered within participatory system dynamics (Videira et al., 2017; Antunes et al., 2015). Also, some modellers were present at stakeholder engagement events to learn about the local context directly from stakeholders. This was a valuable exchange that helped modellers to personally hear the concerns of stakeholders and to understand the complexities of opportunities and trade-offs (global carbon emissions reductions over local social economic impacts). Stakeholders also learnt about the potential economic and climate impacts of their preferences, considering the global dynamics (discussed later in Section 3 – Results and Discussion).

Fig. 1 shows the timeline for stakeholder-model integration. Initially, interviews with generalists were carried out to identify the broader local context and refine the necessary assumptions for the modeling exercise, where possible. Interviews were combined with bilateral calls and meetings to verify the interview outputs. The first report included outcomes from the consultation that served to establish the first modeling run (GCAM.1), which provided a wider context for the three perspectives. From those results, two stakeholder workshops were organized to identify key risks. The risk elicitation process was conducted via a survey followed by two modeling exercises (GCAM.2 and E3ME.1). With the release of a second report on scenarios and modeling, another modeling iteration (GCAM.3 and E3ME.2) was performed to refine the findings. This set of data informed the third stakeholder workshop, where participants impressions of the modeling outputs were recorded and analyzed. Questions asked to stakeholders during the public workshops are presented in detail in Section 1 of the Supplementary Information. Lastly, interactions with field experts continued through 2019 to verify the modeling results. We did not present the risks we identified via literature review to the stakeholders in order to avoid influencing their own perception of risks. Our goal was to gather local perspectives of risks at the time and not to impose our own understanding of risks at the local level. This was a deliberate choice of research method, as we were also aware that our own views could introduce some bias into the local perspectives (e.g., settler perspectives and/or those historically colonizing communities in Canada). We also wanted to avoid an extractive research process, particularly with Indigenous communities as this would perpetuate the inequalities of the colonial past. Thus, our aim was to provide a platform for stakeholders to express their viewpoints without us placing our values on stakeholders.

The integration of qualitative and quantitative research results used for this research served to provide more accurate assumptions for the models while increasing the stakeholder interest in the results. Initial participation, and promoting co-development of research results between researchers and stakeholders, resulted in positive engagements while generating more meaningful results relevant to

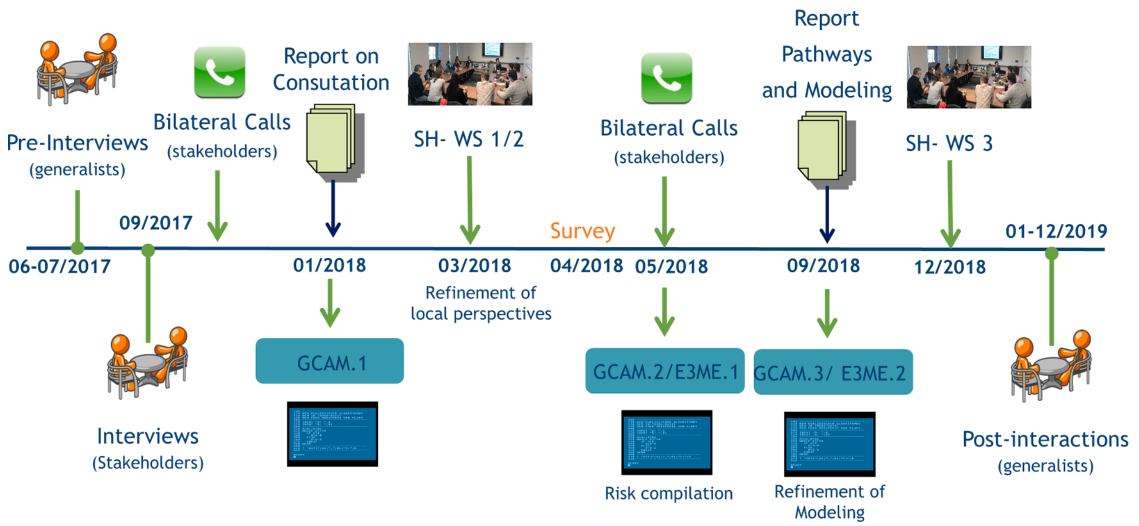

Fig. 1. Overview of stakeholder and modeling integration. Modified from Bachner et al., 2020 42 under the terms of the Creative Commons CC-BY license.

the local reality.

3. Results and discussion

3.1. Stakeholder perspectives about risks in policies for the alberta oil sands

Three categories of stakeholder perspectives were formulated based on existing policies and studies, as presented previously by Virla et al. (Virla et al., 2019). In addition, consultations were carried out to further inform the three distinctive perspectives, which broadly reflected the official (i.e., documented) expectations of different stakeholder groups. The perspectives considered were:

(i) “Local Community” (LC), where a paced development is emphasised to protect the ecological integrity of the land, as reflected in a scientific study commissioned by a local Indigenous community;
(ii) “Provincial Policies” (PP), incorporating a carbon price based on Alberta’s own climate policy; and
(iii) “Federal Policies” (FP) which aim to decrease carbon intensity of the Canadian economy by increasing the share of renewable energy in the energy mix and increasing carbon pricing (a vision proposed by varied stakeholders and represented in the federal policy for sustainable development).

Details about these perspectives are presented in Table 1.

This study revealed that a range of stakeholder groups - including local politicians, industry players, and Albertan residents - view a sustainability transition for the Alberta oil sands as achievable. Yet they have different understandings of how a transition may occur. Such perspectives rely on technological innovations and governmental support to ensure the survival of the sector under a global context that meets the Paris Agreement targets. These local perspectives have influence over the development and implementation of actions for reducing carbon emissions from the Alberta oil sands. While federal or international actors may (in)directly impact the oil sands, an energy transition strategy must occur at the provincial level, as the management of natural energy resources in Canada falls within provincial and territorial jurisdiction (Government of Canada 1982).

Risks associated with the discussed narratives were identified by stakeholders and have been previously discussed in detail in Virla et al. (Virla et al., 2019). In general, during public workshops stakeholders highlighted both implementation barriers and deployment impacts from LC, PP or FP. These risks were mainly focused around social rejection of climate initiatives; political barriers associated

Table 1
Details of stakeholder perspectives for the Alberta oil sands selected for modeling purposes.

Perspective	Inspired by	Considerations
Local community (LC)	Fort McKay Access Management Plan (Alberta Ministry of Environemnt and Parks 2018)	– Establishment of protected land areas within the Athabasca region, where no industrial activity is allowed.
		– Land protection based on the criteria of maintaining key wildlife areas and caribou ranges areas. – Protected land areas of Fort McKay traditional territory fixed at 9% (total key wildlife area protected), 37% (total key wildlife area and 50% of caribou ranges area protected), and 56% (total key wildlife area and caribou ranges area protected) of the total Alberta Oil sands region (see Supplementary Information, Table S.3 and Fig. S.3) – Prioritized exploitation of more available and economic resources outside protected areas.
Provincial Policies (PP)	Alberta Climate Leadership Plan (Leach et al., 2015) and Technology Innovation and Emissions Reduction (TIER) Regulation (Government of Alberta 2020)	– Trading system for carbon credits.
		– Carbon pricing for the sector, variable (0–100 \$/tonne) according to policies implemented on facilities that produce 100,000 tonnes of carbon dioxide equivalent (CO_2e) or more per year and applied based on a specific benchmark considering emissions intensity. – Possible implementation of 100 $MtCO_2e$ cap in carbon emissions from the Alberta oil sands.
Federal Policies (FP)	RoadMap for lower-carbon energy sector from the Energy Futures Lab (Energy Futures Lab 2021), and the Canadian NDC (Government of Canada 2017)	– NDC for Canada 2015.
		– Economy wide carbon price, variable (30–80 \$/tonne) adjusted to meet the carbon targets set on the NDC. – Investment in energy efficiency across industry, buildings, and other final energy users. – Regulation and financial incentives to encourage low-carbon transitions in power generation, road transport, and heating. – Complete phase out of traditional coal power generation by 2030. – Methane regulations for the upstream oil and gas sector. 45% reduction in methane emissions intensity by 2025 from 2012 levels.

with policies and regulations; conflicting political power; and environmental impacts involving pollution and climate change. Stakeholders also highlighted health impacts from increased pollution and specific impacts regarding the livelihood and governance of indigenous communities. In addition, economic impacts were flagged by stakeholders as potential risks (Virla et al., 2019), as policy changes limit the growth of extractive industries and consequentially affect the local economy, employment rates and private investment. Most of the risks identified by stakeholders affected two groups simultaneously: community-government, community-industry, or government-industry. Risks that affect only one stakeholder group are those concerned with local communities, such as negative impacts on community well-being, the local environment and the absence of direct benefits for the local community at large. However, environmental and economic risks impacted all three stakeholder groups. Also, all of the stakeholders consulted perceived these consequential risks as those with more potential to negatively impact the province.

Table 2 summarizes the key risks that stakeholders identified during public workshops, as reported in Virla et al. (Virla et al., 2019). These risks were classified based on their type and stakeholder impact and represent the challenges that local perspectives potentially have on meeting Canadian climate targets. Note that the yellow asterisks (*) represent the risk blind spots.

The symbol/color coding on Table 2 highlights the characteristics of the risks proposed by local stakeholders. In general, most of the risks identified posed a potential negative effect for a national low-carbon energy transition. If any of these perspectives (LC, PP and/or FP) were to be deployed, the transition plans for Canada would be negatively impacted. Most of the risks that may have a positive impact on a national transition are those linked to slowing down oil sands projects, increasing the costs or reducing the profits of such projects, and possibly having a negative economic impact on the private sector.

The number of (*) yellow cells in Table 2 can be associated with the level of blind spots on each policy from a stakeholder's point of view. LC perspective showed the lowest number of (*) yellow cells, suggesting policies developed by communities (bottom-up) could have the most comprehensive set of elements, enabling a more detailed assessment of different risks when compared to other perspectives. LC is followed by FP with an increasing number of (*) yellow cells, mostly related to a lack of consideration of impacts, or actions related to local Indigenous communities, and province-wide economic impacts. Provincial Policy perspectives (PP) were the hardest to assess by stakeholders, showing the largest number of (*) yellow cells, or risk blind spots. However, these responses may be associated with an (un)intentional dismissal of critical aspects that connect provincial and federal policies. As blind spots may be associated with risk blindness, PP seems to be more exposed to negative impacts of potential risks associated with a transition in the energy sector.

According to stakeholder testimonies, any policy targeting the Alberta oil sands will have a socioeconomic impact beyond the sector. For instance, flexibility of environmental regulations could result in increased pollution, extended environmental degradation and pollution-related illnesses. This can incapacitate community members, recue their ability to work and raise unemployment levels. Also, Government stakeholders could be affected as the given policies may fail to meet carbon emissions targets, lead to decreasing royalties, more health-care spending, and potentially political instability. Forthcoming Government plans should consider at least these three stakeholder groups to co-develop comprehensive policy instruments. Moreover, our results suggest that co-developing action plans to align federal energy transition policies with provincial policies requires building consensus across different local stakeholder groups, especially in economic and environmental matters (Baker and Westman, 2018; Lieu et al., 2018).

3.2. What are the missing risks?

We further assessed the potential impacts of risks associated with LC, PP, and FP perspectives over a sustainability transition in Canada, as well as those of risks not identified by stakeholders using EEMs and publicly available literature.

3.2.1. Multisystem perspective needed for a significant decrease of carbon emissions

The current Government discourse in Canada includes a decrease in oil sands GHG emission intensity as a necessity of meeting Canada's Paris Agreement targets (FP, Table 1). At the same time, provincial stakeholders have proposed different action plans to decrease the environmental impact of the sector while allowing growth in the oil sands, with the expectation of maintaining economic benefits (PP, Table 1). The impact of three multi-level perspectives (LC, PP, and FP) on environmental indicators was studied using the GCAM model. Fig. 2 shows the estimated carbon emissions trajectory (2020–2050) for the Alberta oil sands sector under different perspectives (Fig. 2a), and their impact on the GHG emission projection for Canada (Fig. 2b). The figures presented are for production emissions only. The no-climate-action scenario (NCA), corresponds to a perspective where Canada takes no climate action. The scenarios were studied against a baseline where all countries in the world meet their NDC targets.

Fig. 2a shows that all three perspectives studied resulted in a decrease of CO_2 emissions, with respect to the baseline scenario where Canada makes no changes to the current practices (NCA). All perspectives resulted in a growing emissions trajectory over time, except for PP where carbon emissions from the Alberta oil sands are capped at 100 Mt/year CO_2eq. The projections do not consider the impacts of COVID-19 in oil supply and demand for 2020–2021 and the net-zero pledge of the Canadian Government for 2050.

Comparing perspectives, FP shows the lowest CO_2 emission trajectory for the Alberta oil sands among all the alternatives up to 2035, maintaining an emissions reduction of about 16% with respect to the base case (NCA). However, by 2035 PP keeps constant CO_2 emissions below what is predicted for FP. Cumulative CO_2 emissions estimated for FP are lower than for PP when considering the complete trajectory. This means that country/region-wide carbon pricing could have a faster impact than sector specific carbon pricing and emissions cap, as outlined in the PP. In addition, PP shows a higher CO_2 emission intensity, similar to NCA, until the emission cap is reached by 2030. For LC, the largest predicted impact on carbon emissions was for 56% of the area protected to avoid industrial development, and this therefore will be the only variant shown in the next sections of this study. LC-56% resulted in CO_2 emissions reductions in the range of 4-16%, and also showed a decline in CO_2 emissions after 2040. This trend is a consequence of a decline of

Table 2
Risks from local perspectives about the Alberta oil sands to Canada's climate targets. Risk-actor interactions identified by stakeholders.

Categories	Stakeholders impacted	Local Community Perspectives (LC) Risk	Type	Provincial Perspectives (PP) Risk	Type	Federal Perspectives (FP) Risk	Type
Social rejection	Community	(˅) Lack of representation of local values	IR	(*)		(˅) Renewable sector also affects the local environment (not in my back yard)	CR
	Government	(*)		(*)		(*)	
	Industry	(˄) Delays, increase of costs	CR	(˄) Rejected by industrial sector / too slow	IR	(˄) Delays, increase of costs	CR
Political barriers	Community	(*)		(*)		(*)	
	Government	(˅) Political transition (conservatives come into power)	IR	(˅) Unfavorable policy mix for carbon emissions reductions	IR	(˅) Political transitions, loss of support, lack of complementary policies for large emitters	
	Industry	(˄) Delays, increase of costs	CR	(˄) Delays, increase of costs	CR	(˄) Delays, increase of costs	CR
Environmental impacts	Community	(˅) Continued environmental degradation, impact on traditional way of life	CR	(*)		(˅) Continued environmental degradation, impact on traditional way of life	CR
	Government	(˅) Plan may not meet Canadian NDC, carbon leakage	CR	(˅) No reduction in carbon emissions	CR	(˅) No effect on carbon emissions	CR
	Industry	(˅) Occurrence of natural disasters, risking assets	CR	(*)		(˅) Occurrence of natural disasters, risking assets	CR
Health impacts	Community	(˅) Increase of associated diseases	CR	(*)		(˅) Increase of associated diseases if pollution increase/ maintains	CR
	Government	(˅) Increase of health care costs	CR	(*)		(˅) Increase of healthcare costs if pollution increase/maintains	CR
	Industry	(*)		(*)		(*)	
Local Indigenous communities	Community	(˅) Affects the community dynamic	CR	(*)		(˅) Not benefiting local communities	CR
	Government	(˅) Increase of health care costs	CR	(*)		(*)	
	Industry	(*)		(*)		(*)	
Negative economic impacts	Community	(˅) Decrease accessibility to jobs	CR	(˅) Decrease accessibility to jobs	CR	(*)	
	Government	(˅) Decrease in royalties	CR	(˅) Decrease in royalties	CR	(˅) Decrease in royalties	CR
	Industry	(˄) Less attractive for investment, lost profits from oil sands	CR	(˄) Less attractive for investment, lost profits from oil sands	CR	(*)	

Note 1: Community - Indigenous and non-Indigenous groups, Government - provincial and federal public institutions / policy makers, Industry - represents energy and indirect private sector.
Note 2: (IR): Implementation risk - a barrier to, (CR): consequential risk - a consequence of, the implementation of a clean energy transition in Canada.
Note 3: Symbol/color code: (˄) Green - positive impacts; (˅) Red - negative impacts; and (*) Yellow - unidentified risks/ blind spots, local perspectives could have on a sustainability transition in Canada.

bitumen production caused by the high costs of the remaining resources.

The effect of the stakeholder perspectives on the trajectory of the GHG emissions for Canada are shown in Fig. 2b. PP and LC could reduce total GHG emissions by 3–6% with respect to NCA. However, FP generates a reduction in GHG emissions of around 30% compared to NCA. This result reflects the difference between perspectives that only consider the Alberta oil sands sector (such as PP and LC), and a policy that looks at the whole Canadian energy system, therefore reflecting the entire Canadian NDC 2015 (such as FP). As expected, FP is the only one capable of meeting the expectations in projections presented by the Canadian Government in the 2017 Pan-Canadian Framework (Government of Canada 2016), since the inclusion of emission reductions in other sectors is essential to meeting the targets (Galvez and MacDonald, 2018; Erickson, 2018). However, FP still fails on meeting current 2030 targets (Sawyer, 2020). In the case of LC, despite clear benefits to improve the ecological integrity of the area and enable traditional practices of the local community, managing land use does not by itself help to meet the GHG emissions targets set at the federal and international level. These results highlight another difference between priorities for community stakeholders and industry/Government stakeholders.

In the latest update of the Canadian NDC in 2017, the Canadian Government expressed more ambitious targets to reduce GHG emissions to 523 $MtCO_2$ by 2030 (Government of Canada 2017). We have not run a scenario in which the NDC target is met, but evidently actions are required in both the oil sands and other sectors to meet these goals. In the duration of the data collection period of this research project (2016–2018), the federal Government had not released a comprehensive plan setting out how it will meet this

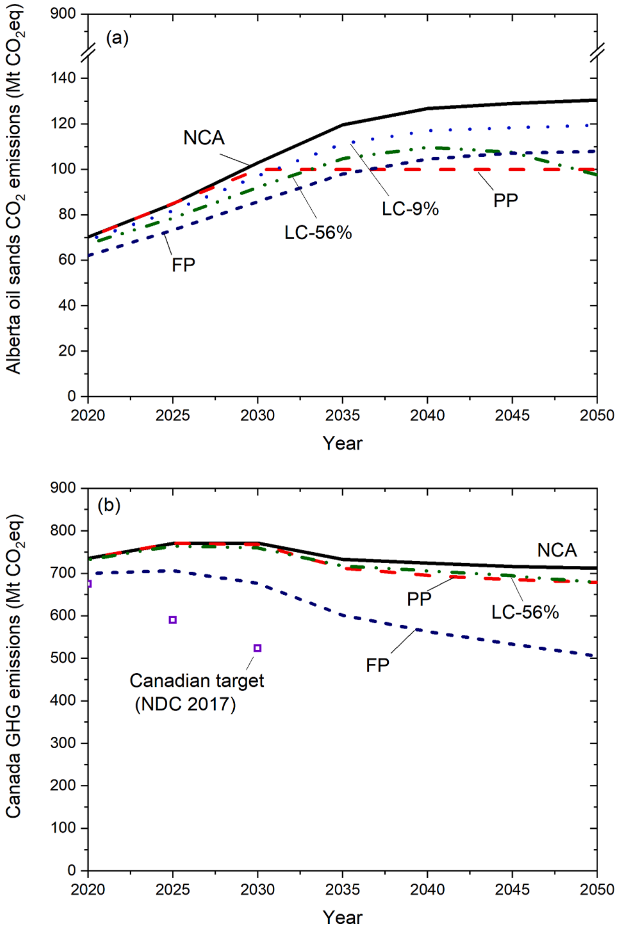

Fig. 2. Carbon emissions trajectory as a function of local perspectives: (a) Alberta oil sands CO2 trajectory 2020–2050, (b) Total Canadian GHG emissions. Lines correspond to projections from the model and the symbols corresponds to predictions presented on the Canadian NDC 2017.

target. However, many critics have suggested that the policies outlined in the NDC were not sufficient to meet these targets, and that stronger regulations are needed (Jaccard et al., 2018; Galvez and MacDonald, 2018; Harvey and Miao, 2018; McKellar et al., 2017; Sleep et al., 2017). New updates on FP are expected to support the 2017 NDC targets to help Canada in getting closer to its new net-zero goal by 2050 (Environment and Climate Change Canada 2020; Sawyer, 2020; Research, 2020).

3.2.2. Canada climate targets heavily reliant on us climate policy

Fig. 3 shows production projections for the Alberta oil sands from GCAM under the three different perspectives. As shown in Fig. 3a, bitumen production based on NCA is expected to reach 4 Mbbl/day by 2050. However, production could rise to 5 Mbbl/day[3] if there is a market expansion, especially if driven by demand in the US. The projected values in Fig. 3a are in line with predictions reported by the Alberta Energy regulator, the Canadian Energy Research Institute, and the Canadian Energy Regulator (Canada Energy Regulator 2020; Alberta Energy Regulator 2018; Millington, 2018). When climate policies, pollution regulations, and reductions in demand are considered (mainly as described in NDCs), a decrease in projected production was observed for all cases. For PP (Fig. 3c), bitumen production reached a plateau after 2030 due to the limit set by the 100 $MtCO_2$ cap on carbon emissions.

The LC and FP perspectives, Fig. 3b and Fig. 3d, showed a production trend similar to NCA, but with a production decrease of approximately 25% and 12% respectively in comparison to the base case. For LC, crude bitumen production peaks by 2040 and decreases afterwards due to a reduced demand for Canadian bitumen, influenced by the production of more economic unconventional oil in the United States of America (USA) and the Middle East. For FP, the increase in production is below the NCA, with an estimated output of 3.5 Mbbl/day by 2050.

The effect of the policies on bitumen output was also evaluated in a global context, under scenarios where countries do not meet their NDC targets (Fig. 3, hatched area in purple). Although it may seem extreme, non-compliance by the US alone is sufficient to

[3] Currently, ~2.98 million barrels per day (Mbbl/day) of crude bitumen are produced using: (i) surface mining (~49% of production); and (ii) in-situ recovery (~51% of production) (Alberta Energy Regulator 2021)

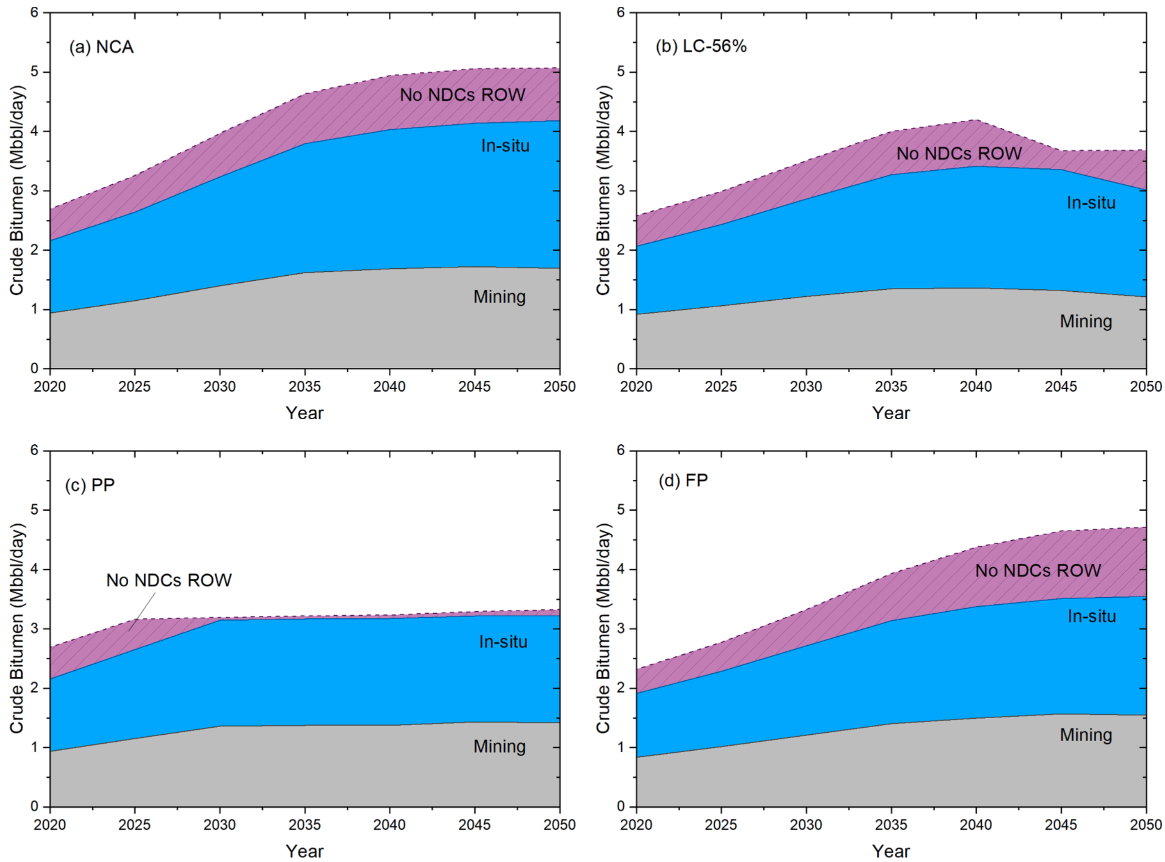

Fig. 3. Projected production for the Alberta oil sands under different perspectives from mining (gray) or in-situ (blue) extraction processes. Hatched areas in purple correspond to the total production increment in case the rest of the word does not comply with their NDC targets.

trigger this scenario, since the US accounts for 98% of the market for exported Canadian oil (Natural Resources Canada 2020). For the US, oil consumption is expected to fall 2% by 2025 (~19 Mbbl/day) and 44% by 2050 (~11 Mbbl/day) if their initial NDC goals are met (26–28% GHG reduction by 2025 relative to 2005, extrapolated towards 2050) (Fawcett et al., 2015). For all perspectives, no climate action in the rest of the world generates a significant increase in bitumen output (3–18%) and associated GHG emissions (see Supplementary Information, Fig. S.4). However, this increase varies according to the context of each perspective. For PP (Fig. 3c), emissions are not affected by non-compliance with NDCs in the rest of the world, because there is a cap in place for CO_2 emissions (assuming only incremental technological innovation that allows increased production due to a lower carbon intensity). For LC (Fig. 3b), the increase in bitumen production is also subject to market changes expected by 2040. Finally, the increase in bitumen production for FP (Fig. 3d) reflects a strong dependency on compliance by other nations with regards to their NDC targets. It is expected that the new US Biden-Harris administration, elected in 2020, will deploy a more ambitious climate agenda favoring cleaner energy sources (Biden For President Campaign 2020). Therefore, the Alberta oil sands market may be restricted, which in turn would have a positive impact on Canada's plans for a sustainability transition (O'Brien, 2020).

3.2.3. Missing specific technology policies to maintain high bitumen production at low carbon intensity

Based on the production outlook shown in Fig. 3, oil sands production is expected to increase if carbon removal technologies in the bitumen extraction process are incorporated (e.g. carbon capture and storage) (Middleton and Yaw, 2018). This is one of the main arguments that the Government of Alberta uses to justify the continued growth of the oil sands sector (Leach et al., 2015). In a 2019 open letter, three major oil sands producers claimed that carbon intensity of the sector has decreased by 30% in the past two decades (McKay et al., 2019). However, Katta et al. (Katta et al., 2019) evaluated several scenarios for reducing GHG emission in the oil sands that considered operational, project, and technology improvements, including improved energy monitoring and management, energy integration, heat recovery, increased energy efficiency and process optimization, as reported in a roadmap developed for the industry in 2012 (Bohm et al., 2012). Katta et al. found that, when implemented together, the recommended strategies could reduce GHG emissions by 7% in 2050 with marginal cost impacts (Katta et al., 2019).

Today, there is no specific policy for deploying such a technology roadmap. The absence of a clear roadmap for technology innovation to cut GHG emissions in the sector to align with the federal targets, represents a big risk for sustainability transitions in Canada and highlights an unrealistic expectation to increase oil sands production while maintaining emission reduction targets. In addition, this perspective does not consider the increase in emissions related to burning fuels derived from the Alberta oil sands. Therefore, a market reduction as US consumers reduce their consumption of carbon-intensive fuels would also act as a barrier for the expected growth in the sector.

3.2.4. Lack of ambitious climate policy could decrease GDP and employment

One of the risks most frequently identified by the stakeholders consulted was the negative economic impacts of implementing energy transition policies. Oil and gas extraction represents almost 2.6% of Canadian GDP and more than 10% of the total Alberta Government revenue (Finkel, 2000; Canadian Association of Petroleum Producers 2017; Canada and Canada, 2016; Dobson, 2015). In addition, in 2019, 332,847 direct and indirect jobs were estimated to exist due to the Alberta oil sands (Millington, 2019) (~15% of total employment of Alberta and ~2% of total Canadian employment (Statistics Canada 2021)), meaning that changes in this sector could have a moderate impact on the employment rate of Alberta (Romaniuk and Rahmanifard, 2018). However, the temporary effects of COVID-19 in the (global) economy show examples of how a collapse in oil demand can impact growth and employment (Krauss, 2021). Therefore, these indicators should be further studied to assess the real scale of climate policies in the economy and employment rates.

The estimated economic impact of selected perspectives, in terms of GDP and employment, were evaluated using the E3ME model, with the results are presented in Fig. 4 and Table 3. For this assessment, four stylized scenarios were modelled. These scenarios aimed to assess the impacts of global climate policy on the exploitation of Canada's oil resources and on Canadian economic growth. They are: (i) current policy scenario baseline; (ii) current policy globally, unilateral action in Canada to meet its NDC; (iii) multilateral action globally, all regions meeting or exceeding NDCs, unilateral withdrawal by Canada; and (iv) 2-degree scenario, multilateral action globally, all regions meeting or exceeding NDCs. The simulations with the E3ME model focus on the whole economy and go into less detail on the oil sands. In the scenarios where Canada meets its NDC target, an adjusted version of the FP scenario from above is used. Other countries pursue policies as laid out in their NDC submissions, with carbon pricing applied to cover any remaining policy gaps. Although the E3ME baseline solution includes substantial growth in Alberta oil sands production by 2030, production in Canada is expensive compared to other countries and is therefore vulnerable to a decline in global demand.

Based on the model results, international action to cut carbon emissions could have a substantial negative impact on Canadian economic growth, with GDP changes of up to −14% with respect to scenario (ii). Canada's stranded fossil fuel assets (Mercure et al., 2018), i.e. oil reserves that are never extracted, could result in significant foregone economic activity in the upstream oil and gas sector and its supply chain. Investment by the sector will fall to near zero. The other important effect is reduced royalties paid to government. In the modeling, fiscal policy is adjusted across scenarios to balance the loss or gain of royalties compared to the baseline. In a scenario of lower royalties, fiscal policy is contractionary compared to baseline, with lower Government current expenditure and higher taxation rates (further information about royalty structures and E3ME model assumption can be found at the Supplementary Information, Section 2.2). In reality, the Canadian Government could choose to run large deficits during a transition period. Finally, there are also multiplier effects due to loss of income and spending power. These scenarios do not account for growth in (new) potential low-carbon sectors, as these were not originally reflected in the NDC or climate targets at the time of research. But we encourage further analysis to consider emerging low-carbon technologies, such as hydrogen, that might counteract GDP changes from declining high carbon sectors (Ministry of Natural Resources Canada 2020).

If Canada takes no action towards meeting its NDC targets (and does not develop a more environmentally sustainable economy), the impact on GDP growth is greater still. Changes in employment growth are also expected to be up to -5% with respect to scenario (ii), which would be reduced (more growth) if Canada is able to generate employment in the green energy sector. Table 3 isolates the impact of pursuing domestic low-carbon transitions, under scenarios of global action and inaction. This analysis highlights the socioeconomic co-benefits of low-carbon transition pathways for Canada. A comprehensive climate policy in Canada yields positive

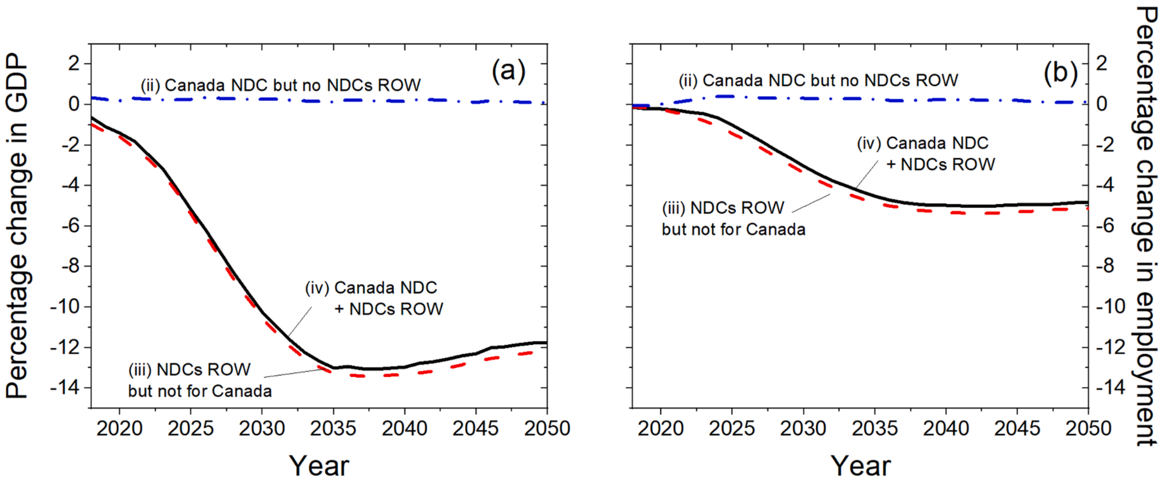

Fig. 4. Economic impact (GDP) of energy transition in Canada with respect to a current policy scenario baseline in the trajectory 2018–2050.

Table 3
Impacts of NDC targets in the Canadian economy.

Compared scenarios	Difference (%)	GDP		Employment	
		2030	2050	2030	2050
No global NDC	(i) Current policy scenario baseline, vs, (ii) current policy globally, unilateral action in Canada to exceed NDC.	0.3	0.1	0.3	0.1
All meet NDC	(iii) All regions meeting or exceeding NDCs, withdrawal by Canada, vs, (iv) 2-degree scenario, multilateral action globally, all regions meeting or exceeding NDCs.	0.4	0.5	0.3	0.3

results in total employment and GDP, regardless of action taken in the rest of the world.

The projected positive economic effects of climate policy in Canada, as shown in Fig. 4 and Table 3, are driven by investment activity, a reduction in imports of other fossil fuels and carbon price revenue recycling. Investments in energy efficiency measures introduce a substantial demand stimulus throughout the modelled period. Energy efficiency investments, coupled with carbon pricing, result in a reduction in demand for fossil fuels, both domestic and imported. Fuel switching redirects some of the demand for imported fossil fuels to demand for domestically generated electricity. Consumer expenditure saved on energy is redirected to other categories. Carbon pricing revenues are recycled through reductions in taxation, increasing disposable nominal income. This analysis is consistent with previous studies that find positive employment and GDP effects of similar climate policy in different geographic regions (Pollitt et al., 2015; Barker et al., 2016). Although there are very few studies on the scale of policy impacts on economic indicators for Canada, these results are in agreement with a recent report from TD Bank on the potential impacts of the energy transition on workers (Caranci and Fong, 2021).

We used a sensitivity analysis to assess the significance of the royalty rates, given the uncertainty over the mechanism. We found that positive economic results of climate policy action in Canada were weakened by high sensitivity of the model to royalty rates. In the case of unilateral action by Canada, GDP results were slightly less positive in 2030 than the central case (0.2% compared to 0.3%) and negligible by 2050 (−0.0% vs 0.1%). The negative economic effects of global climate action increased under a high royalty rate sensitivity. In the 2-degree global policy scenario, negative GDP impacts were greater than under the central case in 2030 (−12.0% vs −10.2%) and 2050 (−14.7% vs −11.7%).

3.2.5. Canada's economy dependent on global climate policy

A key result of the E3ME modeling is that Canada's economy is likely to be much more sensitive to global climate policy than domestic drivers. The magnitude of the macroeconomic impact of a global transition away from fossil fuels would dominate over the effect of potential domestic climate policy, as highlighted in Fig. 4. In the 2-degree scenario, oil extraction in Canada peaks in 2020 and declines towards 2050. Canada becomes a net importer of oil and gas in 2035, that is Canada imports cheaper resources instead of developing its more expensive domestic resources. This scenario, although possible from an economic perspective, may be subjected to regional backlash across the federation due to negative impacts on oil producing provinces. Compared to business-as-usual, the annual volume of oil extraction is 62% lower in 2030, and global oil price is 13% lower. Figures for 2050 are 92% and 43% respectively. Total cumulative extraction of Canadian oil resources from 2019 to 2050 decreases by ~64%.

Table 4 details the disaggregated GDP effects of a 2-degree scenario for the Canadian economy. The most important direct effect of a 2-degree scenario on the Canadian economy is a potential reduction in demand for Canadian fossil fuel resources, seen in the contraction in net exports. Investment impacts in oil and gas dominate the reduction in aggregate investment. Induced effects contribute substantially to reductions in consumer expenditure. Royalty effects are captured in the decrease in Government and consumer expenditure, through tax increases.

3.2.6. Neglecting external pressures, a barrier for timely action

Due to higher costs, unconventional oil supply - mainly from the USA and the Middle East - could out-compete the Alberta oil sands on production costs and take market share, as shown in Fig. 5 based on GCAM projections. If the rest of the world meets its NDC targets, the reserves left available in the Alberta oil sands are estimated to become too expensive to compete with emerging suppliers by 2040. Similar findings have been reported by Jaccard et al. (Jaccard et al., 2018) and the Canada Energy Regulator (CER) in the Canada's Energy Future 2020 report (Canada Energy Regulator 2020).

Table 4
Economic impact of 2-degree scenario with respect to current global policy. Central royalty assumption.

GDP Component	Percentage Difference		Absolute Difference (Billion 2017 CAD)	
	2030	2050	2030	2050
GDP	−10.2	−11.7	−217.9	−374.7
Consumption	−4.3	−8.3	−57.2	−163.4
Investment	−3.6	−3.8	−20.4	−32.1
Government Expenditure	−7.9	−10.5	−40.4	−79.5
Exports	−14.1	−9.0	−136.3	−117.3
Imports	−4.0	−1.3	−36.5	−17.5

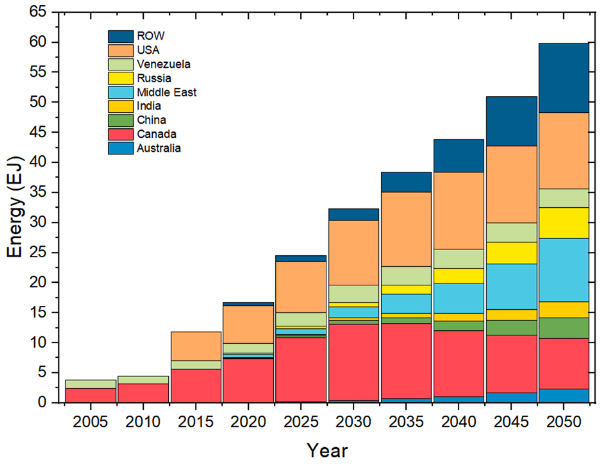

Fig. 5. Projection of future unconventional oil production per region if the rest of the world meets its NDC targets.

Losing competitiveness to other producers represents a pressure on the oil sands sector, but in turn a positive effect over realizing a sustainability transition in Canada. However, Alberta has no current plan to respond to this potential market constraint and seems to rely on the hopes of a future growth in oil demand.

Another potential pressure lies in the possibility of the assets in the Alberta oil sands becoming stranded. McGlade and Ekins (McGlade and Ekins, 2015) explored the potential magnitude of stranded assets in Canada: 75% of Canada's oil reserves are "unburnable" under global decarbonisation in a 2-degree scenario. Mercure et al. (Mercure et al., 2018), examined stranded assets globally under a range of technology and behavioural scenarios, including "sell-out" behavior by OPEC countries. This analysis highlights the potential of global decision making to reduce demand for Canadian oil due to high costs in a carbon constrained market.

A third thread identified is the impact of calls for a Green New Deal and the divestment movement in the sector. MacArthur et al. (MacArthur et al., 2020) proposed that a transition in the oil sands would be accelerated by increasing international pressure as well as growing support within organized labor for migrating to more renewable energy. The authors also highlighted the contrasting position of the federal government, which is demanding a sustainability transition while also continuing investment in infrastructure for the Alberta oil sands sector, such as pipelines.

On the other hand, the divestment movement is looking to push investors to change their investments in fossil fuel companies to other climate-relevant alternatives (Ayling and Gunningham, 2017). In essence, NGOs are referring to morals and ethics to steer investors towards more responsible investments. In 2020 alone, Deutsche Bank, The Swedish Central Bank, BlackRock (the world largest asset manager), HSBC, BNP Paribas Group, Société Générale of France, and Norway's sovereign wealth fund, were among the most prominent entities to announced divestment from the Alberta oil sands. Also, a continued dependence on oil has driven risk assessment agencies, such as Moody's, to downgrade Alberta's credit rating, citing structural weaknesses due to economic dependence on non-renewable resources (Rieger, 2019). Despite efforts to maintain investment through local financial institutions and provincial policies, capital investment in the oil sands declined by 70% between 2014 and 2019 (a change from 33.9 to 10.6 billion Canadian dollars) (Alberta Energy Regulator 2019). Such a drop has been associated with lower oil prices, limited pipeline capacity and investors favoring opportunities with a faster return on investment such as those offered in tight/shale oil exploitation (Canada Energy Regulator 2020; Canadian Association of Petroleum Producers (CAPP) 2020).

The external pressures on the Alberta oil sands - such as shrinking market, stranded assets, the Green New Deal, US climate policies, and the divestment movement - were not highlighted by the stakeholders consulted. These risks, identified via our literature review, were not mentioned by stakeholders during workshops and not systematically presented in interviews. We purposely did not show these risks to the stakeholders to avoid influencing their own perception of risks. However, in 2019, some of these risks (e.g. stranded assets) were highlighted during interviews to a small group of influential stakeholders, including an economist, a policy maker and an industry association representative. When asked, they did not consider them as relevant at the time. Since these interviews were performed, COVID-19 and many market events have increased the pressure over the sector and made these risks more evident, which could influence the perspectives of some stakeholder groups. For example, in June 2021 the five biggest Oil Sands producers in Canada (includes Canadian Natural Resources, Cenovus Energy, Imperial Oil, MEG Energy, and Suncor Energy) formed an alliance to achieve net-zero greenhouse gas emissions from their operations by 2050 (Suncor Energy Inc 2021). Though emission reduction efforts are well received, some experts have expressed concerns about efforts not ultimately reducing carbon emissions and diverting pressure to meet climate targets to other sectors (Harrison et al., 2021). These elements are part of ongoing research.

There seems to be a risk blindness to wider forces such as the divestment movement (the New Green Deal was not yet underway while we conducted our stakeholder engagement process in this study). It is our reflection from the findings of this study that there is currently no strong emphasis on policies in Alberta that consider these pressures, and therefore, no plan is in place to reduce the negative impacts of unfavorable changes in the global energy market. Neglecting challenges may lead to risk blindness in the sector and decrease the chances of developing an appropriate and timely transition plan that focuses on supporting oil and gas workers, as well as local communities, to adapt to the changing times through just transitions (Healy and Barry, 2017).

3.3. Risk blindness and the local-global disconnection

Implementing policies that are better aligned with Federal and international strategies for climate change could make Alberta less vulnerable to changes in energy markets. From a local perspective, stakeholders in Alberta acknowledge that something should be done for the sake of climate change. However, our assessment showed that there is an overarching consensus among most stakeholders that the oil sands should take part in the Canadian energy transition. The conundrum between the conflicting aspirations requires timely and clear strategies for Alberta to find alternative economic strategies, and avoid larger negative socioeconomic impacts as the energy transition movement grows internationally.

The identification of blind spots in local perspectives, especially around contrasting provincial and national climate policies, could be strongly connected to contextual factors. Risk blindness may stem from the local context sustaining narratives that perpetuate the notion that the Alberta oil sands are sustainable and aligned with global interests (Jaremko, 2020). Examples of narratives promoted by powerful parties include assertions of an infinite demand for fossil fuels – "The world needs Alberta oil" (United Conservative Association 2020), "essential economic benefits for Alberta and Canada" (Tertzakian, 2019), and "unfounded attacks targeting the sector by environmental groups". We have also seen the creation of the Canadian Energy Center, a "war room" to defend Alberta Oil from attacks (Government of Alberta 2019). Unfortunately, such narratives keep local stakeholders isolated from a growing global energy transition movement. With federal policies aiming to achieve targets aligned with the Paris Agreement, key local perspectives are blind to certain risks. More research is needed to further understand risk blindness in local perspectives of energy transitions.

Other risks to the implementation of a sustainability transition in Canada are found in the diversity of interests and perspectives amongst actors. The implementation of sustainability transition pathways in Canada depends on the cooperation of all stakeholder groups; these groups benefit from oil sands resources extraction, but also potentially can be adversely impacted by the future development of the sector. For example, local communities are employed by the sector, industry fulfills a demand, and the Government both receives royalties and acts as a regulator and protector of common goods, including the environment and well-being of communities. On the other hand, oil sands development that does not consider the Indigenous communities most directly impacted by the development sites near their traditional territory, also presents risks. Even though some Indigenous communities benefit economically from oils sands development (albeit with wide gaps among individuals in the community that gain economically), the community at large also seek to protect their traditional way of life, which includes protecting land from resource development. The continued development of the Alberta oil sands without the consent of Indigenous communities has resulted in lawsuits against oil sands companies wishing to develop new sites near their traditional land (Henton, 2016; Weber, 2016). Including land-use protection in the transition strategies could also benefit local communities, but there may also be other potential opportunities for economic activities that do not require new developments.

From the global perspective, international and federal actors need to understand the definitive role of the local context and local stakeholders in strategy development. Such context needs to be identified and assessed when implementing national goals to meet wider global objectives. Also, there should be more efforts to support learning among local stakeholders around the global-scale impacts of climate change, potential alternatives to mitigate consequential risks of low-carbon transitions at the local level, and risk blindness. Therefore, national and international support is fundamental to the design of proper strategies and opportunities in low carbon innovations based on local views, knowledge, and resources. For example, Alberta could consider more ambitious targets, not only identifying the technological innovations needed to reduce emissions, but also the changes required in social and political discourses needed to mitigate the negative effect of changes in one sector, especially with regards to the economic context. Considering stakeholders' preference on future pathways, and various actions required for a low-carbon transition, will become increasingly important in forthcoming years as policies are rolled out and pathways implemented.

3.4. Future outlook

In the context of an energy transition, each stakeholder group has their own perspective and responds to changing societal paradigms around energy, its production, and its use. Identifying and evaluating risk blindness in energy transitions will require different stakeholder groups to acknowledge common objectives for the energy transition, as well as the negotiation of new roles and power dynamics.

Due to the impacts of the global pandemic of COVID-19 and changing energy markets dynamics, the collapse in world oil prices in 2020 has impacted the Alberta oil sands industry and may have altered some stakeholders' perception that the future for oil demand is assured. For instance, there is growing global interest in hydrogen and electricity as zero-emission transportation fuels. This has led companies and governments to reconsider their strategies and policies. Since this study reports stakeholder consultations from 2017 to 2019, it remains to be explored how much stakeholder perspectives have since changed.

In addition, the perception of risks needs to be further explored through the interdisciplinary lens of social and cultural psychology, geography, the different branches of economics and other relevant disciplines. For instance, ecological economics can consider the value of sustainability and social learning, as well as the value of the environment and its interaction with society (Garmendia and

Stagl, 2010). We need to better understand the factors (local and international) that influence local narratives and stakeholders' diverse perceptions of risks. We intend to further this research in another project, TIPPING+,[4] by bringing in knowledge from different disciplines while considering a transdisciplinary research method, in order to engage with stakeholders in carbon intensive regions and develop a greater understanding of the underlying mechanisms of risk blindness in local narratives.

4. Conclusions

In this paper, we have used mixed methods to investigate the risks of three local perspectives on the Alberta oil sands. We analysed stakeholder perspectives and EEMs (GCAM and E3ME) projections to better understand the environmental and socioeconomic implications for current transition plans for Canada. We found that local stakeholders expressed that Canadian low-carbon futures need to include, or at least manage, the Alberta oil sands. Also, most local stakeholders believe technological innovation would make this feasible. The recent collapse of oil prices due to the COVID-19 pandemic and the rapid growth of renewable energy, electrification, and hydrogen, may have affected some of these perspectives, and the extent of this change and its impact on local policies is a subject of ongoing research. Still, the stakeholder perspectives presented do not reflect the authors' own perspectives.

Stakeholders were able to identify socio-political, environmental and economic risks that could impact specific groups in different ways. The clarity of the assessment increased as the perspectives became more comprehensive with regards to sustainability targets. However, it became evident that stakeholders generally were not aware of, or did not acknowledge, potential risks that have been widely reported in scientific literature, institutional reports and mainstream media, even when asked directly. Warnings in global markets about the possibility of disappearance of carbon intensive sectors due to lack of demand for these energy sources are perceived as negative actions against the Alberta oil sands. Such divisive positions could generate a protectionist response in stakeholders that could potentially slow down a low-carbon transition in Canada.

Through quantitative and qualitative methods, we identified a series of risks overlooked by stakeholders. For example, missing GHG emission reduction targets, extreme dependency on policies in the US, benefits of a comprehensive climate plan and neglecting external pressures are among the main risks missed by stakeholders. We argue that the extent of this risk blindness could be enabled by dominant narratives in the region which conflict with current climate science and international climate policies. Also, it remains of relevance to understand the degree of "willful blindness" on these perspectives, which should be the subject of future research. Since an energy transition threatens the growth of the Alberta oil sands, the sector should not be relied on to spearhead strategic energy policy due to a conflict of interests.

To mitigate environmental and economic risks for an energy transition in Canada, it is necessary to develop a range of actions at the local level that look beyond the Alberta oil sands. Setting more ambitious climate targets that explore new low-carbon opportunities, and consider concerns in the fossil fuel sector, is essential for transition strategies. Also, a full awareness of potential international market shifts is important, since it would drive the oil markets away from the Alberta oil sands and reduce the impact of local and national (Canadian) policies. Moreover, participation from communities most impacted by oil sands development, such as Indigenous groups, could enable the design of more effective and just transition pathways, better representing the interests and concerns of all stakeholder groups involved in the sector. However, if stakeholders remain (un)consciously ignorant of these risks, it will be very difficult to develop and implement de-risking policies aimed at ensuring a just transition for Alberta residents. Therefore, further studies are needed to identify enabling framings and action strategies for de-escalating the effects of risk blindness. Building competencies in the ethical formulation of risks and risk management strategies will contribute to decreasing the negative impacts of risk blindness, while creating capacities for critical moral thinking (Rendtorff, 2014).

The global discourse also needs to allow for differentiated actions at the local level. The perceived benefits, particularly those with a longer timeline, may contribute to the global collective benefit but can be difficult to "sell" to the local population over the short term. Synergies should be highlighted to narrow the gap between global long-term goals and more immediate local benefits. Such co-benefits include improved air quality, improved health and preservation of ecosystems for traditional ways of life. Some of these co-benefits are broadly included in models (e.g. health impacts), but without a meaningful level of disaggregation that can inform decision making at the local level. Ecosystem services are currently not well represented in the energy-economy models applied to this case study but have an important social and environmental value to local stakeholders. Meanwhile, trade-offs - including changing social dynamics, environmental degradation, economic stress and job losses - occur at the local level. The energy transition in Canada needs to be achieved in the short and medium term, and both national and global targets are unlikely to be met if there is a disconnect between long-term priorities and the more immediate priorities of local stakeholders.

Declaration of Competing Interest

None.

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[4] https://tipping-plus.eu/home

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.eist.2021.10.008.

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